e-Resilience: A Review of National Broadband Policies, Regulations, Strategies and Initiatives of China, Japan and the Republic of Korea

Asia-Pacific Information Superhighway (AP-IS)
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Abbreviations

ADB	Asian Development Bank
ADESS	Automated Data Editing and Switching System
ADSL	Asymmetric Digital Subscribers Line
AMeDAS	Automated Meteorological Data Acquisition System
AP-IS	Asia-Pacific Information Superhighway
BcN	Broadband Convergence Network
BCP	Business Continuity Plans
BRR	Basic Resident Register
CBN	China Broadcasting Network
CBS	Cell Broadcasting System
CIO	Chief Information Officer
CSTI	Council for Science, Technology and Innovation
CSTP	Council for Science and Technology Policy
DMAT	Disaster Medical Assistance Team
DSL	Digital subscriber line
EBS	Education Broadcasting System
EEW	Earthquake Early Warning
ESCAP	Economic and Social Commission for Asia and the Pacific (United Nations)
FARD	Frequency Analysis of Rainfall Data Programme
FCO	Food Control Office
FDD-LTE	Frequency Division Duplexing-Long Term Evolution
FDMA	Fire and Disaster Management Agency
FFFS	Flash Flood Forecasting System
FTTH	Fibre-to-the-Home
FWA	Fixed Wireless Access
G4B	Government for Businesses
G4C	Government for Citizen
GCF	Global Certification Forum
GMDSS	Global Maritime Distress and Safety System
GMS	Geostationary Meteorological Satellite
GTI	Global TD-LTE Initiative
G-Net	Government Common Network
ICT	Information and Communications Technology
IoT	Internet of Things
HARP	Harmonized Applications Relational Platform
HFC	Hybrid Fibre-Coaxial
HTS	Home Tax Service
INDiP	Information Network for Disaster Prevention
IP	Information Provider
IRU	Indefeasible Right of Use
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ISPC	Information Security Policy Council
ITU	International Telecommunication Union
JFTC	Japan Fair Trade Commission
JMA	Japan Meteorological Agency
KERIS	Korea Education and Research Information Service
KDD	Kokusai Denshin Denwa
KII	Korea Information Infrastructure initiative

KMA	Korea Meteorological Administration
KTA	Korea Telecom Authority
LAB	Local Administration Bureau
LAN	Local Area Networks
LGWAN	Local Government Wide Area Network
LLU	Local Loop Unbundling
LRIC	Long Run Incremental Cost
METI	Ministry of Economy, Trade and Industry
MIC	Ministry of Internal Affairs and Communications
MIIT	Ministry of Industry and Information Technology
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
MNO	Mobile Network Operator
MNP	Mobile Number Portability
MPT	Ministry of Posts and Telecommunications
MSPA	Ministry of Security and Public Administration
MVNO	Mobile Virtual Network Operator
NBIS	National Basic Information System Policy
NCDR	China National Commission for Disaster Reduction
NDMI	National Disaster Management Institute
NDMS	National Disaster Management System
NEIS	National Education Information System
NEMA	National Emergency Management Agency
NGN	Next Generation Network
NIA	National Information Society Agency
NICT	National Institute of Information and Communication Technology
NIED	National Research Institute for Earth Science and Disaster Prevention
NIS	National Information-communication Service
NISC	National center of Incident readiness and Strategy for Cybersecurity
NMPA	National Maritime Policy Agency
NTT	Nippon Telegraph and Telephone
OSS	Open Source Software
OPCI	Optical Packet and Path Integrated
NICT	National Institute of Information and Communication Technology
PDCA	Plan-Do-Check-Act
PKI	Public Key Infrastructure
QPS	Quadruple Play Service
SDG	Sustainable Development Goals
SIM	Subscriber Identification Module
SME	Small and Medium-Sized Enterprise
TBL	Telecommunications Business Law
TCDIS	Typhoon Committee Disaster Information System
TD-LTE	Time-Division Long-Term Evolution
TRS	Trunked Radio System
UBcN	Ultra Broadband Convergence Network
USF	Universal Service Fund
USN	Ubiquitous Sensor Network
VoLTE	Voice over Long Term Evolution
VSATs	Very Small Aperture Terminals
WAN	Wide-Area Network
WGDRR	Working Group on Disaster Risk Reduction
WiBro	Wireless Broadband
WINDS	Wide-band Inter-Networking engineering test and Demonstration Satellite

Executive Summary

Information and communications technology (ICT) has become a key enabler in the new digital economy and society, providing us with opportunities for transformation in a wide range of socioeconomic sectors. It has dramatically transformed the way we live and work and plays a role as a main catalyst in achieving Sustainable Development Goals (SDG). There is also a growing recognition of the importance of resilient ICT infrastructure in this disaster-prone region. The level of ICT resilience matters in terms of facilitating critical emergency responses at a time of disaster and ensuring the availability and reliability of critical information infrastructure and services for people who need it most.

East Asian countries, including China, Japan and the Republic of Korea, have over the past half century experienced a remarkable pace of growth in the ICT sector, experiencing technological development with advanced broadband networks and widespread broadband access. China is going through a distinctive transformation of traditional industries via digital technology and has become one of the largest ICT markets in the world. Capitalizing on the extensive telecommunications networks, Japan is now widely known as a country with well-established e-government and proactively involves the public in decision-making through ICT related channels. The Republic of Korea, a country where it was difficult to access even basic telephony until the beginning of the 1980s, now consistently ranks as one of the most advanced countries in the ICT sector since 2000s.

These achievements possibly result from various factors; along with enabling competition policies and ICT promotion policies, such as infrastructure development, e-government, ICT education and inclusive access, the private sector's role has been equally important. Given this context, the report aims to explore and identify the driving forces behind the transformative ICT development in these three East Asian countries. More specifically, this report sheds light on the components of national broadband policies (including e-resilience policies), regulations, strategies, and initiatives which may have contributed to the broadband growth and access. Each country has developed distinctive ICT policies and strategies, thus forming an enabling national broadband ecosystem. This working paper provides case studies of each country and detailed analysis under the themes of (1) development of ICT policies and their implementation, (2) disaster management and resilient ICT and (3) challenges and opportunities to identify elements of good practices and lessons learned from the three countries. This approach is expected to help investigate the useful lessons and examples and help develop an enabling national broadband ecosystem in other countries in the region.

Background

Information and communications technology (ICT) has become an essential part of people's lives in various sectors. ICT has impacted the fields of agriculture, energy, environment, transport, governance, health, banking, retail, publishing, media and education. In addition, it provides an enabling platform for all countries to engage in the new digital economy and society.

International and regional broadband connectivity is a prerequisite in connecting people, businesses and governments to the Internet. However, the digital divide between and within countries still poses a major development challenge in Asia and the Pacific, according to ESCAP's State of ICT Connectivity in Asia and the Pacific 2017[1]. The report concludes that unless urgent actions are taken, the digital gap between developed and developing countries may widen with the emergence of frontier technologies, such as artificial intelligence, which require robust and reliable broadband connectivity.

Technologies that enable long-haul transmission such as fiber optic cables and satellites require a sizeable initial investment. According to a recent estimate of the Asian Development Bank (ADB)[2], climate-adjusted telecommunication infrastructure investment in the region is estimated to cost USD 2.3 trillion until year 2030. It is therefore imperative to develop effective plans for financing the development of affordable broadband connectivity and to include private sector involvement. In order to develop these plans, policies and regulations, high-level coordination is necessary among ICT and other relevant sector ministries. Thus, it is vital to create an enabling environment and raise wider awareness on the urgency to bridge the digital divide. Governments have a critical role to play in supporting the realization of inclusive access to broadband in all segments of society and setting it as a strategic priority within their development agenda to bridge the digital divide at national, regional and international levels.

The Republic of Korea, along with China and Japan, represent global leaders of advanced broadband networks and widespread broadband access. It was enabled by progressive broadband policies, regulations, initiatives and investments, all contributing to the formation of the national broadband ecosystem. In addition to the extensiveness of broadband connectivity, distinctive features emanating from the three countries' broadband development include the level of resilience at a time of natural disasters. Based on past experiences, lessons learned and good practices after major disasters, these countries' broadband policies have embraced various elements of e-resilience[3]. Resilient ICT infrastructure not only facilitates critical emergency responses at a time

[1] http://www.unescap.org/resources/artificial-intelligence-and-broadband-divide-state-ict-connectivity-asia-and-pacific-2017

[2] Asia Development Bank (2017). Meeting ASIA's Infrastructure Needs. Available from https://www.adb.org/publications/asia-infrastructure-needs

3 http://www.unescap.org/sites/default/files/pre-ods/CICTSTI1_5E.pdf: "Resilience can be defined as the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of

of disaster but also ensures the availability and reliability of broadband infrastructure and services under normal circumstances.

Against this background, this report aims to identify elements of national broadband policies (including e-resilience policies), regulations, strategies, institutional set ups and initiatives which contribute to the aforementioned broadband growth and e-resilience. The report is structured to present case studies of three countries under the broad themes of 1) development of ICT policies, 2) resilience and ICT and 3) challenges and opportunities to identity elements of good practices and lessons learned from the three countries. It is expected that the findings will provide policy makers, government officials and relevant stakeholders with insights, models and good examples in the development of ICT policies and strategies and institutional capacity.

Recognizing the importance of broadband infrastructure, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) endorsed the development and implementation of the Asia-Pacific Information Superhighway (AP-IS) initiative in its resolutions 71/10[4] and 73/6[5]. The findings of the report will help advance the implementation of the Asia-Pacific Information Superhighway (AP-IS) Master Plan and Regional Cooperation Framework Document[6]. The ultimate aim of the initiative is to enhance the availability, affordability, reliability and resilience of regional broadband connectivity and narrow the digital divide in the Asia-Pacific region.[7]

a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.7 When applied specifically to ICT (e-resilience), the concept implies two dimensions: (a) ICT for disaster response and recovery, including the rapid restoration of ICT infrastructure and services; and (b) ICT for disaster risk prevention, risk reduction and preparedness."

[4] http://www.un.org/ga/search/view_doc.asp?symbol=E/ESCAP/RES/71/10

[5] https://www.unescap.org/commission/73/document/E73_RES6E.pdf

6 http://www.unescap.org/our-work/ict-disaster-risk-reduction/asia-pacific-information-superhighway/master-plan-for-the-ap-is-and-ap-is-regional-cooperation-framework-document

[7] http://www.unescap.org/our-work/ict-disaster-risk-reduction/asia-pacific-information-superhighway

Chapter 1. Development of ICT policies

1. Policy Framework

China

The precursor of broadband connectivity in China was the establishment of the Ministry of Posts and Telecommunications (MPT) in November 1949. Since then until 1978, a government-granted monopoly was adopted: the government applied strict restrictions on the business operations of telecommunications and tariffs with government pricing while only serving party officials. The establishment of China Unicom in 1979 continued the government-granted monopoly under the Administration of Posts and Telecommunication. The difference from pre-1979 was the industry extended its activity to serve its citizens for the purpose of promoting economic development.

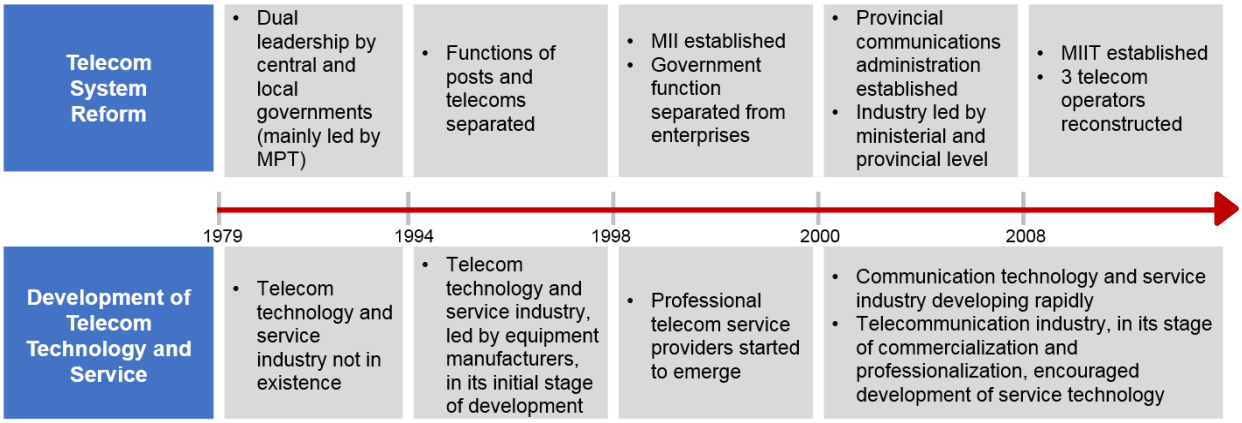
On 20 April 2000, the establishment of China Mobile Communications Corporation ("China Mobile") turned over a new page in China's telecommunications industry. Mobile communication assets of Directorate General of Posts and Telecommunications of China were separated to form China Mobile – a state-owned communication business.

The founding of China Mobile indicated the strategic reorganisation of the telecommunications industry through the separation of operation of posts and telecommunications. It played a positive role in accelerating the development of the telecommunications industry, promoting the informatisation of the national economy and strengthening the international competitiveness of China's information industry and symbolised a breakthrough in the reform of China's telecommunications industry.

In October 2001, the north-south splitting scheme of China's telecommunications industry was launched. The new "5 + 1" pattern of China Telecom, China Netcom, China Mobile, China Unicom, China Tietong Telecom and China Satcom was formed following the reorganisation.

Following reorganisation of China's telecommunication industry in 2001, CDMA and GSM businesses of China Unicom were separated in 2008. In addition, China Unicom was combined with China Telecom to form the new China Telecom and the latter was combined with China Netcom into new China Unicom, China Tietong Telecom became a wholly-funded subsidiary of China Mobile, and basic telecommunication businesses of China Satcom were transferred to China Telecom. In the following year, China entered the era of third-generation mobile communication (3G) when the Ministry of Industry and Information Technology (MIIT) issued 3G licenses to its operators.

Figure 1. Development of telecommunications industry in China



Source: ESCAP based on data from MIIT.

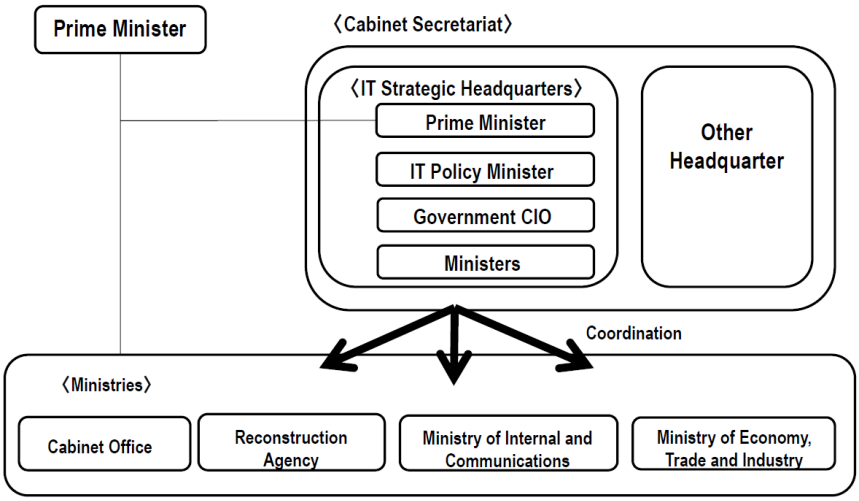
Japan

Japan started its national efforts on fostering the field of telecommunications very early, judging that it would be an important future driving force for the development of the country. Japan initiated the policy and regulatory framework for telecommunications development since the early 1950s along with the establishment of Nippon Telegraph and Telephone (NTT) as the government monopoly network operator. NTT was in charge of R&D investments and setting technical standards, telecommunications regulations and policies in partnership with the Japanese parliament. Furthermore, Kokusai Denshin Denwa (KDD) was established to play a role as an international operator. During the same period, the Ministry of Posts and Telecommunications (MPT) was newly established to regulate the telecommunications market.

Major reforms in telecommunications have been launched in the early 1980s. The Government decided to liberalize the telecommunications market by introducing competition in all sectors of telecommunication services and gradually privatize the NTT Public Corporation from 1985. In the meantime, MPT was granted a stronger authority over price and service regulation, technical regulation, policy and R&D.

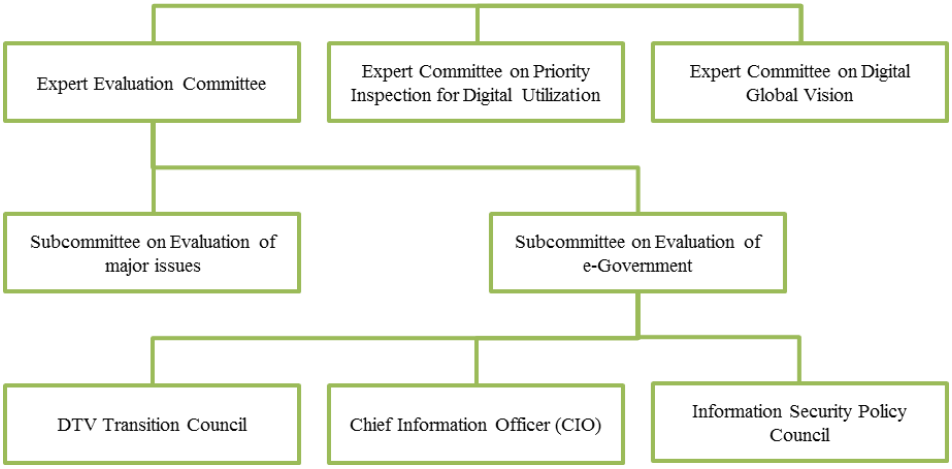
However, when Japan's economic bubble burst in the 1990s, it was very difficult for the country to actively cope with the global transition toward the new era of informatisation. Domestic recession created obstacles for the Government to prepare a systematic policy framework for informatisation with sufficient investments. In the early 2000s, the Government re-established its strong determination to overcome the delay in informatisation to develop advanced telecommunications and information networks. As a fundamental national platform for policy implementation, Japan enacted the Basic Law on the Formation of an Advanced Information and Telecommunications Network Society (IT Basic Law) in December 2000 (implemented in 2001). Based on IT Basic Law, IT Strategy Headquarters was established to design and facilitate priority policy strategies and programs as a control tower.

Figure 2. Organisational structure of ICT policy implementation in Japan



Source: Prime Minister of Japan and His Cabinet website, Ministry of Economy, Trade and Industry (2015). IT Policy in Japan. Available from http://www.cicc.or.jp/japanese/kouenkai/pdf_ppt/pastfile/h27/151013-1jp.pdf.

Figure 3. Committees and Councils under the IT Strategy Headquarters of Japan



Source: Fujino, M. (2010). Law & Policy for Broadband Deployment in Japan. Available from http://www.soumu.go.jp/schresult.html?q=Expert%20Evaluation%20Committee.

In addition, the Council for Science, Technology and Innovation (CSTI), former Council for Science and Technology Policy (CSTP), has been serving as the headquarters for the promotion of developing key ICT technologies in terms of national interests based on the Science and Technology Basic Plans. It allocates the budget for Government-led research and development in the field of ICT and regularly assesses the ICT-relevant projects and research activities of the Ministry of Internal Affairs and Communications (MIC), the Ministry of Economy, Trade and Industry (METI) and other related ministries. MIC and METI, which are the two primary ministries conducting ICT-relevant R&D projects, set up the special committee to analyse the impact of international standardisation and intellectual property rights of the ICT sector.

Republic of Korea

Telecommunication services were provided by the Ministry of Post and Telecommunication until the RoK Telecom Authority (KTA) was separated from the government in 1982. KTA was granted a high level of autonomy in terms of managing and executing budget which was provided in the form of telegraph/telephone bonds or loans. This flexible budget system served as a vital factor to accelerate the modernization of telecom facilities. By the end of the 1980s, KTA had a monopoly in the international, domestic long-distance, and local exchange markets as well as in the mobile telephone market. In the early 1990s, the Ministry announced long-term plans to turn its telephone business into a privatized industry and created a duopoly in international telecommunication-, mobile- and national long-distance services in 1990, 1994 and 1995, respectively.

The government of the Republic of Korea (RoK) developed an agenda of informatization as one of its main national objectives and rebuilt the national informatization promotion system in the 1990s. The government established the Ministry of Information and Communication (MIC) in 1994, integrating all relevant functions from the Ministry of Science and Technology; Bureau of Public Information; and the Ministry of Trade and Industry. The MIC took full control over all functions regarding informatization and ICT industry including: oversee competition policies for the telecommunications industry; designing national informatisation policies; broadband infrastructure planning; fostering ICT industry; supporting technology development; and developing skilled technical manpower.

The MIC and government rearranged the necessary policy framework for national informatization in mid 1990s. The Framework Act on Informatisation Promotion was enacted in 1995 as the first legal basis for promoting informatisation on a national scale. Based on the Act, the RoK government developed master plans for the promotion of the information society. Under the umbrella of the Prime Minister's Office, the Information Promotion Committee was also formulated in 1996 to supervise the government's informatization policies and strategies across all areas of government. Moreover, the role of the National Computerisation Agency was strengthened to implement key policies such as developing network infrastructure planning and e-Government initiatives. It is also pertinent to highlight that the Information Promotion Fund was set up in 1996 to create mechanism to reallocate the profits from ICT fields to be invested into the ICT sector. Through this fund, it was possible for the Government to invest in promoting e-Government, fostering expertise and developing ICT infrastructure. In summary, the Republic of Korea was able to be equipped with the necessary laws, fund and organizations for a jump-start in ICT and emerged as one of world's most advanced ICT countries in the 2000s.

2. Evolution of national ICT policies

China

Broadband market policy

This section highlights some of the policies and regulations which have defined the development of ICT sector and infrastructure in the three countries. The Telecommunication Regulation of China[8] is the basic regulation for the Chinese communication industry authority to supervise and manage the industry. According to the Telecommunication Regulation, the services in China could be divided into two categories – basic and value-added telecommunication services. Basic services refer to services related to providing public network infrastructure, public data transmission and basic voice services, while value-added telecommunications services are provided on the public network infrastructure. On 25 December 2016, the Telecom Business Category (2015 edition) was released by MIIT, and implemented on 1 March 2016. The Category provides a clear classification of the current telecom services and defines characteristics and scopes of all kinds of telecom services.

According to the Category, broadband belongs to basic telecommunications services. The Telecommunication Regulation stipulates that operating basic telecommunication services must be approved by the State Council, obtain the basic telecommunications service license and the following conditions apply:

1) The operator must be a lawfully established company specialised in basic telecommunications business, and China has equity or shares not less than 51 per cent;
2) Obtained feasibility study reports and networking technology solutions;
3) Acquired appropriate capital and professionals to engage in business activities;
4) Acquired corresponding resources for business activities;
5) Have credible capacity to provide long-term services;
6) Met other conditions stipulated by the state.

Broadband China programme

In addition, China's State Council unveiled new plans for the development of the broadband market in August 2013 as part of its Broadband China programme. Under the scheme, the government set targets for the end of 2013, 2015 and 2020 for the expansion of broadband networks and improvements on access speeds. The initial plan envisioned fixed broadband networks to cover 40 per cent of the nation (55 per cent urban and 20 per cent rural) by the end of

[8] On 25 September 2000, this regulation was published by the State Council Order No. 601, and revised by the State Council Order No. 653 on 29 July 2014, and further again by the Decree of the State Council No. 666 on 6 February 2016.

2013, 50 per cent (65 per cent urban and 30 per cent rural) by the end of 2015 and 70 per cent by the end of 2020. Meanwhile, download speeds of 4Mbps were planned to be rolled out to 85 per cent of users by the first deadline, and 100 per cent of all connected homes by 2015, with subsequent upgrades to 8Mbps and 12Mbps. Facilitating the growth in access speeds, fibre-to-the-home (FTTH) networks were expected to be available to 130 million homes by the end of 2013, 200 million by the end of 2015 and 300 million by the end of 2020. Further, the Council targeted the market to reach 210 million subscribers (160 million urban and 50 million rural users), further to 270 million (200 million urban and 70 million rural users) and 400 million respectively.

Fibre to the home (FTTH) national standards

China has not yet issued special laws or regulations requiring the telecommunications infrastructure to be built along with the transport, energy and other infrastructure. MIIT formulated the code for FTTH in residential districts and residential buildings and the code for construction and acceptance of communication engineering for FTTH in residential districts and residential buildings.

The two standards contain the following mandatory requirements:

1) In the cities at the county level or above, covered by fibre optic transmission of the public telecommunication network, communication facilities in new residential districts and residential buildings should adopt FTTH method;
2) FTTH communication facilities in residential districts and residential buildings must have equal access to a variety of telecommunication service operators, and users should be allowed to freely choose telecommunications service; and
3) Underground communication pipes, distribution pipe networks, telecommunication closets and equipment rooms in new residential districts and residential buildings should be constructed and accepted simultaneously with residential building and residential district.

Design code for communication conduit and passage engineering (GB 50373-2006) stipulates "the construction of bridges, tunnels, high-grade highway should build communication pipe simultaneously or reserve place for communication pipe." There are provinces which have issued corresponding notification to increase coverage along highways, e.g. the Guizhou province issued a notification on further strengthening the communication coverage alongside the highway in the Guizhou province.

Tower and indoor distribution system

In principle, China Telecom, China Mobile and China Unicom and their subsidiaries can not build towers, machine rooms, other base station supporting facilities and indoor distribution systems by themselves. China Tower should consolidate construction requirements of the three telecom operators, and build and utilise the stock facilities. The facilities which can be shared shall not be newly built in principle.

If China Tower and other independent tower operation enterprises intend to develop construction requirements of only one telecom operator, they are required to inform the other operators. The other telecom operators should make requests, if any, within 10 working days. Once construction requests are collected by China Tower, an indoor distribution system of one telecom operator could be built by the concerned telecom operator itself.

Broadband access network facilities

All telecom operators, provincial level radio and television enterprises and broadband access network enterprises must strictly follow the national and local standards (e.g. the aforementioned code for construction and acceptance of communication engineering for FTTH in residential districts and residential buildings) when building broadband access network facilities in new residential districts and residential buildings, commercial buildings and campuses. They are restricted from entering into exclusive agreements with real estate development company or property management company.

All construction projects must strictly follow the co-construction and sharing procedure when carrying out broadband access network development in existing residential districts and residential buildings, commercial buildings and campuses. It is encouraged to share ducts along pipelines, fibre optics, wiring facilities and other resources to reduce costs and promote competition.

Pole line, pipeline and other infrastructure

When carrying out construction of pole lines and pipelines, the telecom operator and the China Broadcasting Network (CBN) must strictly follow the co-construction and sharing procedure. If an infrastructure project is considered qualified for co-construction and sharing, it must be co-constructed and shared. The project implanting organization can not sign an entrance agreement with a related construction or management organisation before all the concerned bodies come to an agreement.

Fourth-generation mobile communication (4G) licenses

In the case of mobile technology, 4G standards were adopted after submitting specifications for the Time-Division Long-Term Evolution (TD-LTE) technology to the International Telecommunication Union (ITU) in 2009, and the technology was officially recognised a year later. China Mobile began trialling the system using 2500MHz frequencies from the following year. Progressively, the Global TD-LTE Initiative (GTI), of which China Mobile is a key member, was established in February 2011.

TD-LTE was also advocated in the domestic market through promoting competition among the different service providers. The government issued TD-LTE licenses to all three mobile operators in December 2013. Whilst China Mobile fully embraced the standard, commercially launching services later in the same month, its smaller rivals, China Telecom and China Unicom, were more

reserved, with their development plans featuring the Frequency Division Duplexing-Long Term Evolution (FDD-LTE) technology as their primary 4G technology and augmented by TD-LTE in built-up areas. As a stepping stone towards their ultimate goals, China Unicom and China Telecom were granted permissions to test hybrid TD-LTE/FDD-LTE networks in a number of cities in June 2014, with the MIIT later expanding the number of cities covered by the authorisations to be 56. The regulator finally issued China Unicom and China Telecom full licences for FDD-LTE in late February 2015, prompting the duo to begin full-scale network rollouts. Both operators launched full commercial services over their existing FDD-LTE networks in February 2015.

Mobile virtual network operator (MVNO) legislation

The MVNO sector proved capable of achieving its chief target of improving competition in the mobile space. MIIT took the first step towards opening up the mobile market in January 2013, when it revealed proposals to licence mobile virtual network operators (MVNOs). MIIT planned to launch a two-year trial of MVNO operations to assess their capacity to improve competition in China's mobile sector. In December 2013, MIIT allocated the first batch of 11 licences. Three more batches were issued over the subsequent year, bringing the total number of licensees to 42. More recent licensees include handset manufacturers Xiaomi, Lenovo and Foxconn, cable TV and broadband provider, Dr. Peng, and video portal Youku Tudou. The MIIT expected that by the end of the two-year trial, there would be more than 30 active MVNOs, with a combined total of more than 50 million subscribers.

However, there are challenges encountered in developing MVNO regulations. Pricing was not the only stumbling block for the newcomers. Several MVNOs have complained about issues regarding the distribution of numbers and subscriber identification modules (SIMs). Additionally, the absence of mobile number portability (MNP) was also bemoaned as a further barrier for the nascent MVNO industry.

The difficulties caused by the relevant regulations helped drive innovation, as operators were forced to develop new strategies to compete with mobile network operators (MNOs) and other MVNOs. Rollover of unused data to the next month is one example of such innovation adopted by the three network operators. Another innovative method was the Snail Mobile's tariff structure, featuring a single up-front fee for a set monthly allowance of minutes and data for a year or longer, which proved popular and was quickly adopted by other providers.

Three Network Convergence Policy

In January 2010, the government announced the Three Network Convergence Policy, designed to accelerate the advancement of the convergence of television and radio broadcasting, telecoms and Internet business to realise interconnection and resource sharing among the three networks. The policy was initially trialled in twelve cities, including Beijing, Shanghai and Shenzhen, in 2010. It was expanded to additional 42 cities by the end of 2011, then 54 more cities in 2012, covering more than 300 million people in 2013.

The government officially launched the China Broadcasting Network Ltd (CBN) in April 2014, a state-backed vehicle intended to promote the unification of the nation's cable networks. The company was launched with a registered capital of CNY4.5 billion to focus on cable network construction, operation and maintenance as well as research and development. Heralded as the nation's fourth network operator, after China Telecom, China Unicom and China Mobile, the company has been tasked to drive consolidation of the country's myriad cable networks, which operate all over China at various administrative levels. Beijing has vowed to cut the number of cable networks in operation, but the number of CATV operators is still estimated to be in the hundreds. CBN was awarded its own basic telecommunications licence in May 2016, enabling it and its subsidiary China Cable Television Network to provide domestic Internet data transmission and telecom infrastructure services nationwide.

Japan

e-Japan Strategy[9]

As the first foothold of broadband development, the IT Strategy Headquarters launched its e-Japan Strategy in January 2001. The primary goal of e-Japan Strategy was to establish an ICT-oriented information society through the provision of a broadband network infrastructure. To achieve this ultimate objective, the strategy set up four major initiatives as follows.

First, it sought to create an Internet-accessible environment where at least 30 million households could enjoy ultra-high-speed access networks (30-100 Mbps) and 30 million households could access high-speed access networks (2-10 Mbps) at reasonable rates by 2005 by deploying broadband infrastructure through competition. To guarantee the speed, quality, safety and reliability of Internet access, the plan promoted the development of IPv6 which could be equipped with the Internet networks. In addition, facilitating e-commerce was one of the main goals to be achieved by establishing the framework and market rules. The government initiated its scheme to actualise an e-Government that enables the online use of administrative procedures and the electronic provision of government information. Lastly, improvements in digital literacy were also highly targeted by facilitating Internet access to schools and public institutions. This approach was expected to foster high-quality human resources.

The implementation measures of the e-Japan Strategy materialized as the e-Japan Priority Program and e-Japan 2002 Program formulated projects annually. Supported by the government-led subsidies, tax incentives and low or zero interest loans to broadband providers, the strategy could be accelerated with the implementation of around 220 projects. Eventually, the primary goals were

[9] Prime Minister of Japan and his Cabinet website. Available from http://japan.kantei.go.jp/it/network/0122full_e.html.

achieved earlier than planned, offering 30million households high-speed broadband access by 2003.

e-Japan Strategy II[10]

After the success of the first national strategy, the government launched e-Japan Strategy II in July 2003 aimed at achieving the expansion of ICT use in everyday life by promoting broadband expansion. The main characteristic of the e-Japan Strategy II was that it focused on effective utilisation and advancement of existing ICT infrastructure, rather than investments towards next-generation paradigm.

Based on the achievement of universalization of high-speed broadband access to almost every household, the government promoted widespread application of ICT in seven main areas: 1) medical services, 2) food, 3) lifestyle, 4) small and medium-sized enterprises (SMEs) financing, 5) knowledge, 6) employment and labor and 7) public service. To prevent the conflict between the MIC and METI and overlapped investment, the government strengthened the role of the IT Strategy Headquarters by establishing expert examination committees under it.

u-Japan Strategy[11]

In December 2004, the u-Japan Strategy was launched by the MIC with the aim to create a ubiquitous society where people can get access to massive digital content and information transmitted through various devices that are connected seamlessly to both fixed and wireless networks anywhere and at any time. At the same time, the policy sought to eliminate the number of areas excluded from broadband access by setting a goal of making 90 per cent of all households to have ultra-high-speed access networks by 2010.

This strategy resulted in a paradigm shift towards advanced broadband connectivity. To support the strategy, MIC formulated the UNS Strategic Programme (Universal communications, New Generation Networks, and Security and safety technology strategies) in 2006 as well. There were three key R&D projects conducted under the UNS Strategic Programme, namely: a) New generation networks technologies (New generation networks architecture / New ICT paradigm / Ubiquitous platform), b) Security and safety technologies (Secure networks / Sensing- and ubiquitous time-space infrastructure / Context awareness environments), and c) Universal communications technologies (Universal contents creation / Super-communications / Common reality communications).

New IT Reform Strategy[12]

[10] IT Strategic Headquarters (2003). e-Japan Strategy II.
[11] MIC of Japan (2006). Information and Communications in Japan, White Paper 2008.
[12] MIC of Japan (2008). Information and Communications in Japan, White Paper 2008.

In 2006, Japan established the New IT Reform Strategy. The aim of this initiative was to create a new type of society where various social issues can be solved through the use of ICT. The government put more emphasis on the importance of closing the digital gap between regions by deploying broadband infrastructure, including Fibre-to-the-Home (FTTH) to every household by 2010 and expanded the focal topics which included advanced ubiquitous networks.

The Strategy planned to use the structural reform capability of ICT and improve the level of ICT utilisation to transform people's lives. To promote the structural reform, the IT Strategic Headquarters played an instrumental role in facilitating cooperation between the ministries on various cross-sectoral ICT-relevant issues. The Expert Committee on IT Strategy Evaluation under the Headquarters set up an assessment system on priority policy issues. Issue-specific committees ought to report their evaluation results to the Headquarters through the channel of the Expert Committee, which gave guidance and policy implementation to the relevant ministries responsible for the specific issue policies.

i-Japan Strategy 2015[13]

In July 2009, the government established the i-Japan Strategy 2015 which is a Three-Year Emergency Plan to address issues affecting previous strategies. While previous policies were more focused on the perspective of service carriers and manufacturers, the i-Japan Strategy sought to promote the use of digital technologies from the perspective of users. By 2015, the government strived to standardise and simplify administrative procedures to enhance convenience of the people and transparency of the government. It set a target to advance ultra-high-speed broadband infrastructure (in excess of 100 Mbps for mobile and 1Gbps for fixed access) that enables everyone to easily, seamlessly and safely exchange information at anytime, anywhere.

In line with fostering infrastructure development, the government set three priority areas to put emphasis on 1) e-government and e-local government, 2) healthcare and 3) education and human resources. The government planned to establish the PDCA (plan-do-check-act) structure and diffuse the national e-post box to citizens and businesses to help them use government information concerning themselves (which evolved into the Social Security and Tax Number System) safely. The government accelerated the adoption of the IPv6 protocol to complement the IPv4 as well. The construction of a national digital archive was also encouraged so that people could easily get access. In addition, cloud computing was encouraged to be the main technology to build up the advanced government information system. Government chief information officers (CIOs) were also scheduled to be appointed to be responsible for overall e-Government and administrative reforms. CIOs granted authorities the ability to cope with necessary budgets and funds and to standardise administrative processes and data.

[13] IT Strategic Headquarters (2009). i-Japan Strategy 2015.

IT Declaration[14]

In June 2013, the government announced a goal to be the World's Most Advanced IT Nation (IT Declaration) to reformulate the government ICT strategy for the purpose of using ICT as an engine for revitalizing Japan's economy. After a year of debate on implementation of a roadmap, the Declaration was adopted in June 2014. The Government CIO Act and other relevant legislation was amended and enacted to clarify the primary role of each ministry and attainment goals. The law improved efficiency of the government's ICT investment capabilities by giving authority to the government CIO to coordinate the activities of each ministry at a high level.

The IT Declaration clarified four pillars for society to attain, namely 1) achieving future growth through the use of ICT, 2) utilising ICT in households, workplace and towns, 3) improving safety and security of ICT services and 4) providing a one-stop access to public services through the use of ICT. Building a new institutional framework for the use of big data was highlighted as well as the need to provide a response to the Internet of Things (IoT) era.

Japan has worked on improving the government information system based on the IT Declaration. It strives to consolidate and move existing information systems to the cloud and to conduct business processes through the use of ICT. By cutting the number of information systems (around 1,450 systems as of 2012) in half by 2018, the government expects to reduce 30 per cent of its annual system operating costs by 2021. These efforts will be applied to local governments as well in partnership with the MIC.

Republic of Korea

Digitalizing national information resources by constructing basic computing infrastructure

Following the remarkable economic development through strategic export-oriented industrialisation in the 1960s, the Republic of Korea was prepared for the next phase of national development in line with global trends of intensive investments in ICT, led by major developed countries in the 1980s. As the nation's industrialisation accelerated, the demand for ICT infrastructure grew proportionally. At the time, telecom services were underdeveloped. For example, the fixed-line telephone penetration rate was about 7 per cent and the call completion rate could barely reach 50 per cent due to aging transmission lines. In response to inferior infrastructure and a rising demand, the government took several measures to lay the groundwork prior to initiating a full-fledged informatisation process throughout the country.

As economic growth accelerated from the late 1970s, the Government promoted computerisation of administration to fulfil the public demand on advanced public administrative services. Based on

[14] Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (2013). Declaration to be the World's Most Advanced IT Nation.

the Computerisation Master Plan, the first ICT policy formulated in 1978, and the National Basic Information System Policy (NBIS) in the 1980s supported by the Act on Computer Network Expansion and Utilisation Promotion (1986), the government implemented initiatives to computerise administrative functions by deploying computer networks. These initiatives mostly emphasised introducing computers and implementing computation functions in each government agency by the early 1980s. Following this, the government rolled out national backbone networks connecting government agencies to create five information systems:

(1) National Administration Information System;

(2) Financing Information System;

(3) Education and Research Information System;

(4) National Defense Information System; and

(5) National Security Information System.

To facilitate these systems, national information resources, including the registration database, the real estate database and the vehicle administration database, were digitised.

The primary objective of this computerisation was to improve work efficiency and quality of the public sector. The digitisation of national data and the construction of basic backbone networks became the foundation of broadband success in conjunction with e-Government services.

To plan and implement the initiatives stated above, the committee of the NBIS was organised and administrated by experts from relevant ministries and the secretariat was managed with the staff dispatched from related agencies. Moreover, the National Computerisation Agency was established as a specialised support organisation in charge of standardising computer networks and technical assistance. The government adopted a financing strategy that led carriers to invest first and get reimbursed later.

Key master plans and initiatives for informatization

Since the mid-1990s, the government has established a mid- and long-term framework plans on national informatisation in combination with specific implementation plans. Extensive government efforts were made between the mid-1990s and the mid-2000s to achieve building the knowledge-information society through high-quality information network infrastructure. Starting from the First Master Plan for Informatisation Promotion (1996), consecutive initiatives were designed and implemented based on the Framework Act on Informatisation Promotion, as shown in (see table 1).

These plans were mostly designed in the form of a rolling plan of five-year. Through government loans and investments from the private sector, the impact of the informatisation was felt in all

spheres of the economy in the country. The Republic of Korea was able to construct advanced information infrastructure for both public and private services.

Table 1. Informatisation master plans and policies

Informatisation master plans and policies

Period	Master plan	Main policies
1996-2000	First Master Plan for Informatisation Promotion	Korea Information Infrastructure Initiative (KII)
1999-2002	Cyber Korea 21	National Information Super Highway Basic Plan 11 e-Government Initiatives Comprehensive Policies for e-Commerce Development Informatisation Education Plan for 10 Million Citizens
2002-2006	e-Korea Vision 2006	Broadband Convergence Network (BcN) Implementation Plan Phase 2 of the National Informatisation Education Plan Informatisation Plan for One Million Small and Medium Enterprise Mid-to Long Term Information Security Roadmap
2003-2007	Broadband IT Korea Vision 2007	
2006-2015	u-Korea Master Plan	Ultra-Broadband Convergence Network (UBcN) Initiative
2008-	The Fourth and Fifth Master Plan for Informatisation Promotion	Implementation of Giga-Internet Pilot Project BcN Project in rural areas

Source: ESCAP based on MSIP and NIA (2014). 20 years of record of national informatization in Korea and MSIP and NIA (2014). Achievement of national informatization for two decades in Korea.

The First Master Plan for Informatisation Promotion provided step-by-step goals and strategies to achieve a complete national informatisation by 2010, and specified the tasks that the government needed to undertake during the first period (1996-2000). The object of the first plan was to interconnect public and private facilities including administrative agencies; educational institutes; research institutes; enterprises; hospitals; and households with the latest high-speed internet networks.

For this purpose, the government set primary goals as follows:

1) expansion of one-stop G4C (Government for Citizen) services based on the electronic data interchange;

2) the improvement of Internet-based civil services through bulletin board systems;

3) build up the foundation for education informatisation by including distance education;

4) expansion of integrated information networks for industries such as trade, patent, industrial technology and distribution information; and

5) the reinforcement of business competitiveness by introducing e-commerce in SMEs.

Built upon the First Master Plan for Informatisation Promotion, the Korea Information Infrastructure initiative (KII) was launched as the first and the most essential project to construct the information superhighway in the country.

Furthermore, Cyber Korea 21 Initiative was established in 1999 to construct a high-speed network to improve transparency and productivity of economic players – government, businesses and household – through ICT and highly advanced information networks. In addition, it targeted the ICT industry to promote and create new businesses including Information Provider (IP) and Internet Service Provider (ISP), which could lead to job creation.

Followed by the Cyber Korea 21, e-Korea Vision 2006 was adopted in 2002 to improve working procedure quality and revised in 2003 to construct the Broadband Convergence Network (BcN) to properly cope with the issue of personal information protection and cyber security. BcN is an integrated network that provides seamless multimedia services that converges all different network such as fixed and mobile telecommunications, broadcasting and internet.

Additionally, the U-Korea Master Plan was formulated in 2006 to improve social systems and services by constructing ubiquitous ICT infrastructure using BcN and ubiquitous sensor network (USN). The plan was designed in two implementation phases: (1) the establishment phase (2006-2010) and (2) the stabilisation phase (2011-2015). The first phase was to advance ubiquitous ICT infrastructure, and to provide seamless services anytime and anywhere through mobile handsets that are connected to wired or wireless networks. The second phase had goals to universalise ubiquitous services in overall social sectors and to upgrade national major facilities.

By 2008, the country became one of the world's most advanced ICT countries with world class e-Government services and Internet penetration rates. However, further advancement of network construction was required both in quantity and quality to fulfil the demand of future telecommunications services. Moreover, the focus of attention has gradually moved from the ICT itself to various ICT-converged sectors. Accordingly, the Fourth and Fifth Master Plan expanded the development scheme of BcN into that of Ultra Broadband Convergence Network (UBcN) and Giga Internet. At the same time, the government was reshuffled with relevant tasks distributed to concerned ministries.

3. Implementation of ICT policies and current status

China

Size of the telecommunications industry

In 2016, the number of telephone users increased by 26.2 million to 1.5 billion, a growth of 1.7 per cent compared to that of previous year. Mobile phone users increased by 50.5 million to 1.3 billion and the diffusion rate of mobile phones reached 96.2 per hundred persons, showing an increase of 3.7 per hundred persons over the previous year. There were 10 provinces and municipalities in China with the mobile phone diffusion rate of over 100 per hundred persons:

Beijing, Guangdong, Shanghai, Zhejiang, Fujian, Ningxia, Hainan, Jiangsu, Liaoning and Shaanxi. The total number of fixed telephone users was 207 million, reduced by 24 million.

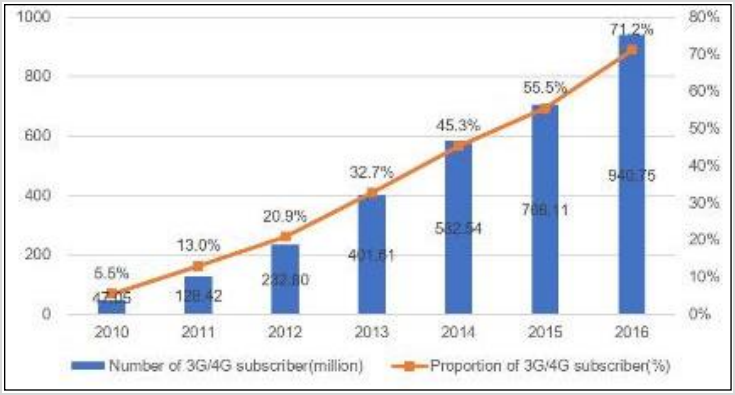
Table 2. Telecommunications subscribers by province, 2016

	Mobile phone users		Fixed phone users	
	Number (in thousands)	Penetration (%)	Number (in thousands)	Penetration (%)
China	**1,321,936**	**96.2**	**1,528,561**	**15.0**
Eastern China	**645,425**	**113.4**	**755,824**	**19.4**
Beijing	38,690	178.3	45,640	32.0
Tianjin	14,998	96.9	18,111	20.1
Hebei	71,210	95.9	79,717	11.5
Liaoning	44,271	101.0	53,177	20.3
Shanghai	31,561	130.7	38,878	30.3
Jiangsu	81,988	102.8	99,071	21.4
Zhejiang	72,259	130.5	85,132	23.2
Fujian	41,590	108.3	49,747	21.2
Shandong	95,945	97.4	105,649	9.9
Guangdong	143,490	132.3	169,587	24.1
Hainan	9,423	103.5	11,115	18.6
Central China	**345,162**	**80.2**	**392,220**	**10.9**
Shanxi	33,657	91.9	37,094	9.4
Jilin	26,548	96.4	31,751	18.9
Heilongjiang	34,456	90.4	39,430	13.1
Anhui	43,430	70.7	49,569	10.0
Jiangxi	31,407	68.8	36,582	11.3
Henan	78,890	83.2	86,876	8.4
Hubei	46,838	80.0	54,154	12.5
Hunan	49,936	73.6	56,764	10.1
Western China	**331,349**	**89.2**	**380,517**	**13.2**
Inner Mongolia	24,708	98.4	27,389	10.7
Guangxi	37,742	78.7	41,231	7.3
Chongqing	28,801	95.5	34,217	18.0
Sichuan	72,945	88.9	87,845	18.2
Guizhou	30,827	87.3	33,414	7.3
Yunnan	39,428	83.1	42,778	7.1
Tibet	2,844	87.8	3,232	12.0
Shanxi	38,133	100.5	44,932	17.9
Gansu	22,038	84.8	25,161	12.0
Qinghai	5,398	91.7	6,418	17.3
Ningxia	7,164	107.3	7,870	10.6
Xinjiang	21,321	90.4	26,030	20.0

Source: MIIT (2016); Broadband Development Alliance.

In 2016, an explosive growth was seen in the number of 4G subscribers. There were 340 million new subscribers, and the total number reached 770 million. Among mobile phone subscribers, the penetration rate of 4G services reached 58.2 per cent. The number of 2G subscribers reduced by 184 million and its proportion to the total mobile phone subscribers dropped from 44.5 per cent to 28.8 per cent.

Figure 4. Number of 3G/4G subscribers, 2010-2016



Source: MIIT (2016).

Table 3. Mobile phone subscribers by province, 2016

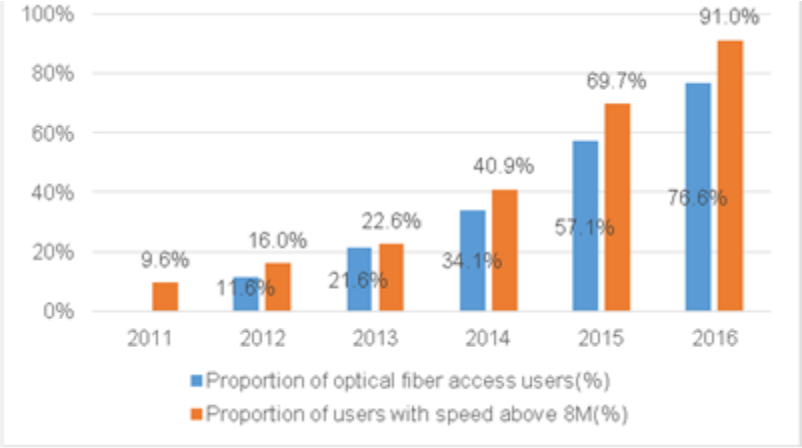
	Mobile phone users		3G users		4G users	
	Number (in thousands)	Growth (%)	Number (in thousands)	Growth (%)	Number (in thousands)	Growth (%)
China	**1,321,934**	**4.0**	**170,805**	**-38.1**	**769,949**	**78.9**
Eastern China	**645,425**	**2.8**	**75,245**	**-43.2**	**384,786**	**70.9**
Beijing	38,690	-1.9	5,029	-40.8	23,052	60.7
Tianjin	14,998	9.5	2,236	-36.0	8,482	86.4
Hebei	71,210	16.1	7,754	-39.6	40,347	102.1
Liaoning	44,271	3.2	5,205	-42.5	24,558	88.8
Shanghai	31,561	0.8	5,125	-37.7	18,776	53.9
Jiangsu	81,988	2.6	8,978	-46.5	53,968	58.5
Zhejiang	72,259	-0.8	7,146	-47.9	46,663	58.4
Fujian	41,590	0.1	4,487	-39.9	25,670	66.4
Shandong	95,945	5.6	12,503	-36.5	46,475	105.7
Guangdong	143,490	-0.9	15,786	-48.9	90,853	62.4
Hainan	9,423	5.4	996	-44.2	5,943	68.1
Central China	**345,162**	**4.4**	**40,329**	**-42.8**	**199,682**	**91.4**
Shanxi	33,657	3.8	3,742	-46.5	18,855	100.3
Jilin	26,548	5.7	3,386	-32.2	13,944	111.6
Heilongjiang	34,456	3.5	4,839	-31.4	16,918	100.1
Anhui	43,430	3.7	5,457	-38.5	25,478	89.1
Jiangxi	31,407	3.6	3,071	-50.6	19,148	71.0
Henan	78,890	4.7	10,318	-34.5	44,035	82.4
Hubei	46,838	3.4	5,670	-40.2	27,700	73.2
Hunan	49,936	6.4	3,846	-65.3	33,604	122.8
Western China	**331,347**	**5.8**	**55,231**	**-24.2**	**185,480**	**83.7**
Inner Mongolia	24,708	3.9	3,383	-32.5	13,179	87.7
Guangxi	37,742	5.0	4,429	-33.6	23,253	79.2
Chongqing	28,801	5.2	3,384	-43.7	17,478	82.9
Sichuan	72,945	7.3	13,408	-20.6	41,248	96.7
Guizhou	30,827	4.8	3,072	-42.5	18,070	81.7
Yunnan	39,428	5.4	4,481	-36.8	23,881	75.6
Tibet	2,844	5.8	1,627	24.9	114	1195.5
Shanxi	38,133	6.9	4,417	-29.8	24,967	61.1
Gansu	22,038	4.7	3,346	-26.4	13,325	83.4
Qinghai	5,398	4.4	1,047	-31.5	2,793	97.5
Ningxia	7,164	12.5	833	-41.0	4,519	71.3
Xinjiang	21,321	5.1	11,805	9.5	2,654	5987.8

Source: MIIT (2016); Broadband Development Alliance.

In 2016, the number of fixed Internet broadband access subscribers of all three telecommunications operators increased by 38 million to 297 million. The broadband city construction continued to

promote the diffusion of fibre optic access. The number of fibre optic access (FTTH/O) subscribers increased by 79 million to 228 million, and its proportion to the total number of broadband access subscribers increased by 19.5 per cent to 76.6 per cent. The proportions of subscribers of broadband access at rates of 8Mbps and 20Mbps to the total number of broadband access subscribers were 91.0 per cent and 77.8 per cent, showing an increase of 21.3 per cent and 46.6 per cent, respectively.

Figure 5. Proportion of subscribers to high-speed Internet broadband access, 2011-2016



Source: MIIT (2016).

Table 4. Household penetration of fixed broadband by province, 2016

Province	Household Penetration (%)	Rank within the region	Domestic Ranking
Eastern China			
Zhejiang	93.2	1	1
Jiangsu	90.9	2	2
Beijing	86.3	3	3
Shanghai	83.5	4	4
Guangdong	80.1	5	5
Fujian	77.5	6	6
Tianjin	69.5	7	9
Hebei	66.1	8	10
Shandong	62.7	9	11
Hainan	61.6	10	12
Liaoning	59.9	11	14
Central China			
Shanxi	58.7	1	15
Hubei	58.1	2	16
Jiangxi	56.3	3	17
Henan	51.7	4	20
Anhui	49.4	5	21
Heilongjiang	45.5	6	25
Jilin	45.0	7	26
Hunan	40.3	8	29
Western China			
Sichuan	71.9	1	7
Chongqing	71.8	2	8

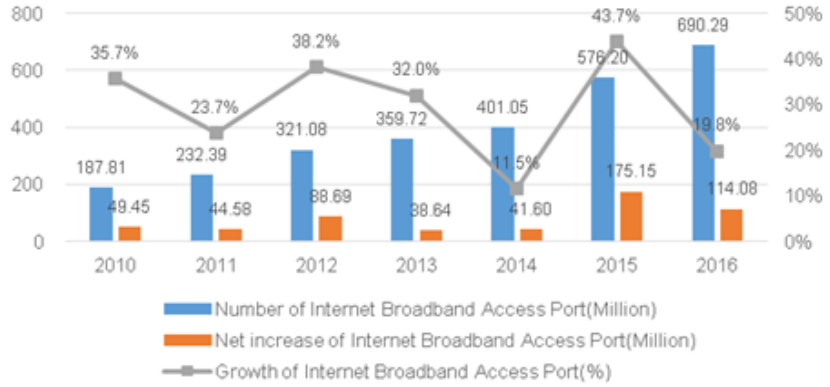
Shaanxi	60.6	3	13
Guangxi	53.3	4	18
Ningxia	52.7	5	19
Xinjiang	48.0	6	22
Qinghai	46.3	7	23
Gansu	46.2	8	24
Guizhou	44.5	9	27
Tibet	41.8	10	28
Yunnan	37.8	11	30
Inner Mongolia	37.5	12	31

Source: Broadband Development Alliance.

Co-location of core infrastructure

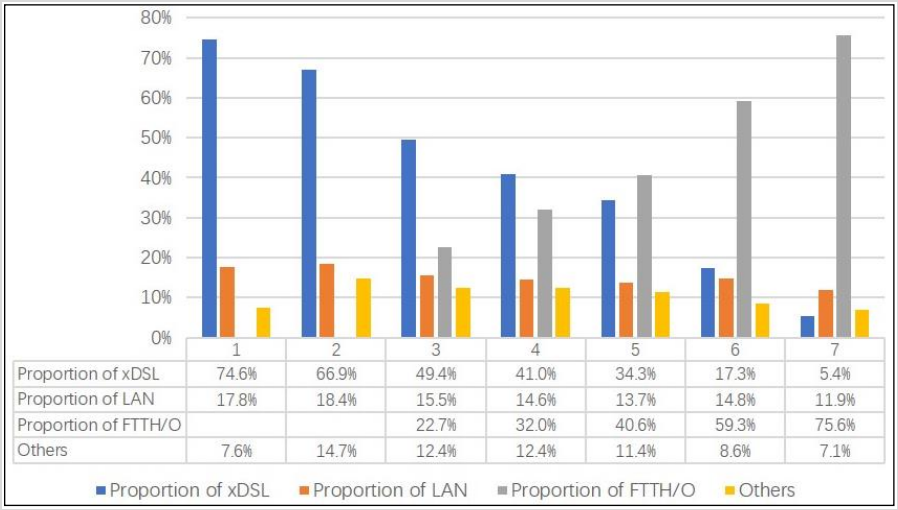
China showed tremendous progress in bridging the digital divide, given that there was an increase by 114 million with a growth rate of 19.8 per cent in 2016 compared to the previous year. There were substantive changes in the way broadband was deployed. Increased use of fibre optic cables and reduced use of copper cables in Internet broadband access ports became more obvious. The number of xDSL ports reduced by 63 million to 37 million and its proportion to the total number of Internet access ports decreased from 17.3 per cent to 5.4 per cent. The fibre optic (FTTH/O) ports increase by 181 million to 522 million and the proportion to the total number of Internet access ports increased from 59.3 per cent to 75.6 per cent from the previous year.

Figure 6. Development of Internet broadband access port, 2010-2016



Source: MIIT (2016).

Figure 7. Proportion of broadband access port by technology type, 2010- 2016

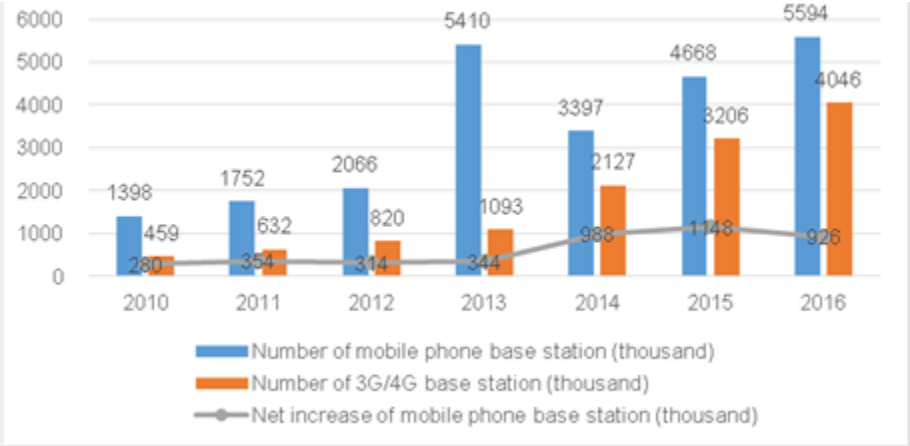


	1	2	3	4	5	6	7
Proportion of xDSL	74.6%	66.9%	49.4%	41.0%	34.3%	17.3%	5.4%
Proportion of LAN	17.8%	18.4%	15.5%	14.6%	13.7%	14.8%	11.9%
Proportion of FTTH/O			22.7%	32.0%	40.6%	59.3%	75.6%
Others	7.6%	14.7%	12.4%	12.4%	11.4%	8.6%	7.1%

Source: MIIT (2016).
Note: Others include other broadband access technology, such as cable.

In 2016, fundamental telecommunication enterprises accelerated the construction of mobile networks and set up 926,000 new mobile base stations, increasing the total number of mobile base stations to 5.59 million. 861,000 new 4G base stations were constructed, increasing the total number to 2.63 million. The coverage and service capacity of mobile networks have been further enhanced.

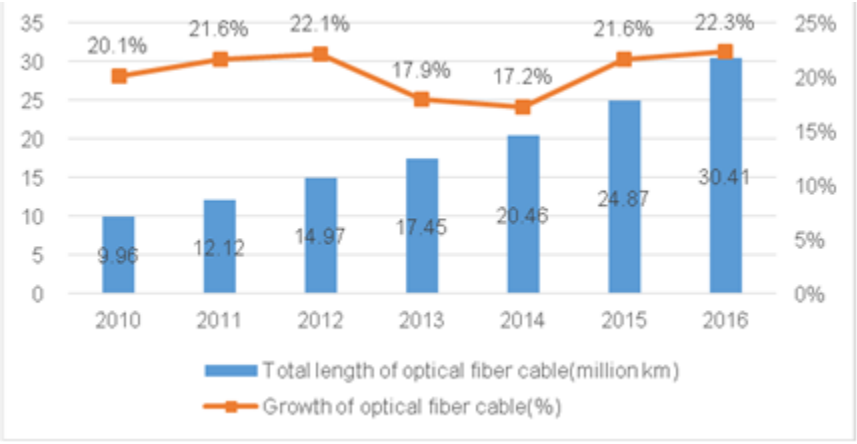
Figure 8. Development of mobile phone base station, 2010-2016



Source: MIIT (2016).

In 2016, fibre optic cable lines of 5.54 million kilometres were constructed with an increase of 22.3 per cent, increasing the total length of fibre optic cable lines to 30.41 million kilometres. A rapid growth is maintained.

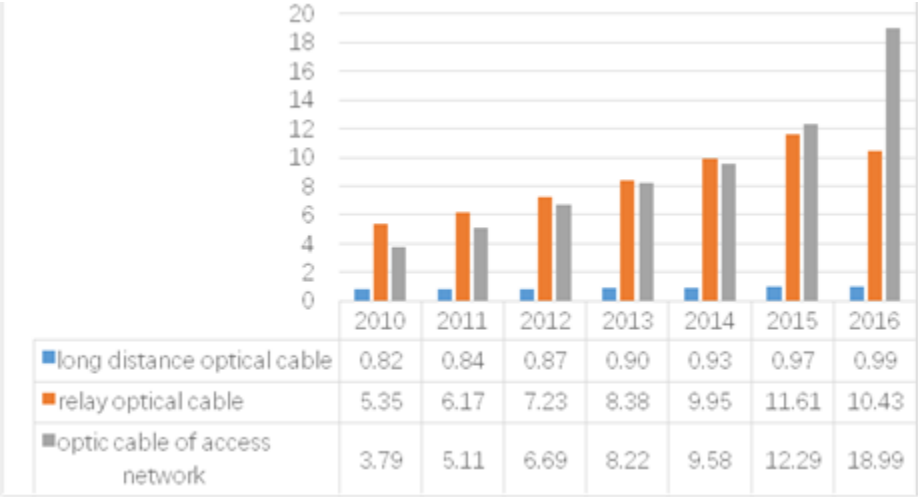
Figure 9. Development of fibre optic cable length, 2010-2016



Source: MIIT (2016).

Among the newly constructed fibre optic cables, fibre optic cables for the access network, relay fibre optic cables for local networks and long-distance fibre optic cables respectively take up 62.4 per cent, 34.3 per cent and 3.3 per cent. The length of long distance fibre optic cables increased slightly, with a growth rate of 3.5 per cent, and the length of new constructed long- distance fibre optic cables has grown to 33,200 kilometres.

Figure 10. Comparison of optical fibre optic cable length, 2010-2016



	2010	2011	2012	2013	2014	2015	2016
long distance optical cable	0.82	0.84	0.87	0.90	0.93	0.97	0.99
relay optical cable	5.35	6.17	7.23	8.38	9.95	11.61	10.43
optic cable of access network	3.79	5.11	6.69	8.22	9.58	12.29	18.99

Source: MIIT (2016).

Operationalisation of the telecommunication universal service

Under the Telecom Regulation, telecommunication business operators must operate in accordance with the relevant regulations of the state to fulfil the corresponding telecommunication universal service obligation. However, the regulation did not provide clear definition of the types of telecommunication universal service.

MIIT launched the "Village-to-Village" project in 2004. It was designed to achieve the goals below over three stages:

1) Stage one (– 2005): connect 95 per cent or more of the administrative villages to phone services
2) Stage two (2006-2010): connect all villages to phone services, and all townships to the Internet
3) Stage three (– 2015): expand scope of universal service from voice service to the Internet service and connect almost every administrative village to broadband services.

The industry wide efforts helped the project to be materialized on time.

In October 2015, the executive meeting of the State Council decided to improve the universal service compensation mechanism for rural and remote areas. The pilot work would be organised by MIIT together with the Ministry of Finance. Later in December, MIIT and the Ministry of Finance issued the Guide to Application for Pilot Application of Telecommunication Universal Service (2016) and initiated the pilot telecommunication universal service to achieve the goal of providing broadband Internet access for 98 per cent of administrative villages by 2020 with broadband access rate up to 12Mbps.

The telecommunication universal service compensation mechanism was proposed in 2000. In the beginning, the government formulated the plan and distributed the task of telecom universal service according to region. Telecom operators were required to undertake the universal service obligation in accordance with the assigned tasks. Before 2015, the operation and maintenance allowance provided by the Government was CNY 400 million each year. But the amount was insufficient to cover the operation and maintenance cost of telecom operators. In October 2015, the executive meeting of the State Council has decided to "increase the investment by the Central Government, guide the local governments to strengthen policy and financial support, encourage telecom operators and private capital to take part in the rural broadband construction and operation fairly by the competitive bidding, the total investment will surpass CNY 14 billion".

In 2016, MIIT and the Ministry of Finance organised two batches of pilot projects of the telecommunication universal service. The funds of the central government and enterprises invested over 30 billion yuan to support the construction and reconstruction of fibre optic cables for 100,000 administrative villages in 27 provinces (autonomous regions and municipalities), including 31,000 poverty-stricken villages. The Internet broadband access constructed in 2016 already exceeded the total number of Internet broadband access constructed during the Twelfth Five-year Plan period.

To promote sustainable and sound development of ICT, MIIT formulated *the 13th Five-year Plan for the Development of the Information and Communication Industries*. The Plan defines the main task of the telecommunication universal service from 2016 to 2020 as increasing the information and communication level in rural and remote areas. Specific tasks are as follows:

1) Carry out the requirements of the State Council to provide the broadband telecommunication universal service in rural and remote areas, closely cooperate with the targeted poverty

alleviation, strengthen policy and resource supports, accelerate the construction of Internet infrastructure in rural areas, expand the effective coverage of fibre optic and broadband networks in rural areas, and provide broadband access for users in rural areas at a rate of 12Mbps;

2) Improve the accessibility of information and communication networks in rural and remote areas, and focus on issues on Chinese domain names, technical consultation and e-commerce service;

3) Encourage various types of capital to participate in the development of e-commerce in rural areas, support third-party platform innovations and expand e-commerce businesses in rural areas.

4) Continue to popularize Internet applications such as e-commerce in rural areas, accelerate the development of innovative applications based on mobile Internet access such as mobile e-commerce platforms and mobile payment, and focus on information and communication services for rural and remote areas.

5) Aim at agricultural modernisation, promote intelligent production and Internet based operation of the agriculture industry to sell agricultural products through Internet and help farmers to increase their incomes; and

6) Increase household penetration in rural areas to achieve over 90 per cent coverage of broadband Internet for poverty-stricken villages by 2020, help to win the poverty alleviation war.

The Plan puts forward the telecommunication universal service pilot work as the key work. Its main goals include strengthening the construction broadband networks in rural areas, fibre optic network coverage for 98 per cent of all administrative villages and providing Internet broadband access for rural household users at a rate no less than 12Mbps. To achieve these goals, it proposes to give priority to funds of the central government, drive local governments to strengthen coordination and policy supports, guide enterprises to undertake the main responsibilities of the market, provide fibre optic network coverage for administrative villages without broadband network access, and upgrade the existing network access into fibre optic cable network access for administrative villages with broadband access at a rate lower than 12Mbps.

Increased access rate with reduced fees

In 2017, MIIT continued to advance the work of increasing access rate with reduced fees. It will explore opportunities for tariff reduction and urge the telecommunications operators to reduce tariffs relevant to below three key areas for the benefit of both the operators and users:

1) Cancel the domestic long-distance and roaming fees within the year;
2) Reduce sharply the fees of Internet private line access for SMEs; and
3) Reduce international long-distance call fees.

Furthermore, MIIT will actively increase effective investments and continue to support telecommunication infrastructure construction to enhance network capacity as below:

1) Continue the universal service pilot and accelerate the broadband network coverage in rural areas to reduce the digital gap;
2) Make efforts to solve the "last mile" problem, accelerate the establishment of the market mechanism for equal access of enterprises and free choice for users to maximise benefits of users;
3) Increase the interconnection bandwidth of backbone networks and bandwidths of international Internet entry and exit, and further enhance the network performance to improve user access experience; and
4) Encourage and support telecommunications operators to set up innovation and business starting platforms, to release network capacities and to strengthen supports to SMEs.

China Mobile expressed that they will increase the access rate in the following aspects:

1) Construct quality 4G mobile broadband networks for enhanced customer perception, focus on and give priority to the user perception under special scenarios with high speed, heavy traffic and high-rise buildings;
2) Accelerate the process to increase access rate to build quality wireline broadband networks – FTTH will be applied for all newly constructed broadband networks and FTTB reconstruction will be expedited for existing users to build 100Mbps wireline broadband networks and 1000Mbps demonstration wireline broadband networks; and
3) Promote social responsibilities to carry forward the telecommunication universal service.

China Mobile will include funds required for the universal telecommunication service project in the annual investment plan to guarantee the fund input. It will implement standardised management to look over construction funds and government subsidies, actively advance the construction and promote the informatisation of rural and remote areas to reduce the digital divide.

China Unicom has also embarked on initiatives to increase the access rate while reducing fees. Furthermore, it is determined to strengthen innovation and cooperation, greatly increase the perception of high traffic consumption, provide supports to innovative business starters and actively help the development of the substantial economy by pursuing below activities:

1) **Double the bandwidth of fixed broadband networks to increase the broadband bandwidth**

   In areas with high bandwidth requirement in medium and large cities, China Unicom aims to increase the rate of access networks from 100Mbps to 200Mbps to double the bandwidths. In addition, it will also actively develop 1000Mbps service pilot points to build 1000Mbps demonstration area to provide supports for start-ups and make innovations with wider information highways;

2) **Double the speed of 4G networks to realise the goal of increased access rates**
   To improve the quality and efficiency of wireless networks, improve the coverage quality, increase the network coverage, targeted construction will be implemented. The aim is to improve network experience and increase the peak rate of key scenarios and hotspot areas from 300Mbps to 600Mbps to achieve increased access rate and to keep its leading position in network rate perception; and
3) **Optimise communication service combinations to provide more benefits to users**
   As of 1 October 2017, China Unicom stopped charging fees to connect long-distance calls and roaming calls for mobile phone users. It also reduced the fees on international long-distance and international roaming calls in addition to reducing the fees on Internet private line access for SMEs. Moreover, it also gave full advantages in traffic resources of 4G resources and informatisation construction of one-point access to support the entire network, deepen industrial cooperation and create innovative products. Henceforth, the company will focus on users with high traffic requirements such as youths, students and Internet surfers to provide targeted preferences on big data services. It will start with the "supply side" communication products and focus on traffic consumption to launch a series of services and innovate the consumption mode. These efforts are targeted to solve the problem of being eager to use but not dare to use, innovate the charging modes to solve the problem of insufficient traffic and innovate the service mode to ensure insured and easy traffic use.

On a similar note, China Telecom announced that it will make an investment of CNY 100 billion to build intelligent high-speed networks, in addition to the total planned investment of about CNY 100 billion. It will increase its investment in fibre optic networks to achieve full coverage for towns or above in South China and increase the coverage for administrative villages to 75 per cent by the end of 2017. Meanwhile, it will launch the 1,000Mbps demonstration event in 100 cities to realise 1,000 Mbps broadband access for major areas. It will continue to accelerate the construction of mobile broadband networks, build quality 4G networks with continuous coverage all over the country and construct the Voice over Long Term Evolution (VoLTE) and narrow-band IoT (NB-IoT) networks covering the entire country.

On a move similar to that of China Unicom, China Telecom plans to reduce Internet private line access charges for SMEs. Concurrently, it will launch customised business private lines at lower prices to provide quality customised services such as safe private lines (Internet + Cloud Bank) and quality private lines, and provide quality cloud computing/data centre, IoT, video conference and industrial information applications to improve the service quality while reducing tariffs. Additionally, the company will reduce the fees on international long-distance calls and calls to Hong Kong, Taiwan and Macao. Fees on long-distance calls to North America, Europe, Southeast Asia and countries and regions along the One Belt and One Road will also be reduced.

The diffusion of multi-mode mobile phones supporting all 4G/3G/2G mobile communication systems to offer more benefits for subscribers is expected to be accelerated by China Telecom. In 2016, MIIT popularised the six-mode mobile phones as the national standard, which reduces the

costs of mobile phones and free users from the restrictions over communication systems when they are choosing a telecommunication operator.

The popularisation of the standard is an important measure for implementing supply side reforms. The savings from mobile phone purchase for China Telecom users in the year was CNY 6.3 billion. Through the joint efforts of the industry, China's six-mode mobile phone standard has been accepted by the Global Certification Forum (GCF) and became a leading certification standard, and laid a solid foundation for domestic mobile phone manufacturers in promoting their international competitiveness and assisting the construction of the One Belt and One Road. In 2017, China Telecom will continue to popularize the standard to provide better experience and more benefits to users.

On the sustainable development agenda front, China Telecom will fulfil its commitment to farmers and the targeted poverty alleviation project. It will actively respond to the call of the Government to participate in the "information to the village and the home" project. Under the guidance of the Ministry of Agriculture, China Telecom will accelerate the construction of offline farmer-benefiting service points and the popularisation of online farmer-benefiting service platforms and launch mobile phone training and popularisation of agricultural technologies to enable farmers to enjoy easy information service without leaving their homes, and implement new applications such as IoT to help poverty alleviation.

In terms of the use of ICT in providing public information and services, China moved up fast in ranking from 78 in 2012 to 65 in 2018 in the UN E-Government Survey 2018.

Table 5. Performance of e-Government system of China

	Online Service Index (OSI)	Human Capital Index (HCI)	Telecommunication Infrastructure Index (TII)	E-Government Development Index (EGDI)	EGDI Level	2018 Rank
Score	0.8611	0.7088	0.4735	0.6811	High	65

Source: UN E-Government Survey 2018. Note: EGDI is composed of OSI, HCI and TII.

Japan

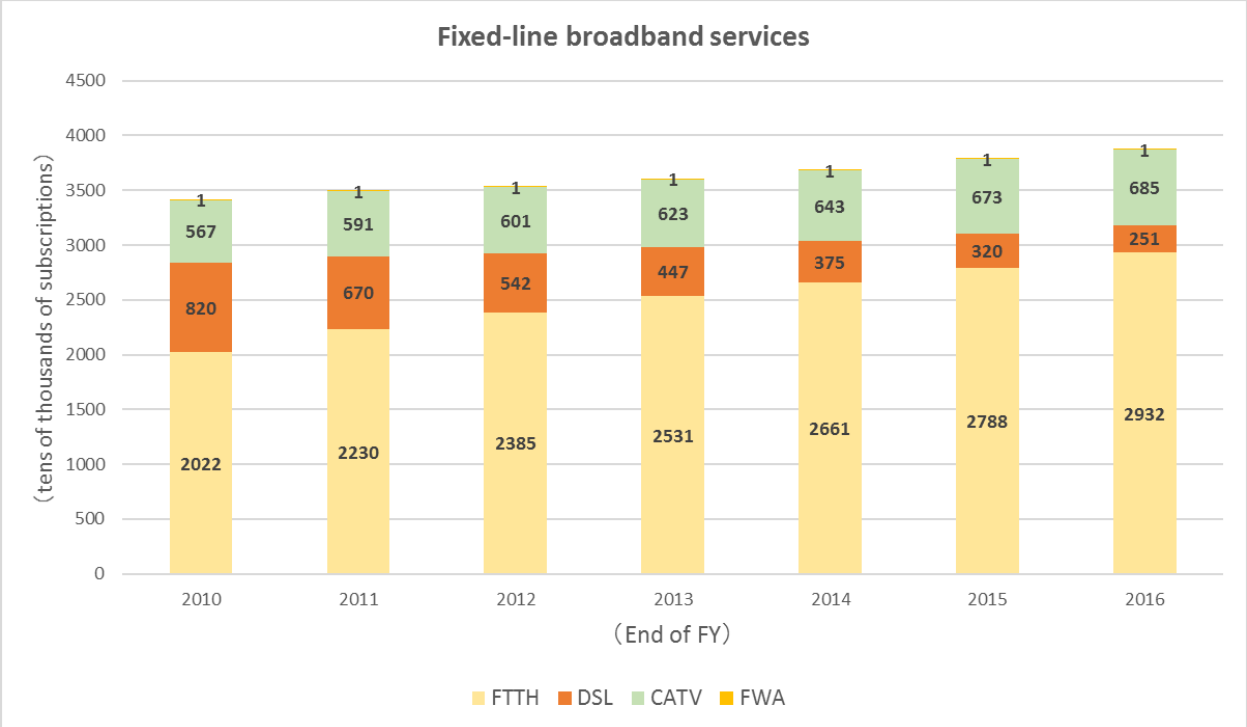
Promotion of broadband network deployment

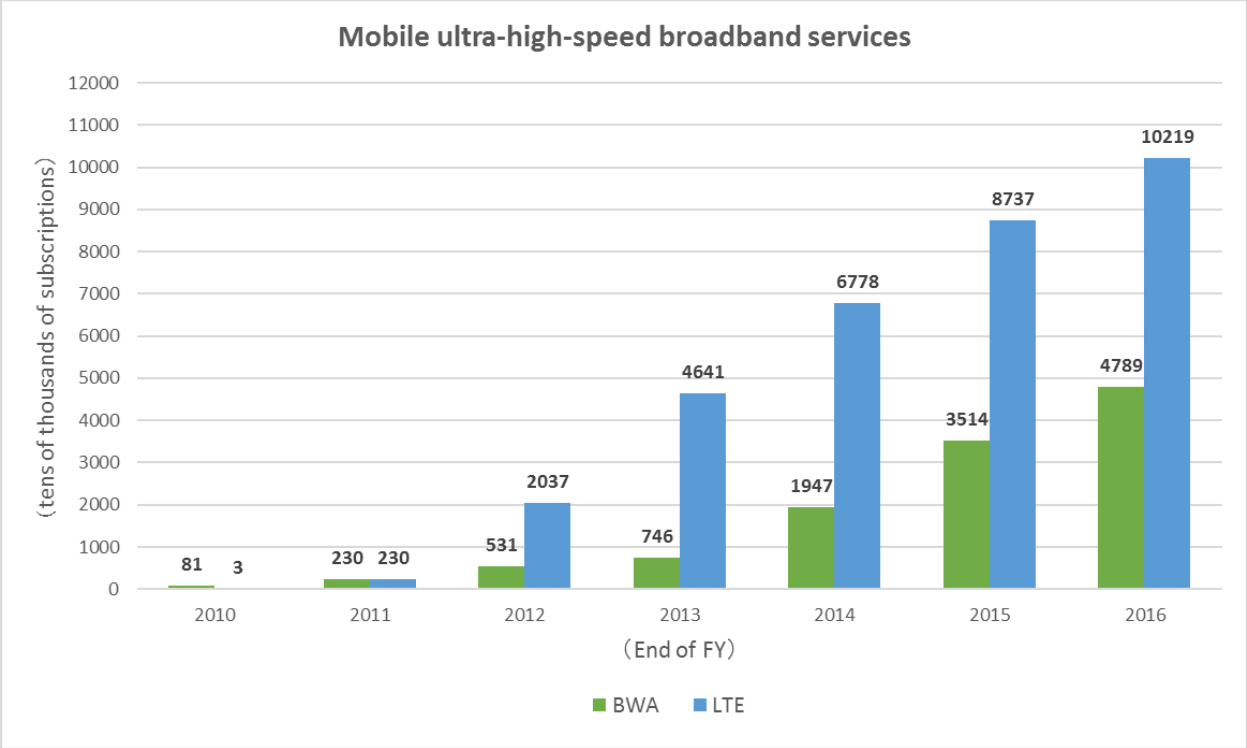
The telecommunications sector of Japan has gone through rapid growth of broadband infrastructure rollout in the 2000s. Starting from the extensive DSL diffusion in the early 2000s, Japan has experienced a demand and supply shift from DSL to fibre-optic networks. At the same time, the country has also been encouraging the deployment of the Next Generation Network (NGN) which enables the provision of various services through packet-based fibre-optic networks along with the NTT's initiation of commercial NGN services in 2008. To overcome the lagged

expansion of informatisation in the 1990s, Japan prioritised the provision of broadband access at affordable prices throughout the country.

Significant improvements in broadband connectivity was observed in Japan following its strategy to push for affordable broadband access. In 1999, ADSL service first appeared in Japan and began to expand from 2001 when Yahoo! BB entered the market with a competitive service price (almost half of the price charged by NTT). In 2002, after a year of implementation of the e-Japan Strategy, the Government began to produce tangible outcomes in terms of informatisation, thanks to the exponential increase in DSL services and introduction of unbundling policy. The number of broadband subscribers in Japan increased dramatically from around 216,000 as of March 2000 to around 3.87 million as of March 2002. Further, the number exceeded 10 million in the mid-2003, which was the target number to be achieved by 2005 based on the Strategy. The Internet penetration rate showed a rapid growth from 21.4 per cent as of 1999 (before the implementation of e-Japan Strategy) to 54.5 per cent as of December 2002. Moreover, all public schools in Japan became connected to the Internet by 2002.

Figure 11. Number of subscribers to fixed and mobile broadband services





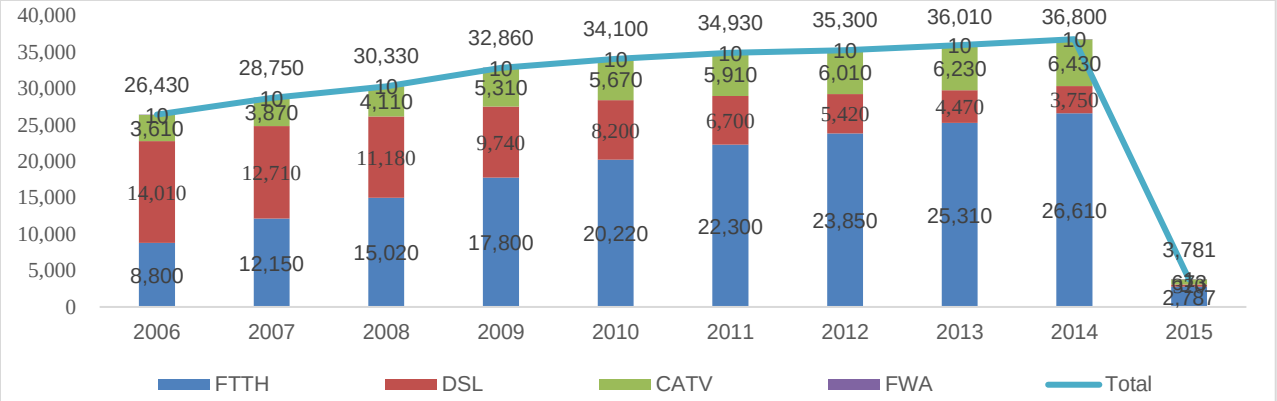
Source: MIC Japan (2017). Information and Communications in Japan: White Paper 2017. P. 73

While ADSL initially showed a remarkable growth in share of broadband subscriptions in the early 2000s, fibre-optic rollout began to catch up with the pace of ADSL deployment at a high speed. The development of FTTH service was witnessed with the launch of USEN Corporation in March 2001 and NTT East and West in August 2001. Also, competition has intensified in the FTTH field as a number of newcomers have entered the FTTH market, including the Tokyo Electric Power Co. in March 2002. Eventually, the number of contracts of FTTH exceeded that of ADSL in 2008. Since then, FTTH has the greatest share of broadband connections in Japan, covering almost 100 per cent of major urban areas, which is unusual in other countries.

As of December 2015, the number of FTTH subscribers reached 27.8 million and many Internet users have migrated from ADSL to FTTH mainly due to the functional advantage of FTTH over ADSL (e.g. FTTH enables a large amount of data to be transmitted instantly, and voice and video services to be provided with a single line.) Given the fact that FTTH provides faster speeds of services at similar costs as ADSL, there is not much doubt why this trend was observed.

Figure 12. Transitions in fixed broadband services, 2006 –2015

Thousands of subscribers



Source: Merged from MIC Japan (2013 & 2016). Information and Communications in Japan: White Paper 2013 & 2016.

The main driving force that resulted in the successful expansion of broadband is the government's proactive implementation of deregulation and competition policies which is explained in a later chapter. Government provided various incentives to service providers to invest in broadband rollout. Accelerated tax depreciation and reduction of tax bases for fixed asset taxes were allowed for telecommunications operators building broadband facilities such as fibre optic and DSL from 1990s. The Bank of Japan also let the carriers borrow money on capital markets at low rates to minimise risks.

Reducing the digital divide: rollout of broadband infrastructures throughout the region

The success of broadband rollout was echoed in aiming to extend it to rural areas, albeit with difficulty. The deployment of fibre-optic networks was the driving force that contributed to the diffusion of broadband services in Japan. However, even though FTTH has covered most parts of urban areas, the penetration rate of broadband services for peripheral regions was still low. It has been observed that mountainous areas typically face difficulty in terms of broadband access. Due to scattered residences with low population rates, it became necessary to establish more facilities in mountainous areas, which caused telecoms carriers to be more reluctant to invest in the rollout of infrastructures. The national efforts for broader household coverage of broadband availability was by the Government in the form of national subsidies toward local governments.

Several grassroots level initiatives were undertaken toward bridging the digital divide in rural regions. Local Intranet Infrastructure Facility Development Promotion Grants was launched in 1999 to subsidize up to one third of the total cost that builds broadband networks connecting public facilities such as schools, libraries and municipal offices. In 2006, the Grant-in-Aid System was formulated under the New IT Reform Strategy for the Government to offer subsidies to local governments that plan to construct broadband infrastructures (for ADSL, FTTH, cable services, Fixed Wireless Access, internet via satellite etc.) in areas under disadvantageous conditions for broadband access. Based on the system, one third of the installation cost is subsidized by the Government when fibre-optic infrastructures are constructed by local governments. The subsidies can amount to one-half if the financial capabilities of local governments are limited; and to two-thirds in the case of remote islands. At the same time, local governments lent the installed

broadband lines to telecom carriers that use facilities to provide Internet services to local residents and public institutions. Local governments make those broadband networks available to the private sector by means of the Indefeasible Right of Use (IRU) scheme. Under the IRU scheme telecom carriers can provide broadband services and charge for broadband services, in return, they have to pay for use of broadband infrastructure to local governments.

As of 2012, 36.6 per cent of the broadband deployment projects were financially supported by the Grants. At the same time, more than 63.2 per cent of projects related to the provision of FTTH services has been subsidised.

In June 2008, the government established the Strategy for Bridging the Digital Divide to offer services to remote areas left behind in terms of broadband access. In the same year, the Program for the Complete Dissolution of Geographical Digital Divide Areas was formulated to ensure that none of the households in Japan are without broadband services and 90 per cent of them would have ultra-high-speed broadband access by the end of 2010. Under the new strategy, the government sought to apply new broadband technologies such as Wi-Max and satellite connections in mountainous and remote island areas. The application of these technologies was also partially supported via national subsidies. As of March 2015, all households (55.94 million) in Japan had broadband access (minimum rate: 144 kbps), and 99.98 per cent of them got access to high-speed broadband services (minimum rate: 30 Mbps), mainly through the FTTH (MIC, 2016).

As a recent example of broadband diffusion, the government funded the region of Akitakata (in north-central Hiroshima Prefecture) to support broadband deployment via two technologies, namely FTTH and fixed wireless access (FWA) from 2012 to 2014. The project planned to make use of wireless technology for the last mile. Around JPY 900 million of the total project cost of JPY 2.8 billion was supported by the national subsidy. While FTTH networks (uplink: up to 200 Mbps / downlink: up to 200 Mbps) were constructed in a large part of the region, FWA was used to cover some mountainous areas to reduce costs. Furthermore, in 2015, the government subsidized approximately JPY 800 million, of the total project cost of JPY 1.2 billion, to support the local government of Kikai-cho (remote islands in Kagoshima prefecture) to deploy trunk lines, including submarine fibre optic lines, between 2014 and 2015.

Promotion of e-Government and Open Government

e-Government

Japan is now a country with well-established e-Government and local e-government systems. According to the UN E-Government Survey 2018, Japan ranked 10th in terms of e-government development (see table 6).

Table 6. Performance of e-Government system of Japan

	Online Service Index (OSI)	Human Capital Index (HCI)	Telecommunication Infrastructure Index (TII)	E-Government Development Index (EGDI)	EGDI Level	2018 Rank
Score	0.9514	0.8428	0.8406	0.8783	Very High	10

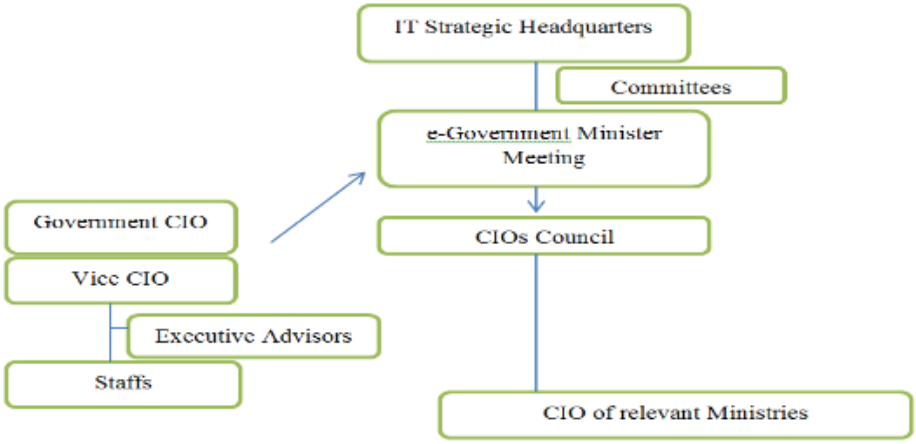
Source: UN E-Government Survey 2018. Note: EGDI is composed of OSI, HCI and TII.

Moreover, Japan stands fifth at e-participation performance with the score of 0.9831, indicating that the country proactively involves the public in decision-making through ICT-related channels with open data. As the figures above imply, Japan has maintained its progress towards mature e-Government despite its relatively late start in initiating e-Government strategies.

The foundations of the e-Government system in Japan were established based on the Master Plan for Promoting Government-Wide Use of Information Technology which was adopted by the Cabinet in 1994. In addition, the Disclosure Law[15] provided a legal foundation for the release of public documents in 1999. The basic idea of the Master Plan was introduced in the Basic Act on the Formation of an Advanced Information and Telecommunications Network Society enacted in January 2001. The core principles of the Basic Act are: to realise a society that allows every person to obtain benefits of ICT; to promote the welfare of people in all communities; and to reinforce international industrial competitiveness through economic structural reforms. Under the IT Strategic Headquarters established in 2000, the Government CIO Council was built as well in 2003 as a part of e-Japan Strategy in order to take role in planning and implementing strategies for e-Government. The organisational structure for promoting e-Government is as follows:

[15] Officially "Act on Access to Information Held by Administrative Organs".

Figure 13. The organisation for promoting e-Government



Source: METI (2014). e-Government, Open Government and Open Data in Japan.

In addition, the government has fostered essential functions and frameworks addressing information security issues. The Information Security Policy Council (ISPC) and the National center of Incident readiness and Strategy for Cybersecurity (NISC) were born in 2005 as well based on "Review of the Role and Functions of the Government in terms of Measures to Address Information Security Issues" by the IT Strategic Headquarters. These two agencies, supported by experts from the public and private sectors, formulate strategies for comprehensive information security measures for governmental agencies, critical infrastructures, businesses and individuals.

Even before the early 2000s, Japan had stepped into a gradual restructuring of the government from the aspect of information technology. In 1997, the Kasumigaseki Wide-Area Network (WAN) was constructed in Tokyo to connect all the major government organs. From the late 1990s, the number of government websites began to increase. Since the 2000s when the use of Internet started expanding in full-scale, the administrative procedures have become available through the Internet. As of 2005, around 96 per cent of the government's administrative applications became available online.

The most important example is the e-Gov.go.jp website, operates to provide one-stop services that include online administrative procedures. The e-Government Customer Support Centre is being managed at the same time to offer guidance to users on how to use the portal. The integrated e-Gov portal connects 47 prefectures, provides cross-ministry administrative information to people and makes the submission of multiple electronic applications possible. However, until the mid-2000s, there were limitations of government websites from the aspect of information provision and Web 2.0 technologies were not utilised by many local governments as well.

In the meantime, the resident registry network entitled Juki-Net began in 2002 based on the Basic Resident Registers Act of 1999, to digitalize compiled paper records of the citizens. It adopted a

11-digit numbering system for personal identity information and allows automatic movement of information among cities[16].

The e-Japan Strategy I in 2001 first presented the guideline for implementing coherent e-government programs. Establishing e-government was one of four policy areas of the Strategy. The Action Plan for Ensuring E-Government IT Security was additionally set up in the following year to provide relevant measures on standardisation of cryptography, IT security and emergency response systems. Under the e-Japan Strategy II in 2003, the national and local governments laid out the scheme for building administrative portals for one-stop services for the citizens. The subsequent series of national ICT initiatives including u-Japan and i-Japan have constantly encouraged user-oriented administrative services and to simplify public administration process for budget efficiency. Especially, the New IT Reform Strategy in 2006 targeted the ratio of online application processes to reach 50 per cent.

As emphasised on the Declaration *To Be the World's Most Advanced IT Nation* in June 2013 (revised in June 2014), one-stop public services was again promoted so that anyone can access administrative services through a single gateway on the Internet at any time. The government also tried to renovate business processes and systems by making a zero-base review for rational and efficient back-office operations. Furthermore, infrastructure has been developed and strengthened for building e-Government. For example, assistant CIOs (technical advisors appointed from outside) have been encouraged. Moreover, measures for security and legal systems have been fortified to protect personal information. Especially since the Declaration was issued, the use of open data and big data has been highly encouraged to create a new innovative environment for public services and industries.

Summary of core objectives of the e-Government pursued since the Declaration
1) Advanced administrative services through the use of ICT - Promotion of online administrative procedures - Promotion of a user-friendly interface in partnership with the private sector - Establishment of authentication platform - Increased public benefits from the use of statistical survey data - Promotion of online statistical survey - Establishment of standard open data technologies - Use of "App De Statistics" that allows people to utilise the data via App - Check system co-managed by central and local government for fire prevention
2) Reorganisation of information infrastructure - Adoption of cloud services to consolidate Government information systems - Budget efficiency for large-scale system - Virtualization of communications network - Promotion of cloud services for information system in local government-level - OSS / virtualization: unifying the PC environment - Automation of paperwork across municipalities
3) Transformation of working process - Adoption of electronic approval: simplifying the procedure for decision-making - Promotion of electronic bidding

[16] For more information, please see http://www.cao.go.jp/bangouseido/

- Business process reengineering in the national tax, social insurance, employment and workers' insurance, etc.
- Use of wireless LAN to change the working environment

Source: Ministry of Economy, Trade and Industry (METI), Japan (2014). E-Government, Open Government and Open Data in Japan, also see Annex 2

Local e-governments

Japan has promoted regional decentralization to strengthen the respective functions of local governments with more authority based on the Comprehensive Decentralization Law which was put into force in 2000. Almost all prefectures with their own councils have implemented e-local government system. The process of advancing the system has been pursued mainly by the Local Administration Bureau (LAB) under the MIC. At the same time, a Special Committee on Computerisation Promotion Policy was established to computerise administration procedures of local governments.

Moreover, two councils were set up as autonomous bodies: the Local Government Network Management Council in charge of the Local Government Wide Area Network (LGWAN); and the Basic Resident Register (BRR) Network System Council that manages the BRR network. The Online Administrative Procedure laws, enacted in 2002, presented a legal basis for various administrative procedures of local governments to be dealt with online.

The MIC formulated the Guidelines for the Promotion of Local e-Government in 2003 and revised it considerably in 2007 to simplify administrative procedures from the aspect of efficiency and to cope with various local issues through the active use of the e-government system. At the same time, each local government designed its respective plan for the promotion of local e-government aligned with national ICT strategies.

In the meantime, because each government has gone through different phases of computerisation, there has been compatibility issues between local governments from the aspect of an information platform. To reduce the costs associated with managing multiple systems, the country has sought to establish a common regional information platform[17]. For example, the Hokkaido government has taken the lead to promote a common e-government system interlinking each region by constructing the Harmonized Applications Relational Platform (HARP) which is a common infrastructure for shared use among municipalities.

Open Government

The government initiated discussion on open data in 2008 and announced the Open Government Project Plan in the following year. According to the definition of G8 Open Data Charter, open data is "an untapped resource with huge potentials to encourage the building of stronger, more interconnected societies that better meet the needs of our citizens and allow innovation and

[17] Please see more at http://www.soumu.go.jp/denshijiti/index.html

prosperity to flourish". The government expects that social structure can be transformed in a positive and efficient way with the use of open data.

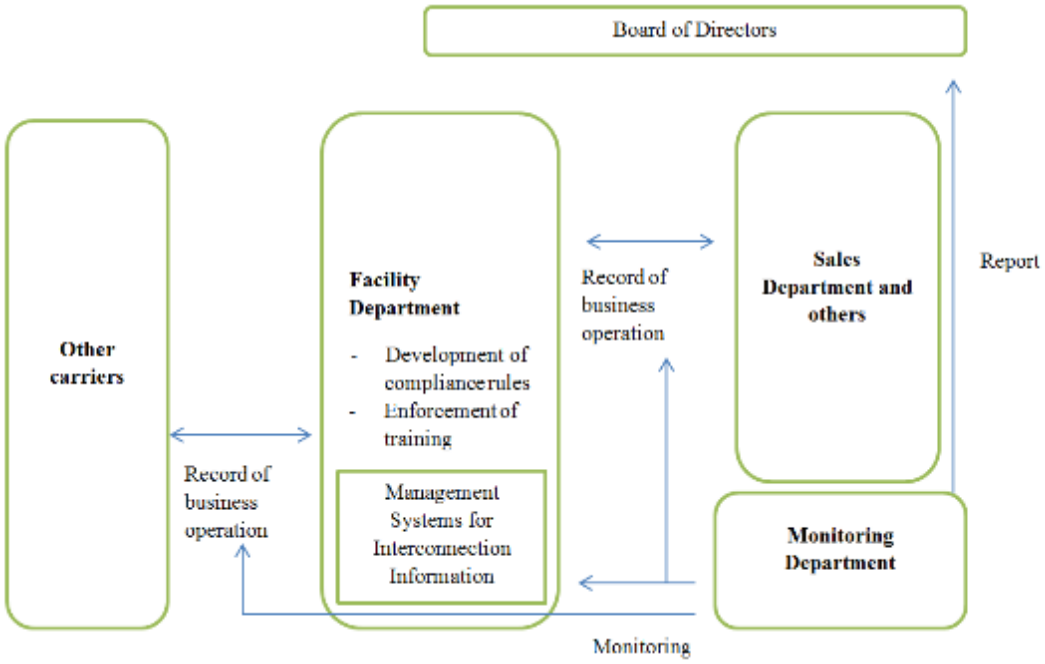
Under the leadership of IT Strategic Headquarters, the Open Government Data Strategy was adopted in 2012 as part of national efforts to stabilise e-Government. The primary goals of this strategy are to enhance transparency and work efficiency of the government and to encourage participation by the public. Based on the strategy, the government is encouraged to disclose public data in machine-readable formats. As the implementation body for open data policies, a committee of open government was established by the Cabinet Secretariat. The main responsibilities granted to the committee are to develop enabling environments for the use of public data; to investigate policies to be implemented; and to review them.

To concretize the strategy, the Roadmap was designed in 2013 by the IT Strategic Headquarters with core targets to (a) establish use rules that enables unrestricted secondary use of data; (b) expand the scope of disclosed data in machine-readable formats; (c) invigorate cross-ministry data catalogue sites; and (d) increase release of data that can be used by business affordably.

Introduction of competition and deregulation in telecommunications sector

Competition in the Japanese telecoms market started to rise in 1985 along with the privatization of NTT. In 1999, NTT faced another phase of structural change when it was reorganised as the holding company along with its three subsidiaries: NTT Communications, NTT East and NTT West. The transformation was part of preparation for promoting telecoms competition along with a series of national broadband strategies. As regional subsidiaries, NTT East and West have been playing major roles in the local voice-call market, while NTT Communications has been possessing NTT's long-distance and international networks. This restructuring was conducted after the government concluded that it was not enough to promote competition in the telecom market solely through non-structured measures against the monopoly of domestic access network. From 2010, NTT decided to launch functional separation of NTT East and West to ensure fair competition and appropriate management of information on business activities of interconnection. There has been a clear separation between the facility department and the sales department for the equal access to the bottleneck facilities.

Figure 14. **Functional separation of NTT East and West**



Source: MIC (2011). Broadband Competition Policy in Japan.

There have been several deregulations on market access as well. In 1997, Japan abolished supply-demand adjustment examination when permitting entry of type I[18] telecommunications business and introduced unbundling to the telecoms market to make market entry smoother to take advantages of increased business opportunity and to promote the diffusion of the Internet.

Since 2004, the permission process for type I carriers has been abolished, which has enabled all types of operators to enter the market with notification or registration. Previously, when telecoms operators wanted to enter the market, type I carriers had to get permission from an authorised minister, while type II service-based operators could notify or register with an authorised minister. There has been a gradual abolition or mitigation on foreign capital participation in the telecommunications market since 1985. At the very beginning, the inflow of foreign capital was prohibited for NTT and KDD (type I), while other type I carriers and radio stations (for telecoms business) were allowed to accept foreign capital partially. From 1998, all the restrictions on foreign capital participation were abolished, exception was made to NTT. In case of NTT, foreign capital could take one-third of the whole from 2001.

[18] Business providing services by installing its own infrastructures, e.g. NTT East, NTT West, NTT DoCoMo, KDDI and Softbank.

Table 7. Outlines of telecoms competition policy

Entry Regulations	Asymmetric Regulations
• Privatization of NTT (1985) • Abolition of supply-demand adjustment provision (1998) • Abolition of foreign investment regulations in principle (1998) • Abolition of permission process (2004)- Introduction of registration and notification system	• Unbundling regulation on NTT East and West (1997) • Establishment of interconnection rule (2001) • Deregulation of the scope of business activities of NTT East and West (2002) • Functional separation of NTT East and West (2011) • Deregulation of procedure regarding business regulation on NTT East and West (2011)

Source: Iida, Yoichi (2012). Japan's Telecom Policy and Infrastructure. Available from http://www.jointokyo.org/files/cms/news/pdf/Presentation_Mr_Yoichi_Iida.pdf.

Regulation of interconnection and infrastructure sharing

The controversy on interconnections between NTT and other telecom operators was settled for the time being when the interconnection rule was introduced based on the Telecommunications Business Law amended in 1997 and NTT was restructured as a holding company in 1999. The interconnection rule requires NTT to provide telecommunications facilities segmented into several functions. In addition, it is regulated to calculate the interconnect fees based on the method of Long Run Incremental Cost (LRIC). However, when the government tried to provide the Digital Subscriber Line (DSL) services through line sharing and co-location in the late 1990s, NTT did not meet the demands from the government. This ongoing discord was arbitrated by MIC and Japan Fair Trade Commission (JFTC) in 2000 and it was concluded that NTT would provide network facility sharing and co-location in the method of LRIC when operators request from the late 2000s. This calculation method allows low-interconnect rate enabling late entrants such as Softbank to conduct proactive marketing by providing low service rate to consumers. It has contributed to a rapid growth of the DSL market. In 2001, the government made the opening up of fibre-optic facilities mandatory through another amendment of the legislation. It is one of the most significant characteristics of Japan's service-based competition that the fibre-optic access network was categorized as the target facility for the opening up.

Unbundling policy was introduced in Japan in 1999 along with the amendment of the Telecommunications Business Law to create a competitive market environment through interconnection of networks between service providers. NTT East and West have been required to accept other operators' requests to use unbundled network facilities and functions. In addition, it is regulated to calculate the interconnect fees based on the method of LRIC.

Along with unbundling regulations, the government initiated co-location strategy from 2000 that allowed other carriers to conduct installation of their facilities such as transmission equipment, switches and cables in NTT's communications building. Parts of infrastructure that are obligatory to be open are: 1) communications building, 2) conduits and ducts from the buildings to the closest manholes and 3) utility poles necessary for interconnection. In 2001, rules on shortening a term of validity of reservation were newly included to prevent one carrier from reserving too much space.

Moreover, penalties on cancellations of reserved space were introduced in 2003, while procedures on co-location in the utility poles became concrete from 2007. Co-location regulations made it possible for other operators to offer competitive services without the burden of building its own infrastructure close to NTT's communications buildings.

In the meantime, NTT had been behind other carriers from the aspect of Asymmetric Digital Subscriber Line (ADSL) provision due to a rapid surge of other operators such as Yahoo! BB (Softbank) in the telecommunications market. From the mid-2000s, NTT began to rapidly change its focus to a fibre-optic network in order to formulate strategies to recapture its shares of the market. Compared to ADSL based on copper cable networks, fibre-optic networks provide much faster speeds with low transmission loss: 100Mbps - 1Gbps for detached house and 50-100Mbps for apartment buildings. NTT has continued investment in developing fibre-optic infrastructure to compete with other carriers such as KDDI or subsidiaries of local electric power corporations that provide broadband services with its own fibre-optic networks.

Financing for broadband service

Under Article 7 of the Telecommunications Business Law (TBL) of 1984, the operators which provide the telecommunication services defined in the Law are obligated to provide universal telecommunications services in an appropriate, fair and stable manner to all citizens. The TBL was amended in 2001 to adopt the Universal Service Fund (USF) system to supplement the costs of service provision. It largely covers three areas: 1) subscriber line access, 2) public telephones service and 3) emergency calls service.

However, the issue with universal service is that the system does not include broadband access and the launch of the New Broadband Super Highway (Hikari no Michi) Plan in 2010 has provided new momentum for the government to review the overall existing system. Regarding the inclusion of broadband within the scope of the system, the recommendation was made by the Task Force of the MIC to consider the necessity of setting up the revised system that can contribute to the universal broadband access, but the broadband service is not included as universal services until now.

In Japan, it has become the private sector's responsibility to deploy broadband infrastructure in principle. However, the Indefeasible Right of Use (IRU) scheme can be regarded as a collaboration model between the Public and Private sectors for the establishment of broadband networks in rural area. The national government provided financial support for local governments constructing broadband networks with grant programs, and charged from private sector for use of broadband infrastructure. In this way, the government could reduce the digital divide and private sectors could reduce the initial investment cost and risk.

Republic of Korea

Development of infrastructure for broadband access

Among the key infrastructure and application development policies since the mid-1990s, the Korea Information Infrastructure (KII) initiative, launched in 1995, was the first and the most significant project to increase capacity to build the country's Information Super Highway.

The KII project set out plans to construct national high-speed backbone and access networks, and to develop ICT applications and services. It was a 10-year project from 1995 to 2005 in three phases, that included KII-Government (KII-G), KII-Public (KII-P) and KII-Testbed (KOREN: Korea Advanced Research Network). These networks serve to (a) expand telecommunications infrastructure; (b) facilitate increased demand of services; and (c) foster industry and development of new technologies.

The main objective of the KII-G was to deploy a nationwide backbone network and provide high-speed Internet services to government and public organisations at a low service charge. It targeted to connect 10,000 schools to the Internet as well. The initial cost of the KII-G was borne by the government and is expected to be recovered from service charges levied on public sector users.

The KII-P aimed to expand commercial access networks and provide high-speed Internet services to enterprises and households through a number of technologies such as ADSL, CATV, satellite and optical cables funded by the private sector. It encouraged the rollout of broadband networks by granting tax incentives and low-rate loans to investors.

The goal of KII-Testbed was to provide a high-speed network environment for universities and research institutes for R&D projects that could produce commercial value. In case of the KII-Testbed, the government conducted pilot projects to demonstrate various aspects of technology development and to generate initial demand at the same time. Starting from a test of 2.5Gbps fibre optical backbone network, KII-Testbed succeeded in rollout of 40Gbps backbone networks in six metropolitan cities, providing high-speed data transmission services to subscribing organisations in those test areas.

Table 8. Key points of KII

Classification		KII-Government (High-speed Korea Internet Infrastructure)	KII-Public (High-speed public networks)	KII-Testbed (KOREN: Korea Advanced Research Network)
Main user		National and public institutions	Private sectors (businesses and households)	Education and research institutions
Investor		Government	Private sector	Government and private sector
Main objective		Construction of backbone networks	Construction of access networks	Construction of test-bed networks
Scope of the construction	**Phase 1 (1995-1997)**	80 call areas connected with up to 5Gbps backbone networks	Optical cables to all cities and counties (up to 40Gbps)	2.5 Gbps tests in Seoul and Taejon
	Phase 2 (1998-2000)	144 local call areas connected with up to 5Gbps backbone networks	Optical cables to rural villages (up to 40 Gbps), and ADSL/CATV penetration (30%)	2.5Gbps test in 5 metropolitan cities
	Phase 3 (2001-2003)	Bandwidth upgrade to 40Gbps	Bandwidth upgrade to 320Gbps, 2Mbps per user	40Gbps test in 6 metropolitan cities

Source: NCA (2006) The progress and outcomes of Korea's informatisation; MSIP & NIA (2014). 20 years of record of national informatisation in Korea.

In total, KRW 33.4 trillion was invested to conduct KII (KRW 32.5 trillion for KII-P and KRW 806 billion for KII-G) and another KRW 101 billion were invested in constructing the testbed network. The KII project continued revisions and upgrades in response to the state of the market and technology development[19].

Table 9. The scale of investment for KII

Billion Korean Wons

Classification (Funding Source)	Phase I (1995-1997)	Phase II (1998-2000)	Phase III (2001-2005)	Total
KII-G (Government)	173	262	371	806
KII-P (Private)	1,982	6,964	23,581	32,527
KII-Testbed (Private)	9	16	25	50
KII-Testbed (Government)	15	11	26	51
Total	**2,178**	**7,253**	**24,003**	**33,434**

Source: NCA (2006). The progress and outcomes of Korea's informatisation.

As a result, a total of 31,632 government administrative agencies, educational and research institutes and medical institutions gained access to KII-G networks at discounted prices. While the number of the agencies using KII networks increased by 19 times (from 1,700 to 32,000), the average bandwidth of them has risen by 16 times from 0.4 Mbps to 4.9 Mbps. The total bandwidth for Internet has increased by 91 times from 843 Mbps to 73,363 Mbps[20]. The number of Internet

[19] For more detail, please reference NCA, 2006b.
[20] For more detail, please reference NCA, 2006c.

users, the rate of PC penetration and the number of high-speed broadband subscribers have rapidly increased at the same time. Behind the successful completion of KII, public-private partnerships and the establishment of Information Promotion Fund led to long-term investments from private enterprises.

While the initial implementation stage of the information superhighway proceeded smoothly, conflicting views appeared between the Ministry of Information and Communication (MIC) and telecommunications carriers on the distribution of construction expenses, the usufructuary right of the networks and the charges for using the services. The MIC supported charges for the utilisation of services should be between 10 per cent and 20 per cent of the existing fares for users in national and public institutions because the government underwrote the expenses of implementation.

However, most of the telecommunications carriers were highly reluctant to accept the proposal because of the financial burden caused by the reduction in charges. These complex conflicts on the ownership of backbone networks, the right of using them and the pricing have been disputed for some time thus hindering the implementation process.

In order to conclude these conflicts based on a lack of mutual understanding, the stakeholders eventually reached a solution: the ownership of the national high-speed Internet infrastructure was granted to telecommunications carriers and excluding the government. In exchange, the carriers were obligated to make a reduction in price of 40 per cent of the charges for users. In short, the budgets supported by the government were offset by charges to the carriers. In 1996, further lowered fares (a reduction in price of 10 per cent to 20 per cent) were imposed on national and public institutions.

Broadband Convergence Network (BcN) Initiative, 2004-2010

The Broadband Convergence Network (BcN) Initiative aimed to construct an integrated next-generation network that provided broadband multimedia services anywhere and anytime. The initiative was based on the converging trend from voice and data, fixed and wireless, broadcasting and telecommunications services to All-IP based technology. The initiative established schemes for network rollout and service provision in three implementation phases as shown in the table below.

The goal of the initiative was to provide 50-100 Mbps broadband integrated networks, which is 50 times faster than high-speed Internet networks, to 20 million subscribers by using technologies including Fibre-to-the-home (FTTH) and Hybrid fibre-coaxial (HFC) by 2010. The government also sought to provide fixed-wireless, telecom-broadcasting convergence services such as wireless LAN, Wireless broadband, Digital Cable TV, IT based TV. In addition, it set out plans for the provision of the Quadruple Play Service (QPS), which combines services of high-speed Internet, fixed-line, mobile telephones and broadcasting.

Table 10. Objectives of BcN Initiative

Classification	Phase 1 (2004-05)	Phase 2 (2006-07)	Phase 3 (2008*-10) *revised as of 2007
Services (examples)	**Video- telephony interconnecting between fixed and mobile service, High-quality VoIP**	**Wireless broadband (Wibro), Multidimensional Digital Mobile Broadcasting(DMB)**	**HD QoS-guaranteed multimedia services**
Fixed line subscribers with 100Mbps per household	2.5m	5.7m	10m *12m
Wireless subscribers with minimum 1Mpbs average for subscriber	0.6m	2.5m	10m *23m
In total	**3.1m**	**8.2m**	**20m** ***35m**

Source: MIC (2004, 2007). BcN Initiative I, II.

The number of fixed-line BcN subscribers with minimum 50 Mbps reached 14.82 million as of December 2010 after the completion of the BcN Initiative. It became possible to use broadband services of minimum 50 Mbps in most of urban areas through fibre optic cable as well as HFC networks. In the case of rural areas, 75 per cent of the total Internet subscribers were the subscribers of broadband services, as of the end of 2010. By 2007, a 3G network was deployed throughout the country including rural areas, while the Wireless Broadband (WiBro) network was expanded into 82 major cities by 2011. All these figures show that the government successfully exceeded its initial goal[21].

While the government led various pilot projects that could create an environment for the development of new applications to identify demands, carriers in principle have taken charge of developing commercialized technologies and advancing the network. As such, government investments into BcN have been directed largely into R&D activities and the launch of pilot services whereas private sector investments have been made into network and service rollout.

Giga Internet Initiative

The Giga Internet Initiative aimed to deploy ultra-wideband converged network by 2012 with an average speed of 10 Mbps for wireless and of 1Gbps for fixed-line based on All-IP, which is ten times faster than BcN, in order to facilitate the flow of high-quality and high traffic.

[21] See more in KCC& KISA, 2011

Table 11. Objectives of the Giga Internet Initiative

Classification			2009-2010	2011-2013
Backbone networks	**Fixed telephone networks IP conversion**		30% of penetration	70% of penetration (2015: 100%)
	Mobile telephone networks IP conversion		-	
Subscriber Networks	**Fixed Broadband**	**Broadband (50M-100Mbps)**	12 million subscribers	14.5 million subscribers
		Ultra-WideBand (maximum 1Gbps)	-	Commercial service (2012), 200,000 subscribers (2013)
	Wireless	**Broadband (1M-2M)**	28 million subscribers	46 million subscribers
		Ultra-WideBand (10Mbps on average)		Commercial service and 300,000 subscribers (2013)
Broadcasting Networks	**Digital terrestrial TV coverage**		93% of penetration	96% of penetration
	Digital cable TV home pass ratio		93% of penetration	96% of penetration

Source: KCC (2009). The mid- to long-term development plan of broadcasting and communication network.

As of the end of 2015, the number of available households for Giga Internet services was 9.96 million out of a total 16.6 million which accounted for 60.01 per cent of the total number of households. The government seeks to reach a 90 per cent Giga Internet coverage nationwide by 2017[22]. The three key telecommunications carriers, namely KT[23], SK Broadband and LG U+, have launched projects to provide Giga Internet services from 2014.

Similar to the BcN Initiative, the Giga Internet Initiative also distinguishes between the government and the private sector in terms of roles. While the government has supported the implementation of pilot projects, private carriers have been granted the responsibility to build networks. According to the plan, the amount of investment from the government was estimated to be approximately KRW 1.3 trillion out of the total investment KRW 34.1 trillion from 2009 to 2013.

e-Government: improving the quality of public services

The government of the Republic of Korea aided the foundation for e-Government by computerising its administrative system in the 1970s, computerising the national basic databases in the 1980s and constructing the high-speed information and communications network in the 1990s. Following the deployment of physical infrastructure by the above-mentioned KII, e-government projects from the late 1990s could proceed with greater ease.

From the late 1990s, the government actively launched key schemes towards an advanced e-government to better serve citizens, to create a market-based government that can support private sector's needs and to enhance transparency and work efficiency in government administration

[22] See more in MISP & KISA, 2016

[23] Renamed as KT (Korea Telecom) from KTA.

without overlapping activities. At the initial stage of the project, the government went ahead with 11 strategic initiatives to complete the establishment of e-Government infrastructure by 2002.

Table 12. e-Government Initiatives

Purpose	Initiatives
Improved services to the public and businesses	4 initiatives including innovation of application services by creating a single access point (G4C), integration of the information systems for the four major social insurances, and integration of administrative affairs on national procurement (G2B)
Greater administrative productivity	5 initiatives including building a national financial information system, comprehensive informatisation of local government administration, educational administration information system, and electronic personnel management system
Solid foundation for developing e-Government	2 initiatives including establishing an electronic signature/electronic administrative signature system and building an integrated and electronic government environment

Source: NCA (2005). National Informatisation White Paper.

After the completion of 11 strategic initiatives by November 2002, the government clarified 31 e-Government projects that included the existing 11 initiatives and 20 additional projects proposed by various ministries in the e-Government roadmap, which made the administration procedures, public service and information management more transparent and efficient. The roadmap especially highlighted the enhancement of online public services and the integration of national welfare and tax services.

Under the e-Government roadmap covering 31 specific projects, major tasks were presented for the improvement of public services, including Government for Citizens (G4C)[24], Home Tax Service (HTS), consolidated construction administration information service, integrated national welfare information service, combined food and medical supplies information service and integrated employment information service. Moreover, e-Government One-Stop Window (www.minwon.go.kr) was launched in 2002 to provide civil services through the Internet, easing the public efforts to visit administrative offices.

As of February 2015, citizens can receive guidance on 5,000 types of legal civil affairs; can register on over 3,000 types of application forms and view and issue 1,200 types of civil complaint forms over the Internet. Citizens became able to apply for 410 types of public services online such as resident and family consensus registry, land registry and tax payment certificates. Since 2003, it has been possible for three types of documents (land register, individual public land price certificate, and certificate of national welfare beneficiary) to be issued online. In 2004, with the expansion of the online issuance service, five additional types of documents were included, namely the abstract resident registry, the real estate registry, the farming land registry, the certificate of persons with disabilities and the certificate of single-mother family. Since then, the online civil affairs services have been continuously expanding. In 2014, the issuance of resident registration

[24] G4C seeks a system that helps citizens to easily obtain information from various governmental agencies through the Internet.

in English language became available for free. This newly added service saves time and money because there is no charge for the issue and does not require translation and authentication process.

Table 13. Numbers of types of online civil affairs services

Classification	2009	2010	2011	2012	2013	2014
Number of application types	1,820	3,020	3,013	2,933	2,968	2,903
Number of issue types	500	1,208	1,191	1,166	1,163	1,143

Source: MSIP & KISA (2015). Korea Internet White Paper.
Note: The types of online civil affairs services have decreased from 2012 to 2014 due to the merge of services.

Table 14. Number of online civil affairs services provided via G4C site (Minwon 24 at www.minwon.go.kr)

Thousand cases

Classification	2009	2010	2011	2012	2013	2014
Application	63,132	62,347	68,262	68,736	64,407	63,435
Issue	16,245	21,106	28,245	39,443	50,093	57,487
View	3,944	5,263	5,950	7,207	10,572	10,959

Source: MSIP & KISA (2015). Korea Internet White Paper.

The Korea Online E-procurement System (KONEPS at www.g2b.go.kr) is another good example that connects all public organisations through a single window. KONEPS was introduced in 2001 and has enhanced efficiency and transparency of public procurement in each stage of bidding, awarding contracts, contacting, delivery and payment. As of 2007, 92 per cent of bidding was done electronically with no need to visit the tax offices in person.

Overall improvement in services for businesses also demonstrated the effectiveness of e-Government. Because of scattered administration procedures for each government agency which prevailed before, many companies faced a lengthy process to obtain information or approval from the Government. However, since the launch of Government for Businesses (G4B) one-stop window, the efficiency and productivity of business sectors could be maximized via online services provided. From November 2003 to June 2004, the Business Process Re-engineering / Information Systems Planning (BPR/ISP) project was implemented to restructure administration procedures as a way to upgrade G4B service with a detailed implementation method.

Since 2008, the government has been actively engaged in implementing projects focusing on connection and integration to encourage value creation of the public, businesses and government. Especially, in order to provide integrated citizen- and business-oriented services, portals such as the Korea e-Government Portal (www.korea.go.kr) and the Government for Business Portal (www.g4b.go.kr) have been developed with integrated functions.

Moreover, information resources have been consolidated, from 4,687 systems in 2008 to 2,535 systems in 2012, to improve the efficiency in management of information resources and to limit related costs. By deliberating plans of each Ministry based on the Government-wide EA (enterprise architecture), duplicated investments could be prevented.

As a result of the efforts and investment, the Republic of Korea continues to offer an e-Government leadership model and focus on telecommunication infrastructure. The country has retained the top 5 ranking in the UN E-Government Survey since the inception.

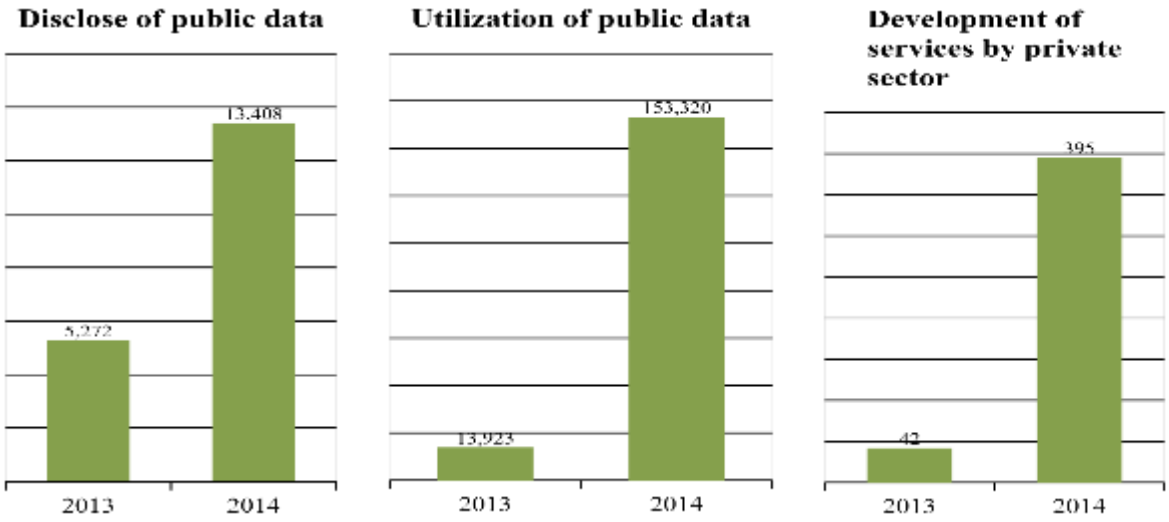
Table 15. Performance of e-Government system of Republic of Korea

	Online Service Index (OSI)	Human Capital Index (HCI)	Telecommunication Infrastructure Index (TII)	E-Government Development Index (EGDI)	EGDI Level	2018 Rank
Score	0.9792	0.8743	0.8496	0.9010	Very High	3

Source: UN E-Government Survey 2018. Note: EGDI is composed of OSI, HCI and TII.

In recent years, the government has sought to transparently disclose information collected and managed by both government and public institutions. By maximizing the scope of disclosed information relevant to policy-making and organisation management, the government expects to accumulate social capital and social trust, to upgrade the quality of data and to promote data-related industry. In 2013, the public data portal (www.data.go.kr) was designed to provide an integrated and easy channel for the citizens to get access to various public data. As a result, the use of public information has been increased. Private entities have actively developed their services based on sets of data provided by the government. The rate of this development has increased 9.4 times, which shows the potential of job creation opportunities for start-up companies.

Figure 15. The state of disclose, use and application of public data



Source: MSIP & KISA(2015). Korea Internet White Paper.

Reducing the digital divide: rollout of broadband infrastructures in isolated areas

Despite the implementation of KII project, many rural and remote areas could not receive enough digital opportunities due to low economic returns on investment. In response to this issue, the government began to partially support investments undertaken by private carriers by providing

low-interest loans for network rollout in rural and remote areas from 1999. Moreover, as a requirement of privatisation, the government enacted a law in January 2002 that imposed a set of obligations on KT to guarantee public interest on ICT infrastructure in rural areas. KT was responsible for providing broadband access to all areas with more than 50 households by 2005. As a result, 94 per cent of households in rural areas could get access to high-speed Internet. However, some remaining rural areas with less than 50 households still did not have access to broadband networks.

When KT's obligation for public interest was completed by 2005, the government presented a new measure for supporting the 6 per cent of area left without broadband access through a national subsidy, which was implemented and completed by 2007. In order to guarantee minimum 2Mbps of the network, wired high-speed networks were mainly established for villages while 2 way satellite networks were deployed in remote areas including islands and mountain areas where fixed networks could not be established.

However, further efforts were required for the government to narrow down the digital divide in rural areas. Due to the partial advancement of ICT infrastructure, many parts of rural areas were still left at an immature stage of informatisation. Thus, as a response, the government launched the Rural BcN Project in 2010 and has successfully deployed BcN at speeds of 100 Mbps via FTTH in 12,156 of the 13,217 villages, covering 92 per cent of the country. The project was completed in all rural areas across the country in 2017.

The Rural BcN Project has been operating in the form of matching funds at a ratio of 1: 1: 2 (the government: the local governments: carriers). From 2010 to 2016, KRW 117 billion (the government fund: KRW 29.25 billion) was invested. In addition, KRW 142.1 billion (the government fund: KRW 35.5 billion) will be invested by 2017.

Table 16. Key outcomes of the Rural BcN Project, as of end of 2016

Total number of villages	Completed projects	Ratio of completed projects	Joint construction (Government, local governments and carriers)							Construction by carriers	Number of incomplete projects
			2010	2011	2012	2013	2014	2015	2016		
13,217	**12,156**	**92%**	658	925	971	1,010	1,301	1,746	1,460	4,085	**1,061**

Source: MSIP (13 April 2017). Press release.

Table 17. Business expenses of the Rural BcN Project

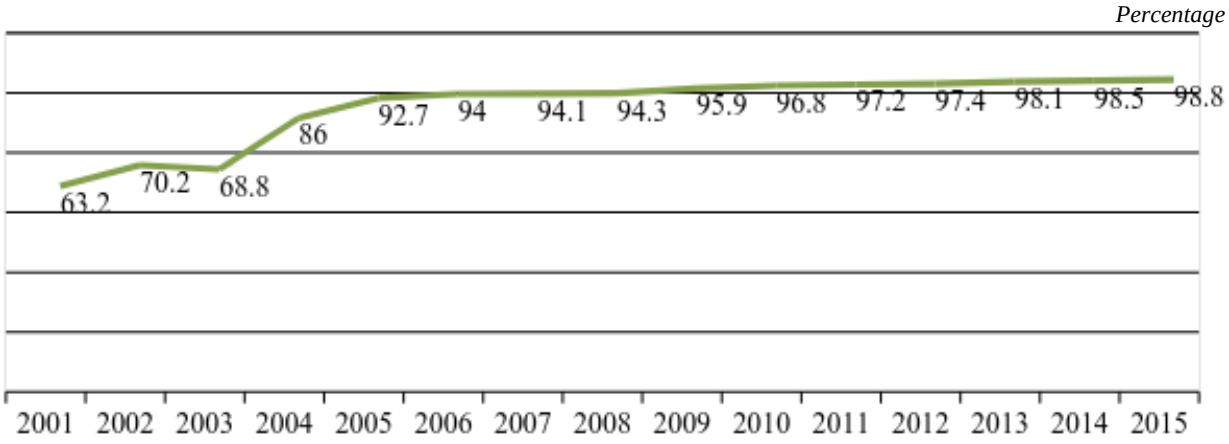
Million Korean Wons

Classification	2010	2011	2012	2013	2014	2015	2016	2017 (Budget)	Total
Government funding	2,230	3,000	3,000	3,100	4,700	6,610	6,610	6,280	**35,530**
Total funding	8,920	12,000	12,000	12,400	18,800	26,440	26,440	25,140	**142,140**

Source: MSIP (2017). Press release.

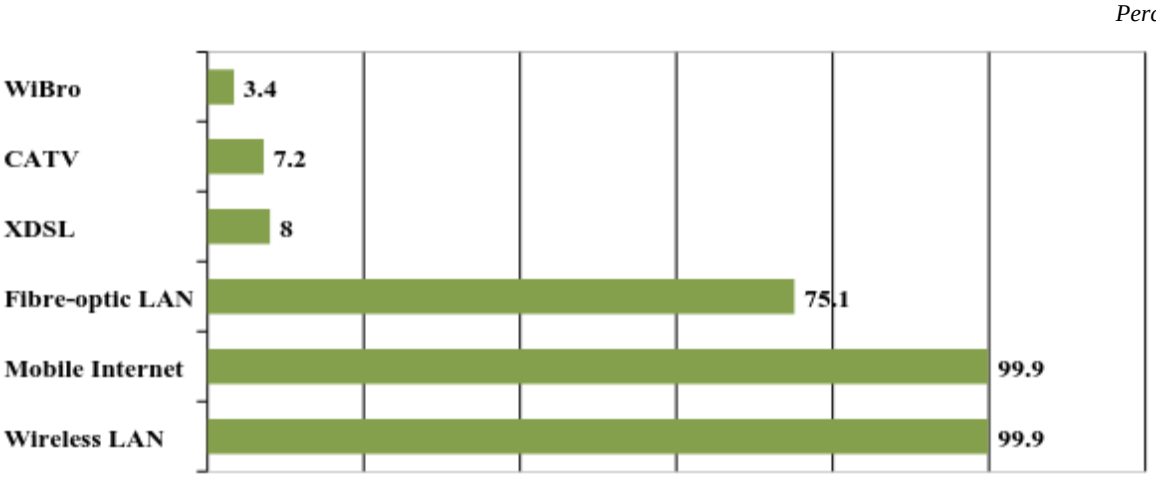
This initiative has enabled 99.2 per cent of the total households to be connected to the Internet in the Republic of Korea as of July 2016. Almost all households now have access to mobile Internet through wireless LAN (99.9 per cent), 3G, and LTE[25].

Figure 16. Internet access ratio (per 100 households)



Source: MSIP & KISA(2016). The Report on the survey of the Internet usage.

Figure 17. Internet access ratio by technology in household (Multiple answers)



Source: MSIP & KISA(2016). The Report on the survey of the Internet usage.

ICT education and digital literacy

In parallel to the broadband infrastructure rollout, the improvement of digital literacy through ICT education was also one of the government's primary measures to bridge the digital divide.

The government established the "Action Plan for Information Education for Ten Million Citizens" in 2000 and implemented intensive education programmes from 2000 to 2002 for targeted groups

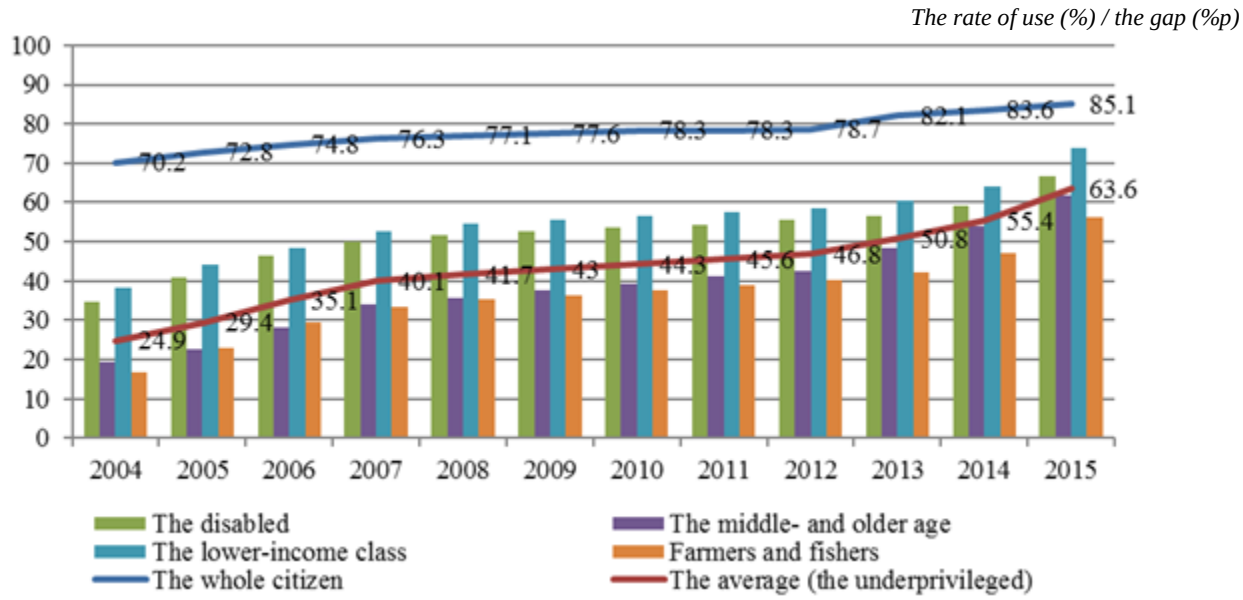
[25] For more detail, please reference MISP, 2016 and KISA, 2016.

of people. These groups of people are 1) teachers and students; 2) agricultural and fishery workers, other labourers and rural residents; 3) homemakers; 4) soldiers; 5) public officials; 6) the disabled and elderly; and 7) prisoners. Following the Information Education Plan for 10 Million Citizens, there have been a series of initiatives conducted such as the Phase 2 of the National Information Education Plan (July 2002 -2004) and the Mid-to Long-term Master Plan for Closing the Digital Divide (2004-2008). Furthermore, the Government has undertaken various projects like the "Development and Supply of ICT Assistance Devices", "Supply of Green PCs of Love," and "Telecommunication Relay Service" in order to offer equal opportunity of information access to various marginalized populations.

Regarding the development and supply of ICT assistive devices, government support provides screen readers, sound output devices, input assistive devices and video-telephone to hearing- and speech-impaired people at low cost (80 per cent of expenses covered by the Government subsidy). Moreover, it has supplied 52,740 telecommunication assistive devices to those in need from 2003 to 2015 according to MISP & KISA (2016).

Since 1997, the RoK government distributed approximately 347,000 second-hand PCs, donated by individuals, private enterprises and public institutions, to those who are unable to purchase such due to low income. In addition, the National Information Society Agency (NIA) has been operating a free online website called BaeumNara (www.estudy.or.kr) to support ICT training. The site has been in operation since 2001, offering training courses that are well categorised by level and topic. A series of policies for digital literacy have resulted in a gradual increase in the Internet usage and computer penetration, and have led to a steady decrease of digital alienation among various disadvantaged populations as shown below.

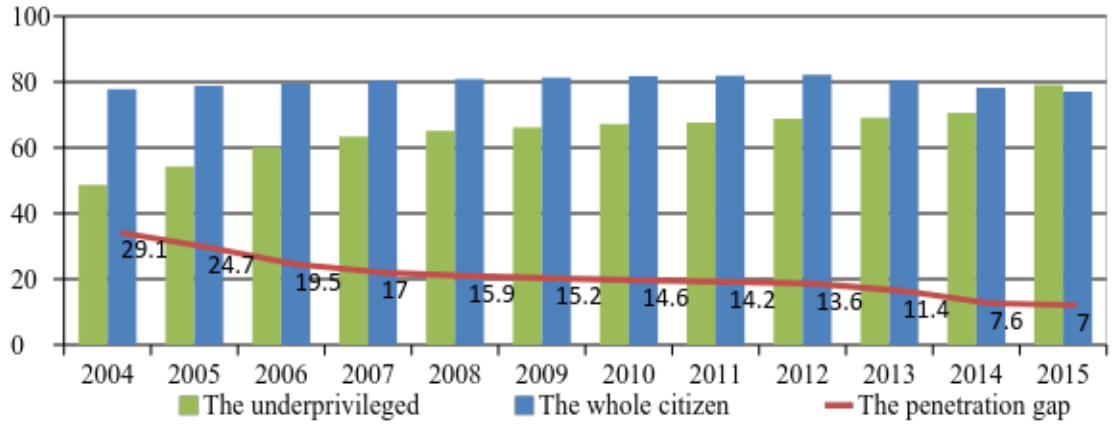
Figure 18. The ratio of Internet usage among the underprivileged / the change of digital gap between the underprivileged and the general population



Source: MSIP & KISA (2016). Korea Internet White Paper.

Figure 19. The ratio and disparity of computer penetration between the underprivileged and the general population

The rate (%), the gap (%p)



Source: MSIP & KISA (2016). Korea Internet White Paper.

The government especially focused on the establishment of ICT education in elementary-, middle- and high schools throughout the country to encourage students and teachers to utilise Internet freely. It has become obligatory for all schools to implement basic Internet education for students. At the same time, the government declared the policy of broadband access in all schools and provided Internet lines to every school in the country free of charge or at a discounted rate as part of KII-P in 2000. While 256Kbps of broadband networks was provided for free, 512Kbps and 2Mbps of networks were offered at 20 per cent off the regular fares. As a result of this provision, average bandwidth increased from 1.9Mbps in 2000 to 3.7Mbps in 2002 and to 8Mbps in 2004.

Table 18. Internet speeds at schools in the early 2000s

Number of lines

Category	2000	2002	2004
Below 512k	6,999	4,687	1,548
Below 2M	2,155	6,863	5,558
Below 45M	51	93	4,609
Above 45M	0	21	31
Bandwidth in total	18Gbps	44Gbps	95Gbps
Bandwidth on average	1.9Mbps	3.7Mbps	8.0Mbps
Rate of increase		244%	215%

Source: Lee, Y.R., B.C. Kim, S.U. Rha and J.H. Hur (2007). Policy of upgrading the analysis of Korea's IT infrastructure. Informatization Policy, Vol 14 No.4 (December), pp. 38-59. Seoul: National Information Society Agency (NIA).

From 2005, the government initiated the National Information-communication Service (NIS) project to provide high-quality ICT services for elementary, middle and high schools. The project encouraged educational institutions to purchase services from telecom service providers, so that high-quality services could be provided continuously at low-cost through integrating demands.

Moreover, in response to the lack of regular upgrading since the government launched the School Net Enhancement Project (2009-2012), Government invested KRW 45 billion in the enhancement

of school net to increase the Internet speed by five times to ensure provision of high-quality video and multimedia education services to schools across the country (see table 19).

Table 19. Comparison before and after the School Net Enhancement Project (2009-2012)

Category		Below 512K	1M	2M	4M-10M	15M-50M	Over 50M	Total
Before enhancement	**Numbers of schools**	64	22	2,307	8,847	443	148	11,831
	Proportion (%)	0.5	0.2	19.5	74.8	3.7	1.3	100.0
After enhancement	**Numbers of schools**	-	-	55	2,249	8,925	652	11,831
	Proportion (%)	0.0	0.0	0.5	18.9	75.1	5.5	100.0

Source: KCC (2010). Broadband for rural areas and schools in Korea.

During the course of policy implementation for providing broadband access throughout the school system, basic infrastructure was put in place for public e-Learning services, thus reducing the burden from private education expenditure. Also, the private sector was engaged and created ICT-based educational applications and contents, in collaboration of the Korea Education and Research Information Service (KERIS). In 2000, schools received government funding to purchase around 200 software education programmes developed by 88 companies. EDUNET, the government funded educational portal launched in 1996, is a good example of free educational content through ICT available to students and teachers.

Since 2001, email accounts have been made accessible to all students for better communication with their teachers. Moreover, since 2002, the Ministry of Education pursued the activation of the Education Broadcasting System (EBS) that provides education programmes over the Internet to reduce private tutoring expenditure. The National Education Information System (NEIS) was launched, connecting schools, the Ministry of Education and the Office of Education in each city and province to manage education-related information.

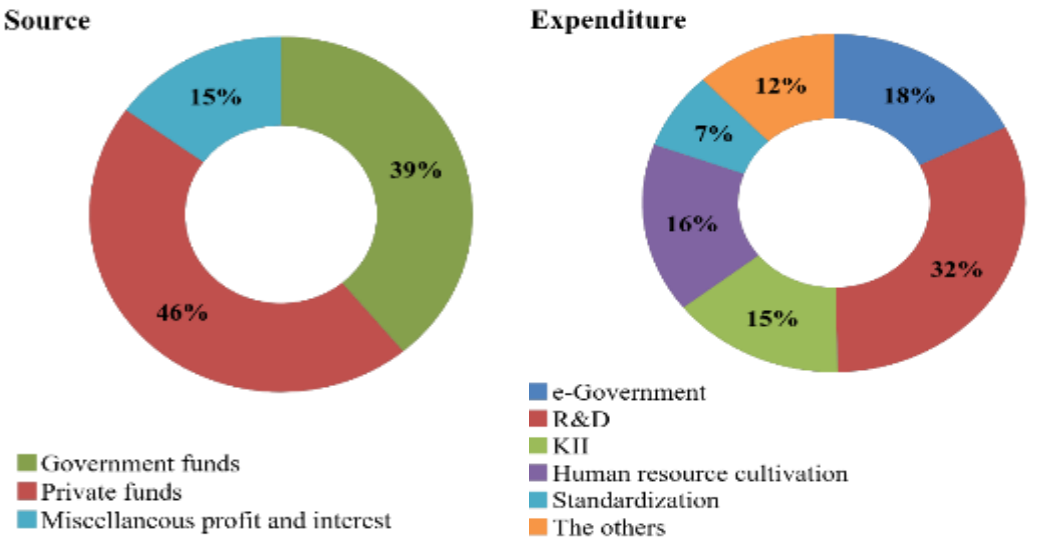
Financing mechanisms: Information Promotion Fund

Construction of telecommunications infrastructure is an expensive undertaking. With the privatization of telecommunications sector, it has become private sector's responsibility to set up telecommunications infrastructure in principle. However, in the presence of uncertainty regarding demand, it was hard for private enterprises to willingly invest in infrastructure. To remove these uncertainties, it became inevitable for the government to initiate financial support such as the Information Promotion Fund created in 1996, to allow revenues generated from the ICT market to be reallocated within the ICT sector. The primary objective of the Information Promotion Fund has been to support the rollout of broadband networks, E-Government, ICT education and ICT research and development.

The fund includes contributions from both the government and the private sector, through spectrum licensing fees, spectrum auction, revenue based contributions from operator and earnings from the operation of the fund, including loans. Contributions from the government have come from resources created by disposing stock holdings of KT. From 1993 to 2002, the total amount of the fund was USD 7.8 billion according to a MIC report 2003-2004. Almost half of this amount

came from the private sector. In the same period, around KRW 6.12 trillion of the funds had been used to support ICT-related R&D, to develop standardisation in ICT industry, to foster ICT human resources, to promote broadband network rollout and to establish e-Government. Based on the Information Promotion Fund, it was possible to apply the PPP model in which the private sector and the government cooperate for the implementation of the large-scale master plan.

Figure 20. Source and expenditure of Informatisation Promotion Fund, 1993-2002



Source: Merged from MIC (2003, 2004). Annual report on the management of Information Promotion Fund.

Competition policies: Liberalization of telecommunications sector

The Republic of Korea has made steady progress in developing its telecommunication infrastructure and service markets since the 1980s. The Republic of Korea's commitments under the WTO Agreement on Basic Telecommunication service and bilateral trade talks with the United States and the European Union have also substantially contributed to liberalization of the telecommunication sectors.

The basic policy of the liberalization was to gradually introduce competition over time from the local market to the global market. Along with the separation of KT from the government in 1982, the telecommunication market was initially opened to competition by creating a duopoly in international telecommunication-, mobile- and national long-distance services in 1990, 1994 and 1995, respectively. In 1996, several new licenses were issued for PCS (Personal Communications Services) and public switched telecommunications network services. Furthermore, the Government began to deregulate the market in 1997 by designating broadband as value-added services for new entrants to easily enter the market with simple notification to the government without the need for extra approval or registration. Accordingly, latecomers that did not possess access to networks were able to provide Internet services by renting necessary networks from other carriers. However, in 2005, the broadband service was re-categorized as facilities-based service to protect customers, and the new entrants could no longer enter the market with a simple notification

to the government but had to acquire the license to enter and to report the terms and conditions of their business.

Table 20. Key events in the liberalization of telecommunications sector

Year	Event
1982	Korea Telecom established
1990	Competition for value-added network services introduced
1990	Duopoly for international telephone services began (DACOM)
1994	Duopoly for mobile services began
1995	Decision to invite competition in national long-distance market
1996	27 new service providers are licensed in the following areas; PCs (3), Trunk Radio Services (6), CT-2(11), leased line facility rental (2), International telephony (1), Onse enters international market as 3rd service provider, radio paging (1) and wireless data transmission (3)
1997	9 new service providers licensed in following areas: local telephone services (1), TRS (4), leased line services (2), radio paging (1) and long distance (1)
1997	Revision of classification of telecommunication services introducing new category of "special telecommunication service providers" (voice resale and Internet telephone)

Source: OECD (2000). OECD Reviews of Regulatory Reform. Regulatory reform in Korea.

Table 21. Creation of the market structure from the early 1990s to the early 2000s

( ): Number of operators

	Duopoly	Competition
Local	1997	2005
Long distance	1996	1997 (3)
International	1990	1996 (3)
Leased line	1990	1998 (18)
Broadband	1999	2000 (6)
Mobile phone	1994	1996 (3)
3G	2003	2004 (3)

Source: OECD (2007). OECD Reviews of Regulatory Reform. Korea: Progress in Implementing Regulatory Reform; and KCC & KISA (2009). Korea Internet White Paper.

Regulations on Interconnection and Infrastructure sharing

In order to ease entry restriction for new entrants and to formulate an environment for fair competition, existing broadband providers were required to share essential infrastructure with new entrants. To this end, the government launched regulations on interconnection and rights-of -way.

From 1996, telecommunication service providers that possess essential facilities have been required to provide interconnections to new entrants such as local exchange, long distance exchange and facilities of common channel signalling networks. Service providers requesting interconnection can choose the point of interconnection. Only dominant incumbents such as KT or SKT have been subject to mandatory interconnection (KT in fixed- and SKT in mobile services). They were required to have the agreement with service providers and to obtain approval from the government. Unless an agreement was reached within the specified period, either of the parties could request government's arbitration.

Access to rights-of-way is similar. Telecommunications operators can request from public authorities the use of land or structures held by the government, local governments, public institutions or other operators when an agreement cannot be concluded by the operator and other parties. The Ministry of Information and Communication can encourage other institutions to consult with operators in the context of rights-of-way and these institutions need to comply with this request.

However, new entrants have asserted that they have experienced delays in accessing dominant incumbents' lines and premises. Accordingly, the government has mandated infrastructure sharing and has expanded the number of entities subject to the obligation.

KT was required to provide local loop unbundling (LLU) under the LLU Directive from 2002. It also was mandated to provide full unbundling and line sharing at a low price in order to discourage unnecessary investments in facilities. Furthermore, it was designated as a major supplier of telecommunications networks or services in 2003 and had an obligation to provide new entrants infrastructures that include telegraph poles, fibre optic cables, duct, utility-pipe conduits (power tunnel) and base stations as needed. However, the fibre optic cables deployed after 2004 have been excluded from the mandatory provision of infrastructure in order to encourage operators' construction of fibre optic cables.

In 2009, agencies possessing key infrastructures such as the Korea Highway Corporation, the Korea Electric Power Corporation, the Korea Rail Corporation and local governments were obligated to provide facilities such as electric light poles or power tunnels when requested by broadband providers.

In 1999, the government also introduced the High-speed Information and Communication Building Certification System that grants certificate to the buildings equipped with the facilities for high-speed Internet or home network services. Infrastructure that ensures last mile coverage is also highly essential in order for Internet services to be transmitted without any bottleneck. This certifying system by the government was established to respond to the rapid increase in Internet usage and to the introduction of new network services such as FTTH. Since it is difficult to newly deploy necessary telecommunication facilities after the building is built, fibre optic cables should be deployed at the start of the implementation stage. This certificate includes Home IoT certificate if the building is equipped with facilities to provide remote-controlled lighting, heating or entry. Since February 2012, the government has strengthened the requirement of certification according to the Giga Internet service.

Chapter 2. E-resilience and ICT development

1. Natural disasters in the region

China

Wenchuan Earthquake

The Wenchuan Earthquake occurred at 14:28:04 China Standard Time on May 12, 2008. The epicentre was located at the joint between Yingxiu Town and Xuankou Town, Wenchuan, Ngawa Tibetan and Qiang Autonomous Prefecture, Sichuan Province. According to the data of China Earthquake Administration, the Wenchuan Earthquake was measured at surface-wave magnitude of 8.0Ms and moment magnitude of 8.3Mw (according to the United States Geological Survey, the moment magnitude was 7.9Mw), and the seismic intensity was 11. The area destroyed by the Wenchuan Earthquake exceeded 100,000 square kilometres. The disaster area included 10 disastrously destroyed counties/cities, 41 severely destroyed counties/cities and 186 less destructively affected counties/cities. By 12 PM, 18 September 2008, there were 69,227 known deaths, 17,923 missing and 374,643 injured reported. It was the most destructive earthquake since the establishment of China with the most casualties since the Tangshan Earthquake.

After the Wenchuan Earthquake, emergency measures for communication were quickly implemented. However, many shortcomings were exposed for the emergency management and system construction (see table 22).

Table 22. Lessons learned from the reconstruction after Wenchuan Earthquake

(1) "Blind zone" in the emergency plans
The emergency plans prepared by communication operators were based on the precondition that no failure occurred to other guarantee industries, e.g. electricity, transportation, etc. After the earthquake, all industries were disabled and transportation and power supply to the disaster area were cut off for a long time. Emergency communication vehicles could not reach the disaster area. How to initiate and perform communication restoration work under such extreme conditions was not considered in their plans, let alone countermeasures for such conditions.
(2) Lack of efficiency in emergency communication command system
The governments did not set up the emergency command platform centred on the emergency communication command system. The emergency systems of communication operators could not interconnect with the emergency platforms of local governments and ministerial departments. Emergency management and command measures that were operational were telephone and facsimile. With their limited and underdeveloped technologies, great difficulties were experienced in operational readiness and command and management of emergency communication and potential risks to performance of emergency missions.
(3) Insufficient investments in emergency communication system
Wenchuan Earthquake revealed the immaturity of the emergency management system and insufficient investment in emergency materials, equipment and reserves; and the outcome was failure to fulfil the needs for disaster relief and rescue and emergency disposals. Due to insufficient fund support, the investment of the governments and communication operators in emergency communication guarantee were very limited and extremely insufficient, leading to great shortage of emergency material reserves, behindhand emergency communication teams and devices, vulnerable facilities such as communication base stations, power supply systems, and transmission lines, especially in remote areas where natural disasters occur frequently.
(4) Weakness in professional emergency communication teams and shortage of materials

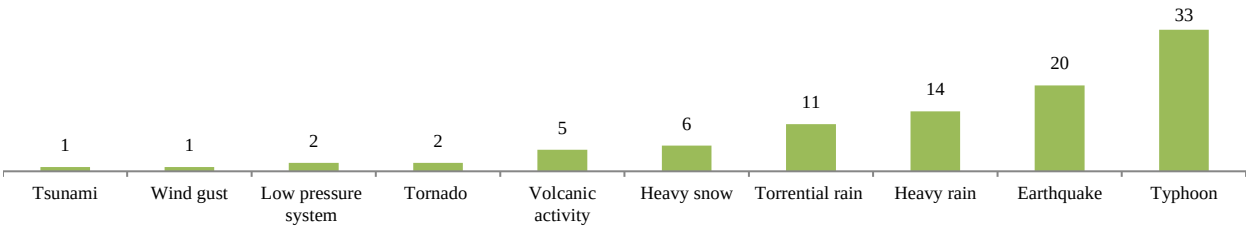
In regard to the construction of emergency communication by communication operators, operators paid more attention to construction investment, operating cost and operation benefits. As they were the direct undertakers of emergency missions and responsible for guaranteeing emergency communication, conflicts arose between performance evaluation and social obligations. The governments granted the professional function of emergency communication guarantee to some enterprises. However, they put insufficient investments and this resulted in a shortage of multi-channel emergency communication guarantees when the earthquake occurred.
(5) Vulnerability in communication systems and insufficient emergency response capabilities of public networks
Some nodes configured regularly failed to accommodate peak call traffic as the capacity of communication systems was configured according to the common redundancy. Therefore, these communication systems could not withstand the impacts of heavy call traffic, causing communication clogging. No special user importance was assigned to emergency communication in public networks and all users were classified in the same level and used the same network, thus, communication of important users cannot be guaranteed. No multi-measure or multi-routing backup protection was provided for telecommunication networks and the sharing capability was poor. Communication operators have their own network systems and are insufficient in network capability and resource sharing, affecting the overall communication guarantee during disaster relief.

Source: Summarized by the author

Japan

Japan is one of the disaster-prone countries, situated in the circum-Pacific orogenic zone where seismic and volcanic activities frequently occur. Due to the geographical and topographical factors, the country has been affected by a great number of large-scale natural disasters including earthquakes, tsunami, active volcanoes, typhoons, torrential rains and heavy snowfalls. As shown below, these natural disasters have caused a significant loss of lives and property in Japan.

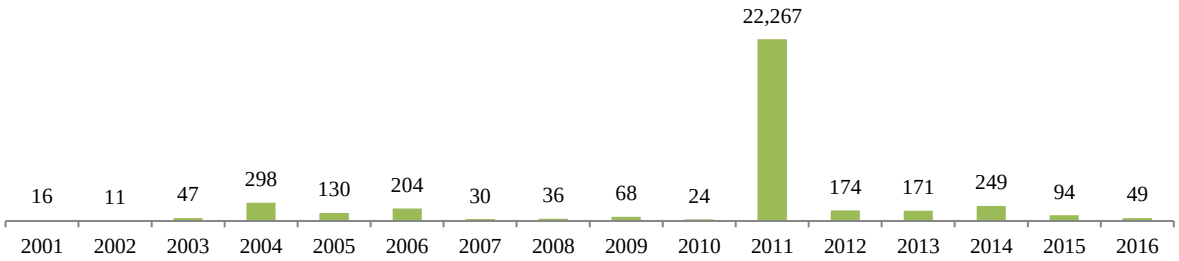
Figure 21. Number of natural disasters in Japan, 2001-2016



Source: Cabinet Office, Japan (2016). White Paper on Disaster Management in Japan 2016.

Figure 22. Victims (dead and missing) from major natural disasters in Japan, 2001–2016

Number of persons



Source: Cabinet Office, Japan (2016). White Paper on Disaster Management in Japan 2016.

More particularly, the frequent occurrence of large-scale earthquakes and tsunamis has constantly posed a huge threat to national safety. It is estimated that nearly 20 per cent of the world's earthquakes beyond the magnitude of 6.0 have occurred in Japan. In recent decades, two large-scale earthquakes have occurred (the Great Hanshin-Awaji Earthquake in 1995 and the Great East Japan Earthquake in 2011), resulting in a significant number of casualties. The Great East Japan Earthquake in 2011, was of a magnitude of 9.0. 22,010 people died or went missing, and resulted in a significant financial loss due to facility-related destruction.

Table 23. Overview of the Great East Japan Earthquake and the Great Hanshin-Awaji Earthquake

	Great East Japan Earthquake	**Great Hanshin-Awaji Earthquake**
Date	11 March 2011	17 Jan 1995
Magnitude	9.0	7.3
Type	Oceanic trench	Inland
Region affected	Agricultural, forestry and fishery regions including Iwate, Miyagi and Fukushima prefectures	Urban centre in Western Japan
Tsunami	Maximum wave height of more than 9.3 m observed	Wave height of about tens of centimeters observed
Damage features	Massive destruction in coastal areas	Structures destroyed
Fatalities and the missing	Fatalities: 19,418 Missing: 2,592 (as of March 2016)	Fatalities: 6,537 Missing: 3 (as of May 2006)
Houses destroyed	121,809 (as of March 2016)	104,906

Source: Cabinet Office, Japan (2016). White Paper on Disaster Management in Japan 2016.

Table 24. Facility-related damage by the Great East Japan Earthquake, as of 24 June 2011

Trillions of Japanese Yens

Types of facility	**Financial loss**
Structures (residential sites, stores, offices, factories, machines)	10.4
Lifeline facilities (communications, water, gas, electricity)	1.3
Infrastructure facilities (airports, ports, roads, sewers, rivers)	2.2
Agriculture, forest and fisheries-related facilities	1.9
Other (educational-, healthcare-, social-, and waste treatment facilities)	1.1
Total	**16.9**

Source: Cabinet Office, Japan (2016). White Paper on Disaster Management in Japan 2016.

As global warming continues, many meteorological changes have been observed in Japan. Along with the growing temperature, the number of rainy days (the daily rainfall amount: 100 mm or higher / 200 mm or higher) has increased as well. This phenomenon can result in an increase in the frequency of floods occurring in major rivers and landslide disasters. Moreover, climate change is highly related to the frequency of strong typhoons. This rise in occurrence frequency and severity of various natural disasters has made the whole society more vulnerable. Moreover, due to an accelerated aging and urbanization, it has been much more crucial for the government to strengthen the unified disaster management system that can enhance the resilience of the society and function efficiently in any type of disasters.

Republic of Korea

The Republic of Korea is not an exception from risks and challenges from natural and human induced disasters and there are growing concerns on managing newly emerging multi-hazards. Poor and inadequate infrastructure can increase the probability of extensive damage including outbreaks of epidemics in post-disaster situations can impact both urban and rural areas reducing their ability to cope with the aftermath of a disaster. Moreover, innovations linked to ICT come with risks as cyber criminals can gain access to personal information, bank accounts, and use the Internet in a number of ways to commit cyber-crime.

Large scale disasters can easily paralyze telecommunications networks. In this respect, the country has been making significant efforts on creating environments that enable seamless and secure data and information transmission to minimise damage with prompt response and recovery when a state of emergency happens. As part of these efforts, there is a growing investment in building critical infrastructure with sufficient disaster-resilience. Moreover, the Republic of Korea also heavily focuses on developing alternative communication infrastructure for disaster and safety such as a system via satellite against worst-case scenarios including the breaking of the fixed terrestrial communication networks.

Further, here has been increasing national demands for an integrated and cooperated mechanism to promote effective emergency management. In recent years, the Republic of Korea has invested in fostering national resilience to hazards using ICT applications. Combined with national R&D programmes, the country has put stronger emphasis on converging ICT into all phases of disaster risk management, in partnership with all levels of government and relevant stakeholders.

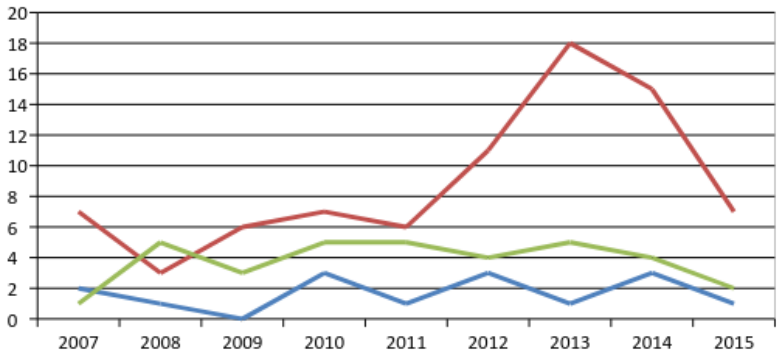
A rising uncertainty on the size and scope of the impacts of disasters has presented a national priority on capacity building on sustaining resilience. Resilience is the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. As an effective way to enhance national

resilience, the Republic of Korea finds the answer from ICT. Broadly, ICT can contribute to disaster risk management in two aspects via utilising ICT for early warnings and recovery against disasters. To ensure that ICT is accessible during disasters, the physical infrastructure need to be either enhanced to withstand disasters or new infrastructure built to new standards to increase its resiliency when disasters strike. According to the Regional Safety Index provided by the Ministry of Safety and Security, there has been a considerable disaster resilience gap among municipalities, indicating that certain regions are more vulnerable to damage caused by disasters in addition to a lack of capability to minimise impacts. In this respect, ICT enables to propose measures to cope with this geographic variation of resilience throughout the country.

Located in Eastern Asia, the Republic of Korea is a mountainous peninsula with around 70 per cent of its terrain covered by mountains including two major ranges: the Taebeak and Sobaek Mountains. The Republic of Korea is prone to various destructive natural hazards, including floods, typhoons, snowfalls, tidal waves, landslides and high winds. In addition, the frequency of tropical storms has increased in recent years due to climate change. Two-thirds of these disasters occur mostly in the summer time between June and September which is the country's monsoon season. This season brings heavy rainfalls averaging around 60 cm that lead to flooding and landslides in mountainous areas. In July and August, typhoons originating east of the Philippines frequently travel towards the country and often lash the country with strong winds and heavy rain. While the temperature increases due to the climate change, the average rainfall intensity is increasing and the average minimum pressure in typhoons is being strengthened as well.

The frequency of heavy rains has been the highest in recent years, causing the greatest amount of financial damage. Heavy rain is also the main reason for damage to the life in the country with the number of the victims of disasters dramatically increased from 2010 to 2011 linked to heavy precipitation combined with typhoons.

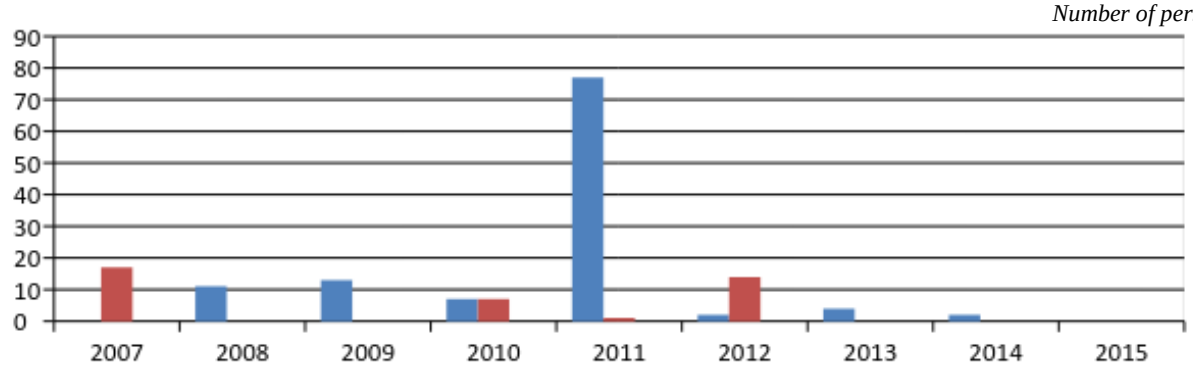
Figure 23. Number of natural disasters in the Republic of Korea, 2007-2015



Source: MPSS website. Statistical yearbook of natural disaster.

Figure 24. Victims (dead and missing) from major natural disasters in the Republic of Korea, 2007-2015

Number of persons

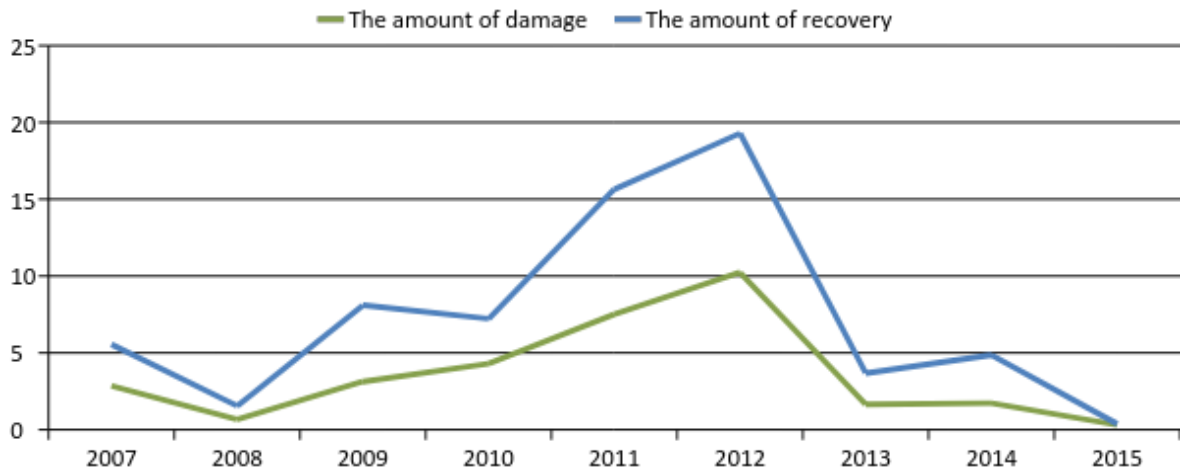


Source: MPSS website. Statistical yearbook of natural disaster.

The Republic of Korea has continued to experience significant economic and social losses due to natural disasters that have resulted in substantial property damage in recent years (see figure 25). During this period, the biggest property damage happened in 2012 due to frequent heavy rain and three strong typhoons in a two-month period from the beginning of August to September.

Figure 25. Financial damage from natural disasters, 2007-2015

One million Korean Wons



Source: MPSS website. Statistical yearbook of natural disaster.

Table 25. Financial damage as a proportion of GDP

Percentage

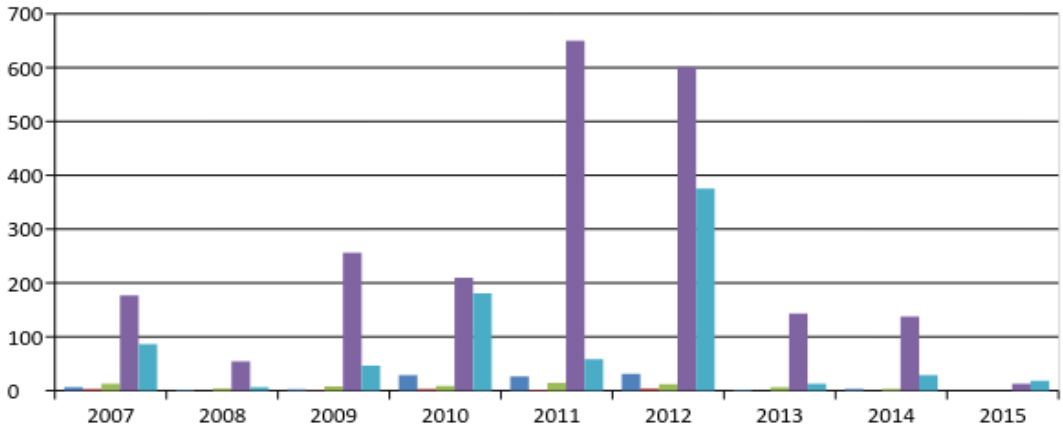
Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
Financial damage / GDP	0.024	0.006	0.026	0.034	0.060	0.079	0.012	0.012	0.002

Source: MPSS website. Statistical yearbook of natural disaster.

Note: There has been continuous financial impact on public and private structures from natural disasters. The amount of damage on public facilities has been especially high calling for increased efforts to build resiliency into public infrastructure (see figure 26).

Figure 26. **Financial damage of public and private structures from disasters, 2007-2015**

Millions of Korean Wons



Source: MPSS website. Statistical yearbook of natural disaster.

In the meantime, there has been increasing concern on the potential impact of seismic activity, followed by small and large earthquakes that have recently struck. This has raised concerns over the safety of the nation's nuclear power plants following in the wake of Fukushima, Japan. According to the Ministry of Public Safety and Security (MPSS), only 44,732 facilities out of 105,448 key domestic infrastructures (42.4 per cent) are considered earthquake-resilient as of 2016. In case of nuclear facilities and multi-purpose dams, 98.4 per cent of facilities are fully resilient against earthquakes up to a certain magnitude. However, five oil pipelines need to be improved to absorb seismic events to a certain magnitude. In addition, 22.8 per cent of education facilities are considered prone to disasters and only 35.5 per cent of telecommunications equipment facilities, 56.9 per cent of water supply plants and 78 per cent of gas supply and storage facilities can be considered as resilient enough.

Table 26. **Earthquake resilience of key facilities, as of October 2015**

Number of sites

Facility type	In need of earthquake resilience	Adopted earthquake resilience	Rate of adoption (%)
Public building	33,430	16,360	33.7
Airport facility	412	232	56.3
Water supply plant	2,568	1,462	56.9
Road	23,473	13,212	56.1
Urban railway	1,075	866	80.6
Railway facility	3,565	1,430	40.1
High-speed railroad	704	399	56.7
School facility	29,558	6,727	22.8
Hospital	2,811	1,821	65.4
Oil pipeline	5	0	0
Nuclear facility	247	243	98.4
Multi-purpose dam	16	16	100

Source: Korea JoongAng Daily (28 April 2016). Assessing the danger of earthquakes in Korea.

The MPSS plans to reinforce more than 7,000 structures including major bridges across the country. The safety of Seoul's subway facilities is also considered to be advanced in the aspect of

earthquake resilience, though according to the Seoul Metropolitan Government and Seoul Metro, 33.7 miles of subway lines required reinforcement as of 2013. In this regard, the Seoul Metro had planned to allocate KRW 1,254 billion for reinforcement between 2014 and 2016.

The Korea Meteorological Administration currently operates a pre-warning system that announces warnings to the public within 50 seconds for earthquakes which are larger than the magnitude 5.0. The administration sets a goal to have capacity to provide emergency warning within 10 seconds by 2020.

2. National disaster risk management mechanisms

China

National Disaster Response Command System

China is among the countries most severely affected by natural disasters in the world. These natural disasters affecting China feature various types, high frequencies, vast coverage and cause heavy losses. In the past five years, various natural disasters struck China frequently and affected 310 million person-times, wherein about 1,500 persons died or went missing, over nine million persons were relocated, and nearly 700,000 rooms collapsed, with direct economic losses of over CNY 380 billion.

In 2016, the General Office of the State Council issued the amended National Natural Disaster Response Framework ("the Framework") (Guo Ban Han (2016) No. 25) to further regulate and improve the natural disaster response and the response processes at the Central Government level. This amendment is to adapt to the new situations and changes in natural disasters and relief work in China, and reflects the lessons learned from and practices during major and extraordinarily serious natural disasters happened over the years. The Framework defines the command system of China's domestic emergency rescue work.

The China National Commission for Disaster Reduction (NCDR) is the natural disaster relief coordinator of China and is responsible for organising and leading the natural disaster relief and coordinating the rescue and relief during major and extraordinary serious natural disasters. NCDR member units undertake related natural disaster relief work according to their respective responsibilities. The NCDR Office is responsible for communicating with related departments and local governments, organising disaster discussion and assessments, and disaster relief, and coordinating the implementation of related supporting measures.

The NCDR has set up expert committees to provide policy consultation and suggestions for decision-making and important planning for disaster relief, and provide advice for assessment, emergency rescue and post-disaster aids of major natural disasters.

National Disaster Response Level

According to factors such as the extent of harm caused by natural disasters, the Framework classifies natural disasters into Level I, II, III and IV. Classification is based on the severity of natural disasters, where Level I represents the most severe level. The Framework specifies the initiating conditions of each level based on the number of deaths, and number of persons to relocate or to relieve, etc.

Table 27. National disaster response level

	Level I	Level II	Level III	Level IV
Precondition	An extraordinary serious natural disaster occurs in the administrative area of a province (autonomous region, municipality)	A major natural disaster occurs in the administrative area of a province (autonomous region, municipality)		
Number of deaths	>200	100-200	50-100	30-50
Number of persons to relocate or relieve	>1 million	800,000-1 million	300,000-800,000	100,000-300,000
Number of rooms collapsed or severely damaged	>200,000	150,000-200,000	100,000-150,000	10,000-100,000
Number of persons requiring government aid due to drought related water and food shortages	>30% of the farm and husbandry population or >4 million	>25% of the farm and husbandry population or >3 million	>20% of the farm and husbandry population or >2 million	>15% of the farm and husbandry population or >1 million

Source: General Office of the State Council of China (2016). National Natural Disaster Response Framework (Guo Ban Han (2016) No. 25).

The Response Level I will be organised and led by the Director of the NCDR; the Level II will be led by the Deputy Director of the NCDR (Minister of Civil Affairs); the Level III will be led by the Secretary General of the NCDR; and the Level IV will be led by the NCDR Office.

Stakeholders of National Disaster Response Framework: Natural disaster relief coordinating agencies

To support the initiative of "International Decade for Natural Disaster Reduction (1990-2000)" (IDNDR) advocated by the United Nations in 1987, the Chinese Government set up the China Commission of the IDNDR in 1989. The Commission was headed by the vice premier of the State Council and included 32 ministries and commissions such as the Ministry of Civil Affairs, the Ministry of Foreign Affairs and the Ministry of Economy and Trade, and related departments of the People's Liberation Army (PLA) of China. In October 2000, the China Commission of the IDNDR was renamed International Disaster Reduction Commission of China which was responsible for coordinating major disaster reduction activities and disaster reduction by local governments. In April 2005, the International Disaster Reduction Commission of China was renamed again as the National Commission for Disaster Reduction. During the same year, the General Office of the State Council issued the National Natural Disaster Response Framework

which defines the responsibilities of the NCDR. In 2011, the amended Framework further defined NCDR as the natural disaster relief coordinator of China, which is responsible for organising and leading the natural disaster relief and coordinating the rescue and relief during major and extraordinary serious natural disasters.

Supporting natural disaster relief administrative agencies

In the administrative system of the government, administrative departments have their own service scopes, specialties, resources, equipment and capabilities and therefore have their non-replaceable roles in supporting and cooperating the natural disaster relief activities. The Framework issued in 2005 defines the responsibilities of the members of the NCDR. Based on the requirement to reform the organisational structure of the State Council and natural disaster relief activities, in May 2013, the NCDR adjusted its members to include four-member units including the Ministry of Civil Affairs, China PLA General Political Department, Publicity Department of the CPC and the Ministry of Foreign Affairs. Later, China Railway was added. The four response levels defined by the Framework define the tasks, responsibilities and mandatory requirements for supporting agencies.

Figure 27. Members of National Disaster Reduction Commission

Source: Zhang Wei, "Flood scene in Hebei, the official representative of the Party Central committee!", Best China News, 24 July 2016. Available from http://www.bestchinanews.com/Domestic/326.html.

According to the applications of local governments and the investigations of disasters by relevant authorities, the Ministry of Finance and the Ministry of Civil Affairs allocate the funds of the Central Government for living subsidies to people suffered from natural disasters in a timely manner. The Ministry of Civil Affairs allocates living subsidy materials to disaster areas, and instructs and supervises the implementation of disaster relief measures and the distribution of relevant funds and materials by local governments. Departments such as transportation, railway and civil aviation strengthen the organisation and coordination of transportation of disaster relief materials to guarantee transportation work. The Ministry of Public Security is responsible for maintaining the social security of disaster areas, helping relocation of people and supporting disaster relief work. The PLA General Political Department and the Headquarters of Chinese People's Armed Police Force are responsible for organising armies, Armed Forces, people's militia

and reserve forces to participate in disaster relief activities as requested by relevant departments and local governments, and provide assistance for local governments in transporting, unloading and distributing disaster relief materials if necessary.

Japan

In response to these ongoing disasters, Japan has concentrated on developing systematic disaster management mechanisms as one of the national priorities in order to strengthen national resilience against hazards and to protect the property and lives of the people. Especially, three major disasters in Japan: the Isewan Typhoon in 1954, the Great Hanshin-Awaji Earthquake in 1995 and the Great East Japan Earthquake in 2011 have become critical moments for the country to update the national plan of disaster management measures, which will be covered below. Along with a series of reviews and reforms, the country has constructed an integrated strategic system that connects the national and local governments with the people for more accurate information sharing and prompt disaster response in a unified manner at the national and local levels.

Overview of the national disaster management framework

As stated above, there have been three phases of transformation in terms of the national disaster management system. As the first phase, following the occurrence of Isewan Typhoon in 1959, Japan had devised the Disaster Management 1.0 to overcome the lack of national capability to swiftly respond to large-scale disasters and lack of clarity of each relevant agency's role in emergencies. First of all, the country enacted the Disaster Countermeasures Basic Act in 1961 to set a foundational legal framework that integrates disaster management system for each stage of prevention, preparedness, mitigation, response, recovery and reconstruction. It clarified the roles and responsibilities of the national and local governments and related entities from both the public and private sectors for implementing various disaster countermeasures. On this legal basis, the Central Disaster Management Council was established. At the same time, this phase was the preparation period of the Disaster Management Basic Plan for the long-term disaster management plan.

After the Great Hanshin-Awaji Earthquake in 1995 which had caused a significant number of casualties and destruction of houses and various critical infrastructures, the Government entered into the second phase, the Disaster Management 2.0 to enhance the response mechanism at the initial stage of the crisis. As part of the response measures implemented, an emergency meeting team was formulated for swift grasping of the disaster situation and better communication. This earthquake, stuck in the city centre, had highly raised the issue of resilience of infrastructures as well, which led to the enactment of the Act on Promotion of Seismic Retrofitting of Buildings and the Act on Support for Reconstructing Livelihoods of Disaster Victims.

The Disaster Management 3.0 was followed after the Great East Japan Earthquake struck in 2011. Massive damage that occurred in the coastal areas of the Tohoku region had shown the necessity for fostering measures against a complex disaster that involves a natural disaster and a nuclear emergency. In this phase, the concept of disaster mitigation was regarded a fundamental principle of disaster management for the first time. Under the third phase, the government has undertaken a major amendment to the Disaster Countermeasures Basic Act with additional provisions in recent years. In 2012, the provisions concerning the regional response to large-scale disasters were added. The amended Act clarifies the measures for improving regional disaster management capabilities by involving related entities in the implementation process. In the year following 2013, the measures that aim to protect affected people and their livelihood were stipulated for prompt rescue and the safe evacuation of residents in times of regional disasters. In addition, the Act has strengthened regulations regarding unattended vehicles in opening up roads for emergency vehicles. In the meantime, reflecting on the nuclear emergency caused by the earthquake, policies on nuclear power were revised along with the establishment of the Nuclear Regulation Authority.

In December 2015, the Cabinet Office's Disaster Management Bureau launched the Disaster Management 4.0 Future Vision Project that encourages more participation from various stakeholders in disaster management to fully prepare for potential disaster risks through viable social networks that connect each other. The project seeks to allow each stakeholder including citizens and companies to take practical actions in the process of designing disaster management measures. Especially, in case of companies, it is necessary to prepare themselves to maintain economic activity and minimise the impact from the disaster by implementing business continuity plans (BCP). The project is expected for companies to appropriately secure supply chains and critical life line infrastructures that include electricity and communications. All these objectives are encouraged to be achieved through the active use of ICT.

As the Disaster Countermeasures Basic Act has been the most fundamental legal basis for all disaster management schemes in Japan, numbers of disaster management laws enacted by types of disasters under the Disaster Countermeasures Basic Act are also briefly introduced in the annex.

Based on the Disaster Countermeasures Basic Act, the Central Disaster Management Council was formulated under the Cabinet Office. Here, the Prime Minister is positioned as the Chief, working together with all Cabinet members and heads of designated public corporations and experts. The council plays a significant role in designing and promoting the implementation of the Basic Disaster Management Plan and deliberating important issues on disaster management based on requests from the Prime Minister or the Minister of State for Disaster Management. In the meantime, the Director-General for Disaster Management under the Cabinet Office is given the responsibility of the policy planning and overall coordination regarding response to disasters. In addition, since 2001, the Minister of State for Disaster Management has been appointed to integrate disaster risk reduction policies and countermeasures for ministries and agencies.

In times of national crisis, the Cabinet Office is in charge of collecting/disseminating accurate information and setting up the emergency activities system. The Cabinet Information Centre operates all the year round to provide necessary disaster information to the national and local governments for effective response and rescue. Based on the shared information, the national and local governments decide to set up a disaster management headquarters. Even before the occurrence of a disaster, local governments prepare headquarters in advance to take precautionary measures.

Depending on the severity of disasters, an emergency team can be created, consisting of the director generals of each ministry and agency. The Government is also allowed to establish the Headquarters for Major Disaster Management or the Extreme Disaster Management Headquarters, headed by the Minister of State for Disaster Management and the Prime Minister each, in order to set up the policies for the countermeasures to be taken by each related agency. In addition, a government investigation team is dispatched to the disaster site to grasp the situation and to take quick actions needed on the site.

When disaster strikes, local public entities of the affected region take initial actions at the first-line for emergency countermeasures. However, if the expected damage from a disaster goes beyond the management capabilities at the local level, the coordination system is operated between national and local governments for the comprehensive wider-area measures at the national level. In this process, the Extreme Disaster Management Headquarters or the Major Disaster Management Headquarters takes a leading role in overall coordination for emergent rescue through a prompt communication and information sharing among relevant ministries. At the same time, the on-site disaster management headquarters are set up in the affected areas to coordinate among the local entities and collect information. On a practical level of emergency response, there are entities including the National Police Agency (Disaster Response Units), Fire and Disaster Management Agency (Emergency Fire Rescue Team) and Japan Coast Guard, taking the leading role of the on-site disaster management. Moreover, the Government dispatches the Self-Defense Forces for emergency response upon request from the affected region along with the Disaster Medical Assistance Team (DMATs). At the same time, under the framework of disaster management, Japan Meteorological Agency (JMA) is granted a direct responsibility for observing natural changes and offering accurate information to minimise damage in case of the occurrence of natural disasters.

The Decision Making System is operated by the disaster management headquarters based on the information gathered in a cloud data centre from many of ICT-based disaster information sharing systems. The information becomes a basis of the disaster response manual which provides a guideline for accurate initial disaster response of making system has been constructed by the disaster management headquarters for swift decision making against the disaster situation. Information, simultaneously collected from numbers of supporting systems, is delivered to the cloud data centre which is interconnected to the headquarters.

In times of crisis, the Decision Making System is being operated by the Disaster Management Headquarters based on the disaster response manual in order to support accurate initial responses in collaboration with relevant agencies. The system automatically collects and analyses information in connection with entities concerned, and enables implementation of a suitable course of actions by type of disasters on a basis of a series of situation scenarios which are made beforehand.

Disaster management strategies: Disaster Risk Management Plan

The Basic Disaster Management Plan is the highest-level plan that constitutes the foundation for disaster management activities controlled by the Central Disaster Management Council. It lays the foundation for the Disaster Management Operations Plan and Local Disaster Management Plan. In accordance with Article 34 of the Disaster Countermeasures Basic Act, the plan describes the disaster management system by phases: prevention and preparedness; emergency response; and recovery and reconstruction, and promotes scientific and technological research on disaster management. There are three layers of the administrative system: national, prefectural and municipal government. Each ministry and prefectural government is obligated to design its own disaster management plans in line with the Basic Disaster Plan. And the plans developed by prefectures become guidelines for municipalities to elaborate their own plans.

The plan went through an entire revision in 1995 after the Great Hanshin-Awaji Earthquake. The revision clarified each stakeholder's responsibility depending on the type of disaster. Furthermore, reflecting the lessons from the Great East Japan Earthquake, the plan was again revised entirely in 2011 with the inclusion of a new chapter for Tsunami Disaster Countermeasures. In 2014, another revision was made to foster the measures for removing abandoned vehicles in urgent situations. Then in 2015 and 2016, two types of changes were made based on the lessons from the Hiroshima Landslide Disaster, Mt. Ontake Eruption and others. The changes reinforced countermeasures against sediment disasters by specifying areas with a danger of a sediment disaster and using alert information for timely evacuation. Also, information communication and monitoring systems have been strengthened against volcanic disasters. Further, the revised plan encouraged integrated coordination of information gathering and decision making between Extreme Disaster Management Headquarters and Nuclear Emergency Response Headquarters. Pursuant to the Basic Act for National Resilience Contributing to Preventing and Mitigating Disasters for Developing Resilience in the Lives of the Citizenry (Act No.95 of 2013), the Fundamental Plan for National Resilience was adopted by the Cabinet in 2014 in order to promote national resilience. Following this, the Action Plan for National Resilience 2015 was adopted at the National Resilience Promotion Headquarters to promote initiatives through the cooperation between each ministry and entity. It focuses on supporting monitoring and observation frameworks for sediment and volcanic disasters.

While 28 prefectures and 14 municipalities already have Fundamental Plans for Regional Resilience, local governments of 19 prefectures and 27 municipalities were in the process of

preparing the plans as of 2016. To encourage the implementation of the regional plan system, relevant ministries and agencies decided to allocate 32 grants and subsidies under their jurisdiction.

Plans for disaster countermeasure:

Earthquake

There has been a constant fear of a large-scale disaster with long-period of ground motion along the Nankai Trough. In 2014, the Government designated the large-scale earthquake-prone areas (29 Prefectures including Tokyo, Osaka and Kyoto, and 707 municipalities as of 2014) where precautionary measures are to be taken by public and private entities based on the Basic Plan for the Promotion of Nankai Trough Earthquake Disaster Risk Reduction Countermeasures. The plan stipulates detailed measures and timelines for promoting earthquake-resilient and fireproof infrastructures and developing hazard maps.

As of 2008, around 21 per cent of existing infrastructure built before 1981 were evaluated as not resilient enough against earthquakes. Moreover, as of 2013, around 30 per cent of schools and 40 per cent of hospitals are insufficiently earthquake-resilient. Reflecting this situation, the conduction of a seismic qualification test has become mandatory since 2013 on large-scale public and private buildings. The country set specific goals to be achieved for promoting resilience as follows:

- 95 per cent of houses to be earthquake-resilient by 2020;
- 100 per cent of public school (elementary and junior-high) to be earthquake-resilient by 2015; and
- 81.2 per cent of disaster base hospitals, emergency medical care centre to be earthquake-resilient by 2014.

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) regularly examines structural design techniques for tall buildings to be prepared against long-period ground motion from a mega-quake.

In 2015, the Central Disaster Management Council approved the Plan for Specific Emergency Countermeasures and Activities for a Nankai Trough Earthquake. The details of activities defined on the plan were decided based on the estimates of seismic intensity distribution predicted by the Committee for Modelling a Nankai Trough Mega-quake. Regardless of requests from the affected region, the Central Government can take swift actions under the leadership of the Extreme Management Headquarters in terms of emergency transportation routes, rescue, firefighting, medical care, fuel supplies and goods procurement.

As for countermeasures for the Tokyo Inland Earthquakes, the Cabinet approved the Basic Plan for the Promotion of the Tokyo Inland Earthquake Emergency Countermeasures in 2014 to implement two items: (1) the construction of systems that enable the continuity of the key governmental functions, and (2) the development of seamless response measures. At the same time,

Tokyo and nine prefectures and 310 municipalities were designated in 2014 as areas where urgent measures need to be taken.

Tsunami

The government focuses on enhancing the tsunami observation systems and strengthening education and training on tsunami. Moreover, it enacted the Act on Development of Areas Resilient to prescribe restriction of development in areas susceptible to tsunami.

Volcano

Volcano Hazard Maps for 47 volcanoes were designed by Volcano Disaster Management Councils to indicate areas that can be affected from eruption, along with specific evacuation plans.

Storm and flood

Based on the Flood Control Act, the Government designated 417 rivers subject to flood warning and 1,555 rivers subject to water-level notification. The warning and evacuation systems have been developed for potential inundation areas and landslide prone areas as well. Moreover, the country encourages municipalities to produce flood hazard maps for information sharing with the residents.

The Central Disaster Management Council produced a number of scenarios on expected damage in times of large-scale floods, and designed the Basic Policies for Metropolitan Area Large-scale Water Hazard with appropriate measures.

Business Continuity Systems

In 2014, the Central Government's Business Continuity Plan (BCP) was approved by the Cabinet to ensure the maintenance of pivotal governmental functions in the event of a large-scale disaster. To avoid impact on the political, administrative and economic key functions, the plan established an organisational structure to conduct emergency priority operations in rotation without external aid.

The plan provides guidelines on how building should be constructed in an earthquake-resilient way. It stipulates that the safety of the building should be enhanced via renovation. To maintain the emergency priority services in the event of a disaster, emergency power generators must be installed and stocked with fuel that can be used for at least one-week. The information backup system must be well prepared as well. In case that the main buildings become dysfunctional, alternative facilities should be ready for use.

Reflecting on the fact that the preparation rate of BCP among municipalities (37 per cent) is relatively low compared to that of prefectures (89 per cent) as of 2015, the Cabinet Office supports the formulation of BCP in small municipalities, especially with a population of less than 10,000, by providing guidelines of BCP.

In addition, there are number of companies with their own strict regulations on BCP. However, the overall preparation rate still remains low. As of 2016, less than 80 per cent of large corporations and slightly more than 50 per cent of SMEs are in the process of formulation of BCP.

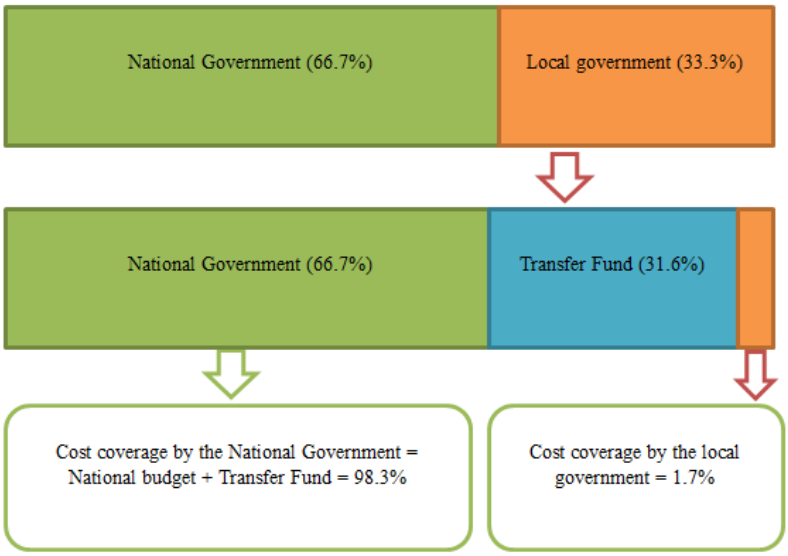
Disaster risk financing support

Japan has continued to implement disaster risk financing to reduce the cost of disasters. In times of disaster, the public sector mainly covers the cost through the contingency budget (reserve fund and temporary tax), while the private sector chooses insurance as the financing tool along with the subsidies from the government.

Financing from the public sector

To be more specific on financing for public assets, two thirds of recovery cost is supported by the national government while one third of it is covered by the local governments. In case the bond is issued by the local government due budget constraints, the national Government covers around 95 per cent of the interest and redemption of the bond through the Transfer Fund. Local governments can begin recovery operations prior to budget assessments by the national government. Up to 100 per cent of the cost can be covered by the bond. When the cost goes beyond the 200 per cent of standard level of revenue, the national government bears the burden of the whole cost.

Figure 28. Cost sharing by governments



Source: Nakao, Yasuhisa (2017). Disaster Risk Financing and Insurance Policies of Japan. Presentation at the APEC Workshop on Disaster Risk Financing & Insurance Policies. Nha Trang, 21 February 2017. Available from http://mddb.apec.org/Documents/2017/FMP/SEM1/17_fmp_sem1_007.pdf.

Disaster insurance

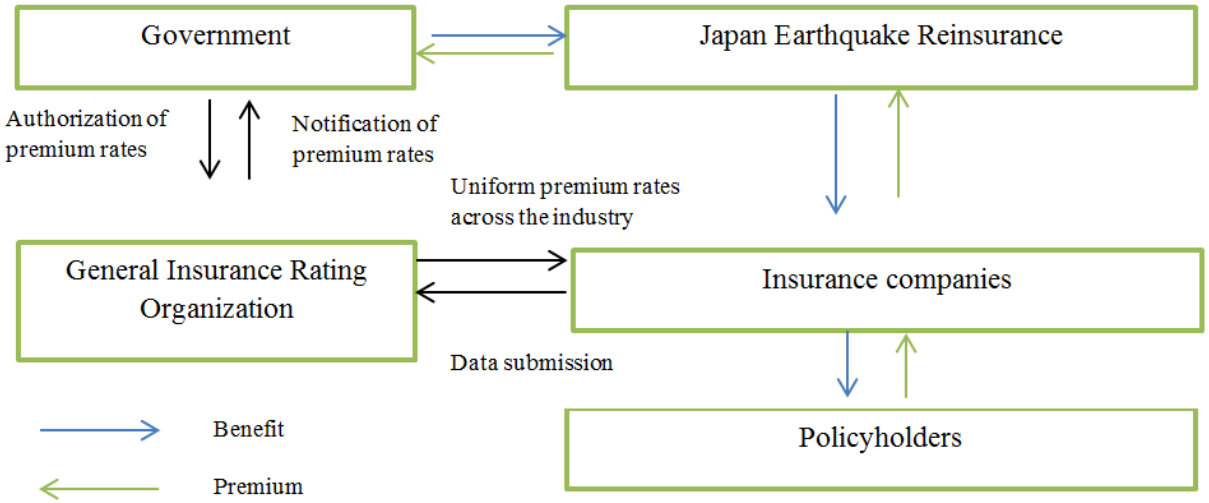
In 1887, the fire insurance company was set up in Japan to cope with financial loss from fire explosion or lightning. However, until the 1950s, there had been no insurance system for natural

disasters. After the occurrence of the Niigata earthquake in 1964, earthquake insurance was established in 1966 for the first time. After that, many insurance companies in Japan began to include natural disasters into their insurance plans.

Today, many private or quasi-public companies, possessing critical infrastructure, use private insurance to be financially supported in the event of disasters. As of 2010, for example, in case of the railroad company, insurance against typhoon and flood has been subscribed by 56 per cent of SMEs, 78 per cent of large companies and 100 per cent of quasi-public companies. In the meantime, insurance against earthquake has been subscribed only by 5 per cent of SMEs and 22 per cent of large companies.

For the household affected by the earthquake, the government and the private sector have been collaborating to cover the loss. The government reinsures earthquake insurance liabilities which are not covered by private insurance companies. For this, the government holds the Special Account for Earthquake Reinsurance to pool reserves. Reinsurance premiums which are managed in the Special Account is discounted to encourage private companies to build more viable buildings based on a year of construction and seismic capacity.

Figure 29. Earthquake insurance for household



Source: Nakao, Yasuhisa (2017). Disaster Risk Financing and Insurance Policies of Japan. Presentation at the APEC Workshop on Disaster Risk Financing & Insurance Policies. Nha Trang, 21 February 2017. Available from http://mddb.apec.org/Documents/2017/FMP/SEM1/17_fmp_sem1_007.pdf.

Special Account of the reconstruction

Since the Great East Japan Earthquake, the government has formulated a special fiscal framework, which is separate from the ordinary fiscal framework, to manage revenues and expenditures for reconstruction purposes. While revenue is comprised of special taxes for reconstruction, issuance of reconstruction bonds and other expenditures are for costs of reconstruction projects and redemption of reconstruction bonds. At the beginning after the Great East Japan Earthquake, the

government highly depended on issuance of a reconstruction bond to finance project costs. Then, it gradually mobilised resources through special taxes, the supplemental reserve and others.

Republic of Korea

National disaster command system

Along with the establishment of the government in 1948, the Republic of Korea began to prepare a national disaster management system by launching the bureau under the Ministry of Home Affairs. From that time, the bureau mainly coped with natural disasters such as floods or typhoons. Subsequently, the Prime Minister's Office was in charge of all of disaster management tasks with the enactment of Disaster Management Act in 1995. This structural transformation was to strengthen the safety management system as response to a succession of serious disasters linked to human negligence including Sungsoo Bridge collapse and Sampoong Department Store collapse.

The basic national platform for integrated management of human, social land natural disasters was established by the government in 2004 based on the First Master Plan for National Safety Management with the supporting legislation, The Framework Act on Disaster and Safety Management. At this time, the National Emergency Management Agency (NEMA) was newly established as well under the umbrella of the Ministry of Security and Public Administration (MSPA)[26]. NEMA enabled all functions of disaster response, which had been scattered throughout all Ministries to be gathered and be managed under a single system with expertise. NEMA was given the responsibility to monitor the Central Control Group of Emergency Rescue. The NEMA's main functions are as follows: (a) pre-disaster impact assessments; (b) a disaster insurance programme; (c) resilience building for disaster-prone areas; and (d) special disaster zoning.

After the horrific tragedy of Sewol Ferry accident in 2014, the government carried out the reorganisation of the government structure to integrate all the response systems that had been scattered under the various ministries and relevant agencies. As a result of the reshuffle, the MPSS was newly established through the combination of the NEMA and the National Maritime Policy Agency (NMPA). The MPSS is divided into three main parts: the Office of Safety Policy, the Office of Disaster Management, and the Office of Special Disaster Management. While the Office of Safety Policy and the Office of Disaster Management are in charge of the entire management process of disasters, the Office of Special Disaster Management is responsible for managing disasters related to air, energy, chemical, gas and telecommunications infrastructure in partnership with each relevant ministry.

Based on the Framework Act on Disaster and Safety Management, enacted in 2003, the operating system for the national disaster management is structured in a vertical hierarchy with the Central

[26] Abolished in 2014.

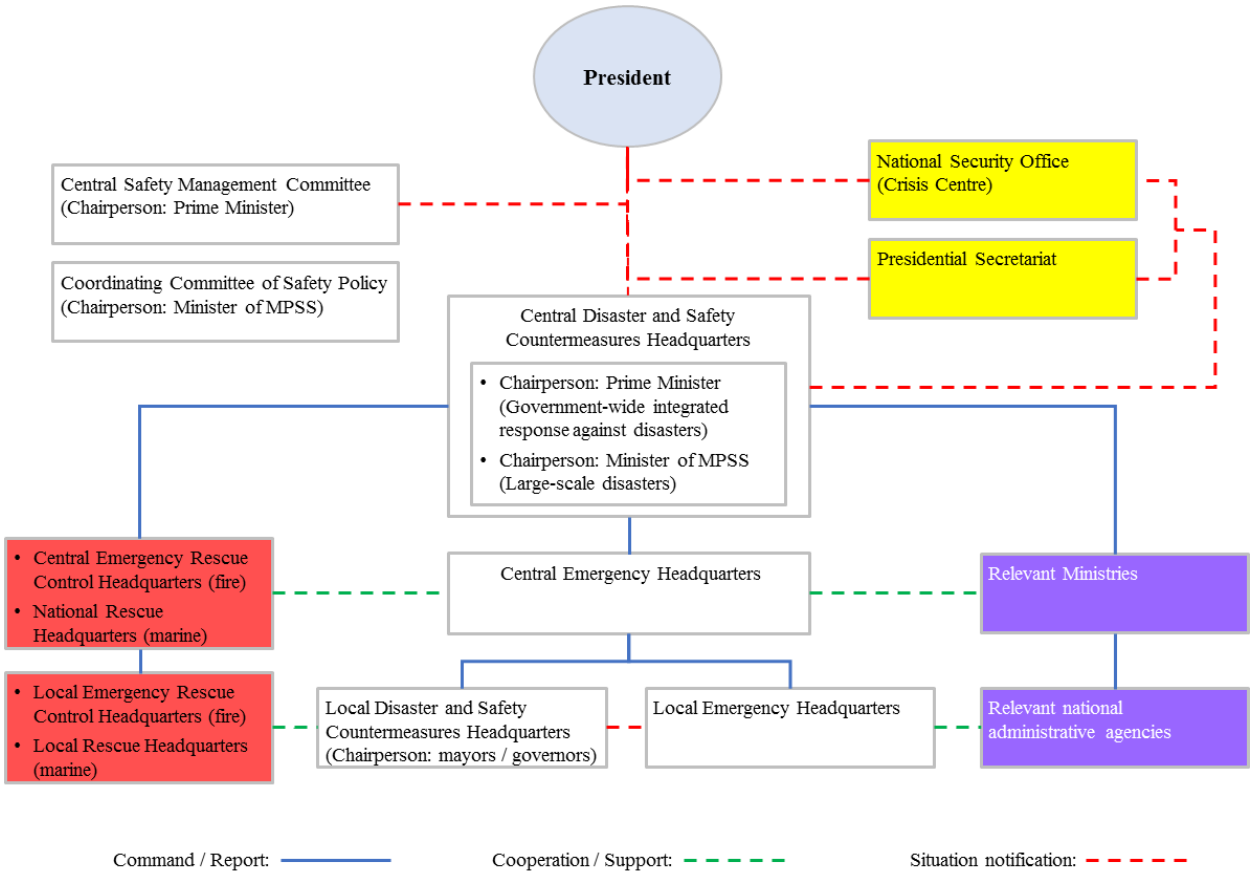
Safety Management Committee at the centre which consists of the Prime Minister as the chairperson. Under the Committee, the Coordinating Committee of Safety Policy has been operating with the Minister of MPSS as the chairperson. At the same time, the subcommittees are managed under the leadership of relevant ministers depending on the types of disasters. At a regional level, Local Disaster and Safety Countermeasures Headquarters have been identified as playing key roles.

When a disaster occurs, the Central Disaster and Safety Countermeasures Headquarters is operated under the Prime Minister and the Minister of MPSS as chairpersons. The Central Emergency Headquarters is also managed differently according to the types of disasters under different ministries like the subcommittees stated above.

For an effective and consistent command in times of a disaster, the Central Emergency Rescue Control Headquarters is required to take a lead at the national level while the Local Emergency Rescue Control Headquarters is in charge of commanding the necessary countermeasures in case a disaster occurs at a regional level.

Furthermore, the duality structure has been adopted to cope with natural- and man-made disasters separately. For the management of natural disasters, the Central Disaster and Safety Countermeasures Headquarters will play a key role for developing countermeasures by types of natural disasters. When it comes to man-made disasters, the Local Disaster and Safety Countermeasures Headquarters take a lead in preparing comprehensive preventive measures.

Figure 30. National disaster management operating system



Source: In Sool Yoo (2015). Disaster Management Planning in Korea.

Disaster risk management policies

In 1996, the Ministry of Home Affairs established the Basic Plan for Informatization of Safety Management and launched the pilot project for informatising the disaster sector in 1997. During that time, two forms of National Disaster Management System (NDMS), namely the System for Storm and Flood Damage and the 119 Emergency Rescue System were established. However, the NDMS at that time still lacked key functions in preparedness and response against peculiar types of disasters such as earthquakes and tsunamis. In addition, other major problems included the lack of inter-connection among related agencies in terms of information sharing and the lack of access to information for the public.

For this reason, the government developed and implemented a two phased informatization strategic plan, which comprises (a) Business Process Re-engineering; and (b) Information Strategy Planning, during the period July 2004 to March 2005. The primary objective of this plan was to build an integrated disaster-related information communication platform where the public can easily get access to necessary data and participate in information sharing. At the same time, governmental

efforts on building a standardised database system has proceeded to complement national functions of risks prevention and preparedness. Moreover, the country began to focus on improving usability and effectiveness of the system and pursued the creation of an independent comprehensive data management system that organically connects each governmental agency and enables prompt information transmission and sharing.

The most distinctive features of the First Master Plan for National Safety Management (2005-2009) were to define national roles of disaster management depending on four phases: prevention, preparation, response and recovery. The first master plan prioritised building necessary information infrastructure and provided a platform for conducting disaster-related R&D programmes. In the Republic of Korea, the National Disaster Management Institute (NDMI) has been operating actively as a specialised integrated research agency under the MPSS. It has developed practical risk reduction technologies and has provided policy guidance for the government.

In the meantime, reflecting limitations of the first master plan, the Second Master Plan for National Safety Management (2010-2014) has mainly prioritised the expansion of the management scope. In this period, the Government began to heavily emphasise utilisation of networks; and to change the system from a hierarchical "command and control" structure to a horizontal managing structure with active participation from various stakeholders.

The government has set out the Plan for Intelligence and Information Society and newly enacted the Promotion Act of the Intelligence and Information Society to foster a new ICT-based resilient society from a holistic perspective. As one of top priorities of the Third Master Plan for National Safety Management in 2015, the plan for preparedness and prevention of risks through new ICT applications and infrastructure is clearly included. For this purpose, the government continues developing technologies such as a smart multi-sensor and intelligent cognitive system as well as technologies of prediction automation, and simulation for post management.

As a cross-cutting national strategy, R&D plans for ICT-converged disaster management have been steadily developed in recent years. The national action plan for strengthening the capacity of science and technology responsive to disasters was formulated for successive three-year planning cycles, with a supporting roadmap of disaster-related technology development. The focus areas of technology development are as follows:

- Building a platform for integrated disaster information management: big data;
- Developing information transmission technology for real-time disaster response: telecommunications;
- Improving risk assessment and prevention capability: forecast / warning system;
- Monitoring hazards through ICT: Internet of Things (IoT), intelligent CCTV and SNS; and
- Strengthening capability of disaster recovery: unmanned robot and intelligent devices.

In recent years, the government has prioritised the securement of core technologies by disaster type for minimising damage as the primary national strategy. It pursues the development of countermeasure technologies through interagency cooperation in order to secure the continuity of people's lives against large-scale disasters with huge social and economic impacts.

R&D investments in ICT-converged risk management has been rising steadily in recent years. As of 2014, it took up 5.57 per cent of the Government's main R&D investment.

Table 28. Budget for Government's main R&D and disaster reduction R&D, 2014-2016

One hundred million Korean Wons, percentage

	2014	2015	2016	Total	Average Annual Growth Rate (AAGR)
Government's main R&D	121,135	129,350	128,822	378,822	-4.9
Disaster reduction R&D	5,880	6,371	7,150	19,401	10.3

Source: KISTEP (2016). The approach for ICT-converged disaster safety R&D in the era of the 4th Industrial Revolution.

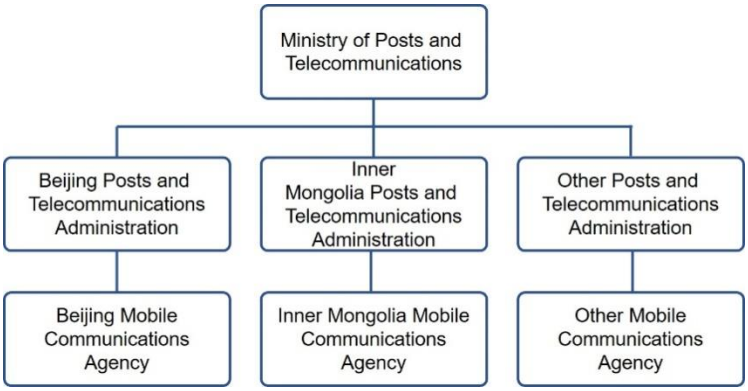
3. Disaster management through ICT

China

Emergency communication in China

Emergency communication in China originated from the Beijing Administration of Posts and Telecommunication during the integration of administration and management in 1969. The organisation was renamed as Beijing Administration of Standby Communications in 1990 and became the earliest professional emergency communication guarantee mechanism in China. Later, under the planning of the Ministry of Posts and Telecommunications, 12 administrations of standby communications were set up successively in Beijing, Shenyang, Hebei, Heilongjiang, Inner Mongolia, Shanghai, Guangdong, Fujian, Hubei, Sichuan, Anhui and Xinjiang under the administration of the Administration of Posts and Telecommunication of each province.

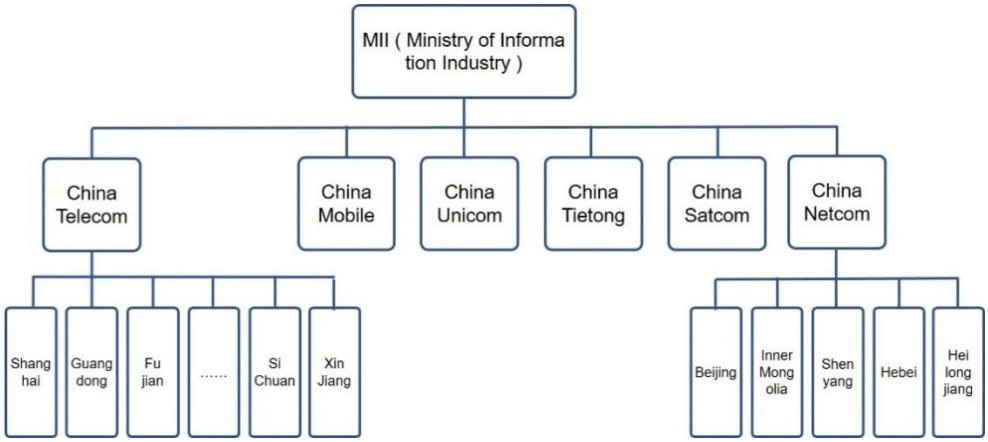
Figure 31. Emergency communication management structure before 1999



Source: ESCAP based on data from MIIT.

In May 2002, China Telecom was split into China Telecom in the south and China Netcom in the north. 7 out of the 12 administrations of standby communications were included in new China Telecom and 5 of them were included in China Netcom, indicating the start of a real business operation. While enterprises operate for profits, the administration of standby communications mainly undertake the universal service responsibilities and do not produce direct benefits for enterprises, and thus become the core of costs. In terms of corporate management, they become burdens to a company. Consequently, they were weakened by initiatives of their respective province (autonomous region, municipality), such as cancellation of departments, reduction of employees, lower the position levels, to "reduce burdens" of the company.

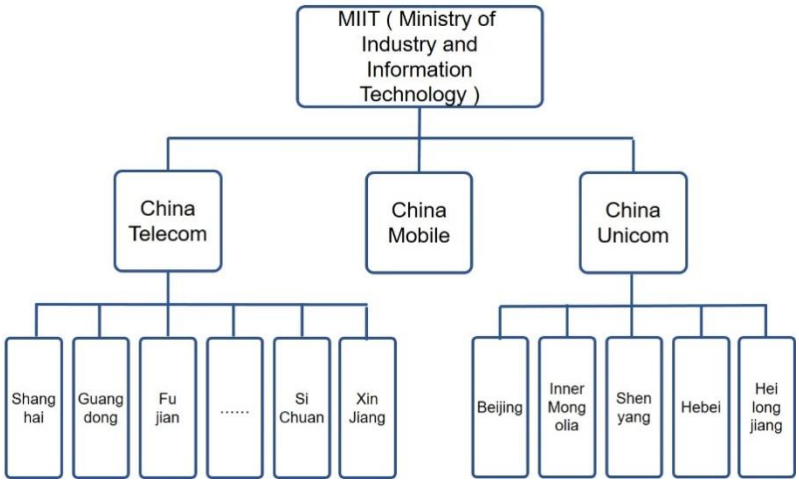
Figure 32. Emergency communication management structure, 1999-2008



Source: ESCAP based on data from MIIT.

With the deepened reform and reorganisation of telecommunications operators in May 2008, a new telecommunication market layout was established: China Telecom, China Unicom and China Mobile. The 7 administrations of standby communications under China Telecom remained unchanged and the 5 administrations of standby communications under China Netcom were transferred to China Unicom.

Figure 33. Emergency communication management structure from 2008



Source: ESCAP based on data from MIIT.

National Emergency Communication Management Structure

After the reform and restructuring in the telecommunications industry, and the separation of the government and enterprises, Chinese emergency communication security work has been mainly borne by the telecom operators and implemented by the public communication network resources. The equipment investment and labour costs were borne by the telecom operators themselves.

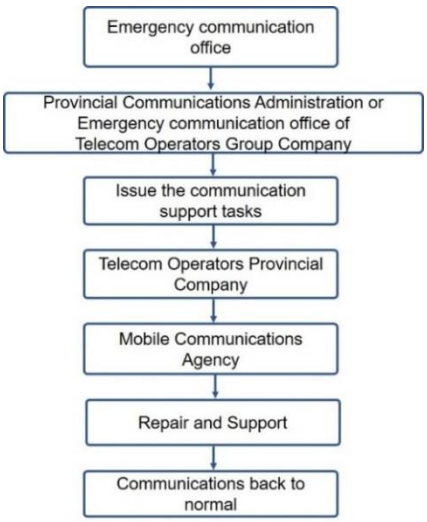
MIIT, administrations of provinces (autonomous regions, municipalities) and telecommunications operators all set up their own emergency communication management mechanisms. MIIT and administrations of provinces are administrative departments of emergency communications of China and each province. MIIT established an independent emergency communication management department which is led by a leadership who took dual responsibilities of a deputy minister and the Director of National Emergency Communications Office. The department's personnel allocation was strengthened with more than 5 full-time management personnel. Their functions include: management of daily and sudden emergency communications; formulation of national emergency communication plans, and revision and improvement of the plans according to emergency situations, teams and equipment; issuance of the notice of initiating Level I Emergency Response across provinces, autonomous regions and municipalities; organisation, coordination and supervision of emergency communication guarantee work, reporting to the State Council, and organisation and guidance cross-provincial, cross-operator emergency communication guarantee work; organisation of cross-operator allocation and distribution of emergency materials; and responsible for the implementation of national emergency communication plans.

Provincial administrations of emergency communications set up an emergency communication management office with no fewer than three personnel. Their functions include: management of daily emergency communications of the province; formulation and revision of provincial

emergency communication plans; issuance of information on emergency responses under Level II of the province; providing assistance to MIIT in organisation and dispatch of Level I Emergency Response; organisation of cross-operation allocation and distribution of emergency resources of the province; organisation, coordination and supervision of the emergency communication guarantee work of the province, reporting to MIIT, and responsible for emergency communication planning of the province.

Currently, telecommunications operators in China only have corporate and provincial emergency communication management mechanisms and none at municipal level. The process for implementing emergency communication guarantee is as follows:

Figure 34. **Emergency communication support implementation process**



Source: ESCAP based on data from MIIT.

National Emergency Communication Guarantee Plan

The National Emergency Communication Guarantee Plan ("the Plan") entered into effect on 10 December 2011. The Plan guides the emergency communication guarantee work of the country and applies to emergency communication for communication cut-off and sudden incidents which requires the coordination and authorisation by the State Council and other important emergency communication missions given by the CPC Central Committee and the State Council. The State Council establishes or authorises MIIT to set up the national emergency communication guarantee leading team to command and coordinate the emergency communication guarantee work of the country. A provincial emergency communication command mechanism can be set up by the provincial administration of telecommunications under the authorisation of the provincial government, a municipal or county emergency communication command mechanism can be set up by the local government under the provincial administration of telecommunications to organise and coordinate the emergency communication guarantee work of its administrative area. If

necessary, an on-site emergency communication command mechanism can be set up to undertake organization and coordination of on-site communication guarantee work.

According to the range of impact, the Plan classifies emergency communication warning into four levels: very severe (Level I), severe (Level II), medium (Level III) and common (Level IV), respectively tagged red, orange, yellow and blue. When a sign of failure or other incidents appear in telecommunication, through study and determination, if it may lead to large area communication cut-off in two or more provinces (autonomous regions, municipalities), the red warning will be initiated; if it may lead to large area communication cut-off in two or more cities in a province, the orange will be initiated; if it may lead to large area communication cut-off in two or more counties of a municipal city (prefecture), the yellow will be initiated; and if it may lead to large area communication cut-off in a county, the blue will be initiated. If no special conditions occur, the warning level can be adjusted according to actual situations.

Japan

Disaster forecasting and information delivery system

Since the 1950s along with the enactment of the Meteorological Service Act (1952) and the establishment of the Japan Meteorological Agency (JMA) (1956), Japan has made progress on institutional development for a meteorological system. From the mid-1960s to the mid-1980s, Japan developed the following nationwide monitoring and forecasting systems:

- Automated Data Editing and Switching System (ADESS), 1969
- Automated Meteorological Data Acquisition System (AMeDAS), 1974
- Geostationary Meteorological Satellite (GMS), 1977
- Nationwide radar network system for observation services (1954-1971)

Based on AMeDAS, GMS and radar networks, automation of local remote control and radio transmission became possible.

From the mid-1980s to the mid-2000s, Japan experienced the next phase of development by digitising many systems. Through nationwide computerisation of networks, it became practical to conduct regional remote control of the systems. The estimation and forecast of Quantitative precipitation was actualised. A typhoon track could also be forecasted for 48 to 72 hours. Furthermore, since the mid-2000s, through the advancement of the network, the centralised control of the operational systems has been available. Warnings have been able to be issued to about 1800 areas at the municipal level as well.

Since the occurrence of the Great Hanshin-Awaji Earthquake in 1995, each ministry and relevant agency has put greater efforts on constructing its independent disaster information management system that can collect and transmit information swiftly. Furthermore, to resolve the issue of

insufficient information sharing between respective systems set up by key entities, the Central Disaster Management Council established the Basic Policies for Improvement of Disaster Information Systems in 2003 with five specific objectives as follows:

(1) To guarantee the scope of information in terms of time and space;
(2) To construct a mechanism that enables better utilisation of information;
(3) To actively share information in normal times as preparation for emergency;
(4) To build up e-Government for disaster management; and
(5) To establish an integrated mechanism to promote the implementation of the information system.

Monitoring and warning systems by type of disaster are in operation, and below are examples explained in detail.

Earthquake and Tsunami

The JMA implemented an earthquake observation network and installed 200 seismometers and 600 seismic intensity meters to monitor earthquake and tsunami in real time. A seismometer is a tool used to monitor earthquake waves and to estimate the location of the epicentre and the magnitude of an earthquake, while a seismic intensity meter is used for measuring the seismic intensity of ground motion. JMA works together with the National Research Institute for Earth Science and Disaster Prevention (NIED) in terms of data analysis. NIED operates 800 high-sensitivity seismometers as well. Various seismic intensity data are gathered from 3,600 stations (as of April 2009) run by local governments and the NIED.

When an earthquake strikes, the Earthquake Early Warning (EEW) is issued immediately, analysing P-wave at seismometers close to the epicentre. Moreover, the EEW system can offer warnings of estimated seismic intensities in advance and expected arrival time of S-waves based on swift analysis of the hypocentre location. EEW messages are distributed automatically if the magnitude of the earthquake is estimated as 5.0 or beyond. To be more specific, below are the types of EEWs promptly issued as soon as the earthquake happens:

- Seismic Intensity Information: Issued within two minutes after the occurrence of an earthquake to offer information on the regions with seismic intensity of 3 or above;
- Earthquake Information: Issued within three minutes with the information of the location and magnitude of an earthquake determined; and
- Shake map: Issued right after the earthquake to provide the shaking-intensity map

In the meantime, when damage from a tsunami is expected, a warning with announcements about the estimated height and arrival time is issued from the JMA within two or three minutes after the earthquake occurs. The collected information is promptly shared with relevant disaster management entities and media outlets, and is then transmitted to residents and maritime vessels in affected zones. JMA operates about 70 tidal gauge stations (stilling-well type / acoustic type) and gathers sea-level data from about 170 stations (as of 2014). There are four main ways of

Tsunami observation: (1) tide gauge, (2) tsunami meter, (3) GPS buoy and (4) offshore-water-pressure gauge. In case of GPS buoys, they are installed offshore in order to detect tsunamis. At the same time, offshore-water-pressure gauges are situated further offshore to grasp a more accurate situation of a tsunami.

When the possibility of tsunami is estimated based on seismic observation data, a Tsunami Warning / Advisory is issued immediately (about two or three minutes after the strike of an earthquake) to all regions in potential danger. For a prompt issuance of warning, JMA possesses a great amount of information on expected tsunami arrival time and heights gained from the computer simulation that assumes earthquakes with various hypocentres and magnitudes.

Volcano

The 24-hour monitoring system is operated by the JMA through a network of seismometers, telephoto cameras and angle meters covering 110 active volcanoes throughout the country. Eruption warnings are issued in case that an eruption that can affect the caldera periphery or populated areas is expected. There are five volcano alert levels based on the status of volcano activity along with a detailed set of disaster countermeasures. In addition, JMA also forecasts volcanic ash dispersion and checks areas that can be affected by volcanic gas.

Storm and Flood

To offer accurate early warning services to the relevant entities, the JMA closely collaborates with the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). While the JMA focuses on gathering weather-relevant data, using the AMeDAS, weather radar and geostationary meteorological satellite that measure rainfall, air temperature and wind direction/speed, MLIT observes the rainfall and the water level of rivers by using visual observation methods, mechanical observation equipment, and a wireless telemeter system that enables automatic transmission of data from remote areas. Since 2001, the JMA and MLIT have included medium- and small-scale rivers into the scope of observation. As of 2015, more than 400 rivers were covered for flood warnings. Furthermore, observed data are provided to the public through Internet and mobile phone with risk levels.

Information issued by the JMA is delivered to regional and local governments, the media and all relevant disaster management agencies through various channels. Based on transmitted information, appropriate actions are swiftly taken by related entities for the public's safety.

Through these wireless networks, all public organisations linked together can communicate and transmit textual and visual data with each other in real time. Warning messages are broadcasted through TV, radio broadcasting, text and email, via below examples of early warning systems.

J-Alert

J-Alert is a satellite-based nationwide early warning system that activates multiple-address wireless communications systems of municipalities. The system is managed by the JMA and the Fire and Disaster Management Agency (FDMA), enabling local governments to send messages to residents on earthquake, tsunami and other emergency warnings. However, since 2009, the coverage scope of J-Alert has been limited to designated administrative agencies and public organisations.

Area Mail

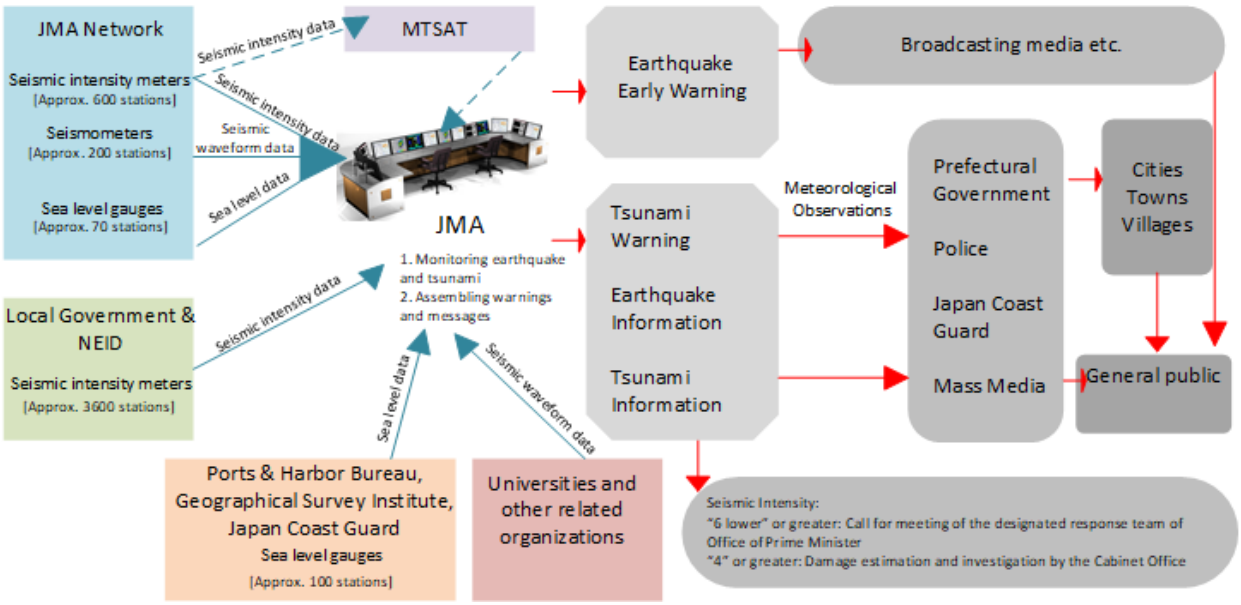
The Area Mail is one of the major nationwide early warning systems that transmit emergency disaster information simultaneously to all mobile users in the subject area covered by a specific base station. When the JMA produces emergency warnings, the national and local governments deliver evacuation information based on warnings to the Area mail centre of each mobile carrier which eventually sends text messages to the people. NTT Docomo, Inc., one of the major mobile carriers, decided to provide the services for free of charge to many municipalities and various organisations. As of 2012, more than 1,000 out of 1,800 municipalities have adopted the service. Area Mail is designed not to be affected by network congestion.

However, in the event of the Great East Japan Earthquake, the local governments in certain areas could not provide the Area Mail service due to the outages and disconnection of communications networks, which raised the issue of importance of preparing multiple resilient communications lines and back-up power sources.

L-Alert

L-Alert is the disaster information sharing system that converts information into various formats such as XHL and e-mail, and sends it to various communication companies. Main information providers are national and local governments and lifeline, and 299 municipalities are connected to this system. The system, using the cloud computing technology, enables the instant grasping of the disaster situation and the automatic transition of information into various formats, which reduces cost and the burden of data acquisition and distribution. The citizens can obtain all the necessary information through various forms of devices including digital television, radio, web, mobile phones, digital signage and car navigation. There is a backup server so that the system can be restored when any main server dies.

Figure 35. JMA's information gathering and dissemination



Source: Japan Meteorological Agency website. Earthquakes and Tsunamis. Available from http://www.jma.go.jp/jma/en/Activities/brochure_earthquake_and_tsunami.pdf.

The Great East Japan Earthquake has become a turning point for Japan to realise the necessity to build up more resilient ICT systems for effective disaster management within 72 hours of a disaster striking. Under the leadership of the MIC and relevant ministries, the country has put more emphasis on creating seamless ICT infrastructure in order to integrate collected disaster data and to disseminate them to the country's citizens through various media, without partial information access and information divide between regions. In the process of constructing seamless ICT infrastructure, the MIC encourages the active use of Social Networking Service (SNS), cloud computing, IoT and big data.

Communications system between disaster-related agencies

Central Disaster Prevention Radio Network

It is highly crucial to maintain seamless communications systems to take immediate actions against disasters based on accurate information. Generally, the disaster management radio communications networks have been used to offer disaster early warning information to residents throughout the country. The networks are operated exclusively for disaster risk mitigation, linking the JMA with public entities of disaster management.

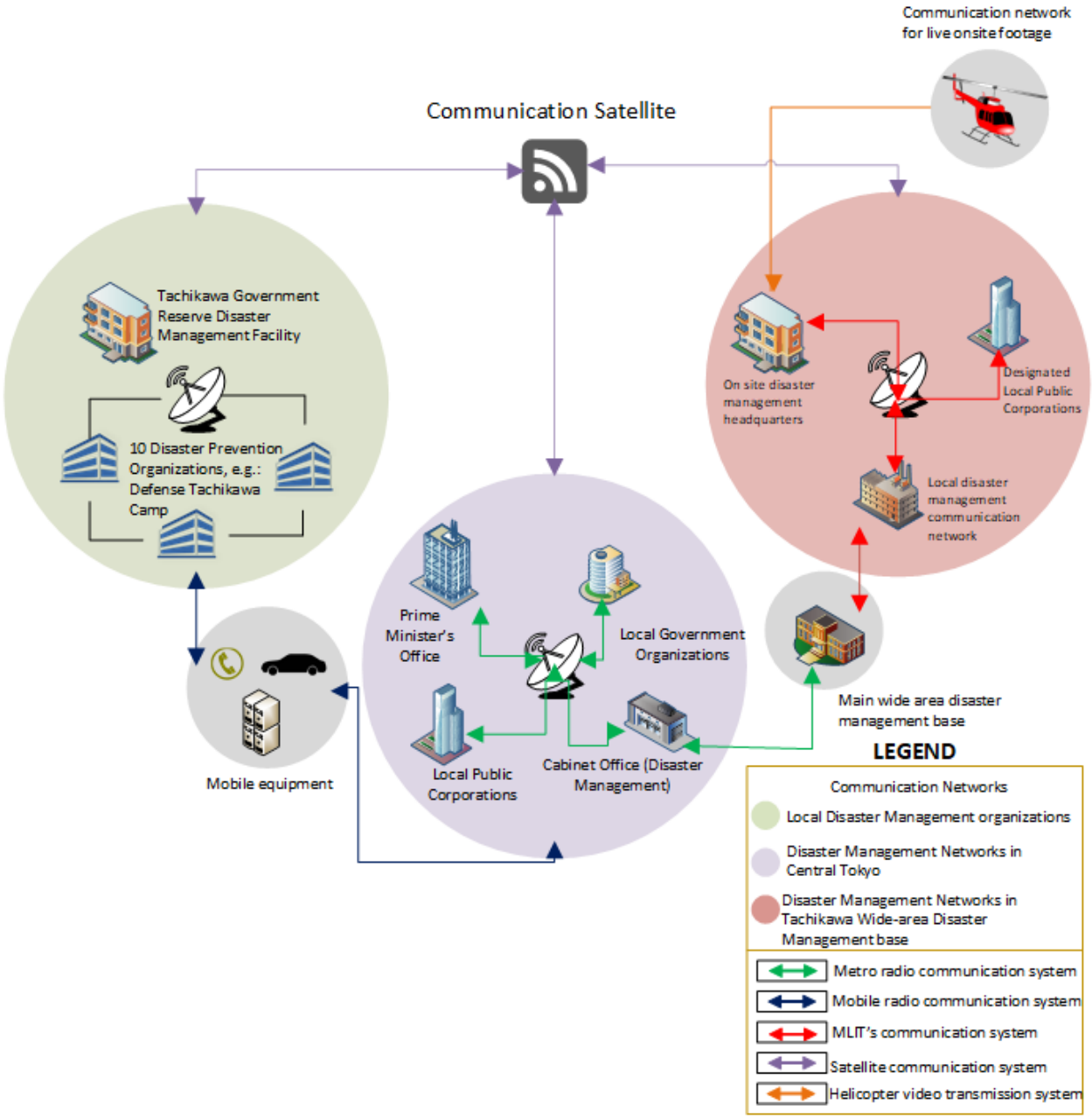
For this, the central disaster prevention radio networks are well constructed in Japan to exclusively deal with disasters as follows:

- The Cabinet Office's Disaster Prevention Radio Communication System: connecting national organisations
- The Fire Disaster Management Radio Communication System: connecting firefighting offices throughout the country

- The prefectural and municipal disaster management radio communications systems: connecting local disaster-related entities and residents

The radio communications network system is regarded as more viable than the fixed network system. Through these wireless networks, all public organisations linked together can communicate and transmit textual and visual data with each other in real time. People are able to receive warnings through TV, radio broadcasting and loudspeakers.

Figure 36. Communication system for disaster prevention



Source: Cabinet Office, Japan (2016). White Paper on Disaster Management in Japan 2016.

Under the radio communications mechanism, there are several types of satellite systems being used for emergency information sharing in a timely manner. Satellite communications systems can be deployed in any region in case land-based communications infrastructures are damaged.

Table 29. Satellite systems for emergency situations

Satellite systems	Services available
Satellite mobile phones	Voice and Internet communications services for people in communities isolated due to the impact from disasters
Very Small Aperture Terminals (VSATs)	VSATs serve as satellite ground stations that enable voice and Internet communications services; also used as portable and truck-mounted mobile phone base stations
Truck-mounted satellite earth stations	Enable video image transmissions from disaster sites to necessary organisations
Marine earth stations	Enable maritime rescue/recovery activities

Source: summarised by the author

Regional communications networks

There are also regional satellite communications networks for municipal disaster headquarters and on-site offices to effectively communicate with and share information. The networks work as supplementary communications tools for efficient sharing of various forms of data in times of crisis. There are mainly four types of transmission: 1) voice communications by satellite mobile phones, 2) digital transmission of images, 3) IP data transmission at 8,192Kbps and 4) transmission of data through connection lines which are distributed for each prefecture.

To facilitate disaster mitigation activities conducted by local governments, the Information Network for Disaster Prevention (INDiP) has been developed by the JMA. INDiP connects disaster related entities of the local governments with the JMA through the Internet, allowing them to exchange both textual and visual data. Via this network, each municipality is able to receive tailored information on natural phenomena. For maritime users, JMA delivers necessary information through NAVTEX broadcast service and the Safety-Net broadcast service using the maritime satellite, INMARSAT under the Global Maritime Distress and Safety System (GMDSS).

Republic of Korea

National Disaster Management System

Since 1997, the National Disaster Management System (NDMS) of the Republic of Korea has been constantly developed until 2014. The NDMS is a scientifically formulated information system which supports general disaster management activities by building a system to prevent dangerous factors from various disasters that hinder public safety and slow the Nation's response to the emergency situation and to support damage repair. The NDMS consists of a central system, controlled at the MPSS, with local systems installed in 16 cities and provinces nationwide. The NDMS includes the system for data collection from the Korea Meteorological Administration (KMA) and Food Control Offices (FCO), which are located along major rivers. The central system collects data from the 16 cities and provinces and constructs an integrated information database.

NDMS is a comprehensive disaster information system for disaster prevention, preparedness, response and recovery.

Table 30. Key functions and roles of the NDMS

Classification		Function
Prevention and Preparation	**Facilities Management**	Consists of disaster prevention facility management, management of accommodation facilities for evacuation purposes, CCTV management installed for disaster preparation in local self-governing entities, etc. Manages of basic information about each facility, inspection, maintenance, and photographs of facilities that have disaster hazard factors during the preparation period.
	Resource Management	Consists of the management of emergency repair equipment capable of prompt input in disastrous situations, flood prevention equipment, the occurrence of contagious diseases, invasion, disease prevention resources, and relief supplies management. Manages information regarding saving locations and the plan preparation record for each resource.
	Special Facilities Management	Manages facilities and locations due to disaster hazard grade and disaster prevention. Facilities are sorted by danger grade. Each facility is managed in disaster management offices by the person in charge and incorporates a disaster preparation system, safety inspection and action, repair history, the plan to reduce the dangers in the long and short terms, and facility photographs.
	Regional Management	Consists of management in disaster hazard districts due to geography, landslide hazard districts, large construction areas, isolation hazard districts, and dangerous districts.
	Web GIS	Indicates conditional and photographic information regarding prevention and preparation facilities/ GIS resources.
Response Management	**Damage situation Management**	Involves the prompt electronic reporting of the damage situation by the concerned municipal district managers when a disaster occurs. Based on this report, the central government and the city state are able to aggregate the amount of damages in due time and are able to provide support for the appropriate responses.
	Electronic Situation Board	Supports the prompt circumstantial understanding and decision-making of the central/city-state/municipal district when a disaster occurs. Supports prompt response by showing various interrelated disaster information on the GIS situation board.
Repair Management	**Repair Plan Management**	Supports the calculation of the repair fund of each afflicted city-state and municipal district by automatically receiving damage data input from the damage situation management system. For more precise calculation of the repair fund, facilities are classified into public and private sectors, and the facility ranks are segmented by each responsible office.
	Repair Progress Management	Supports organised repair by continuously monitoring and managing the utilisation of the repair fund and monitoring the progress of the repair. To manage this progress, all repair-related information are managed and classified by region and facility character, and through various forms of the automatic output and the report function.
	Damage Report on Private Asset	Report is utilised to provide a support package for private damages by integrating and ranking whole private damages. Farmers and fishermen may report the amount of damages wrought by a natural disaster in a document. The report is investigated by the responsible officials of the municipal district and is then confirmed by the city-state officials.

Source: Merged from National Emergency Management Agency (2009); Disaster Management System and Status Control System of Korea and MPSS (2016); and National Safety White Paper.

In addition, there is the dedicated satellite network system which is being managed through the Ku-band using KOREASAT-5 (Mugunghwa) for the purpose of real-time monitoring of disaster areas throughout the country.

Disaster forecasting and information delivery system

Disaster Forecasting System

The Republic of Korea has been experiencing frequent regional torrential rains, which is a serious issue for the country. Regional torrential rains often result in serious disasters such as flash floods in both urban and mountainous areas. The NDMI established a plan to estimate flash floods that occurred within the past three hours; and to operate an early warning system that starts operation 40 minutes before a flooding event take its toll. The KMA and the FCO are parts of major data providers to NDMS. Throughout this operating process, risk factors have been identified so that realistic prevention and mitigation measures could be implemented. For example, the Flash Flood Forecasting System (FFFS) is able to forecast rainfall for up to three hours based on real-time weather data on 4,272 unit basins. The FFFS can identify disaster-prone areas and monitor rainfall in those areas. The accuracy of measured data is checked by a separate specialised system where warning criteria are regularly checked.

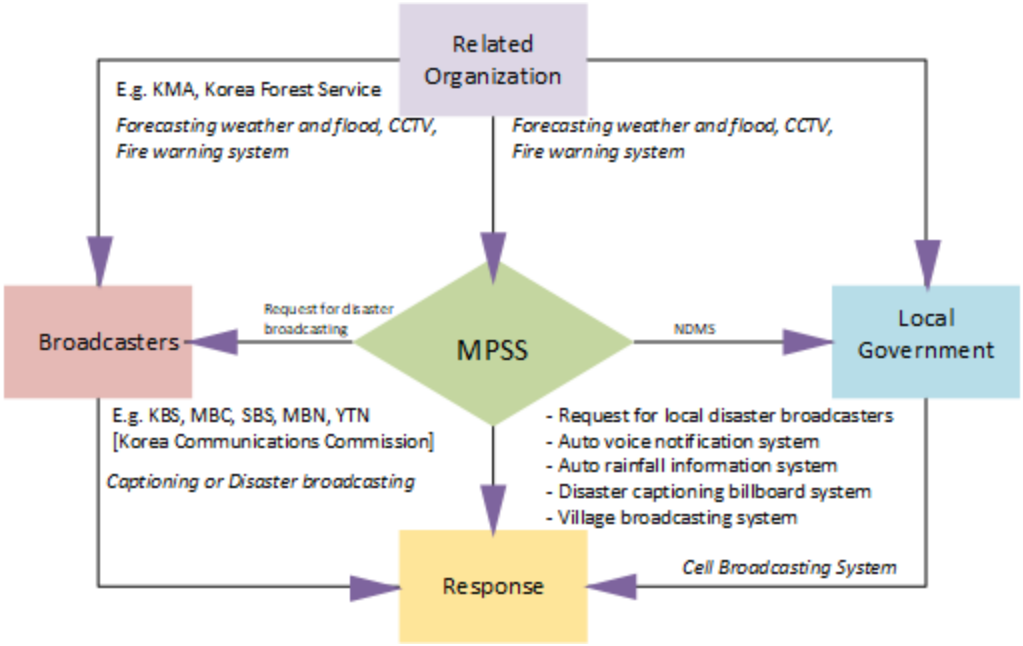
In 2006, the Frequency Analysis of Rainfall Data Programme (FARD) was developed by NDMI to study regional rainfall frequency. The programme is easy to use and suitable for working-level officials. Data of the 38-year long series of maximum daily and hourly precipitation are included as inputs into the FARD system. The programme consists of a test of randomness, parameter estimation of probability distribution functions, suitability tests and an estimation of probable rainfall.

In 2006, the Typhoon Committee Disaster Information System (TCDIS) was established as an efficient data-sharing tool for various cyclone-related disasters in partnership with members of the Working Group on Disaster Risk Reduction (WGDRR). The system has prediction, survey, and recovery support functions through establishing database of typhoon trajectory, damage and precipitation information. It contributes to cyclone-related disaster risk reduction by promoting a timely and efficient way of communicating information through its website.

Disaster Warning System

The Disaster Status Control Centre of the MPSS plays a role as a control tower to diffuse all kinds of disaster-related information collected through the NDMS from the KMA, the FCO and others to local governments and relevant entities (see figure 37). Through the Cell Broadcasting System (CBS), warning messages are transmitted to the public in real-time. The control centre also requests disaster broadcasting to all broadcasters.

Figure 37. Disaster information delivery system



Source: Redesigned based on Oh, Kuk Ryul & Chang Hee Lee (2014). A Study on Building Public Broadcast System for Disaster. Journal of Korean Society of Hazard Mitigation.

Disaster information is delivered to the public through six main channels as follows:

Table 31. Channels of disaster information delivery

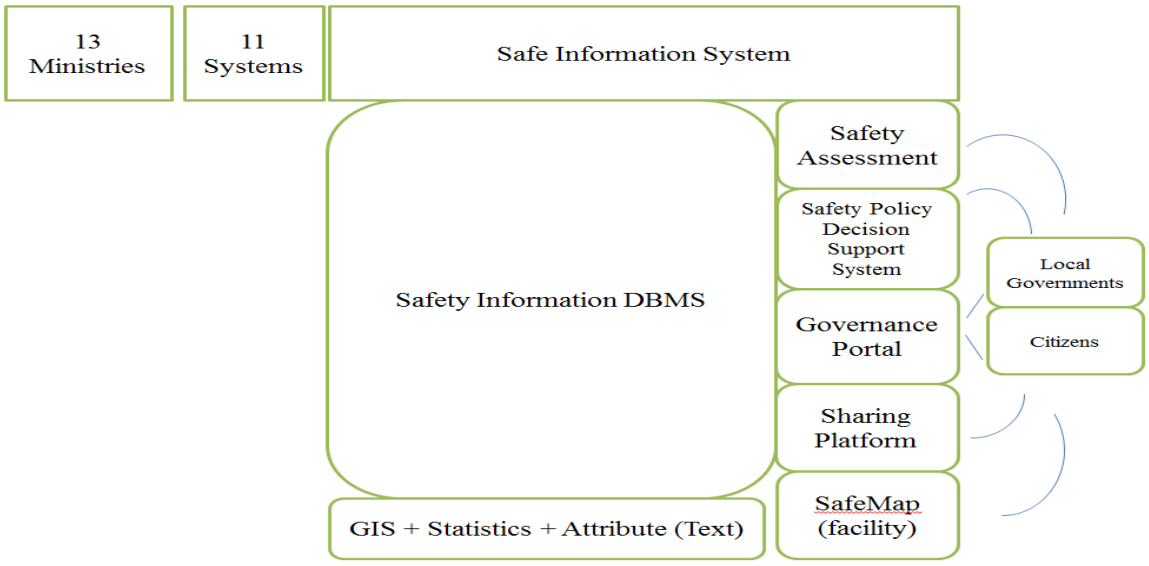
Equipment/ system	Installation set	Target for info.	Alert method
CBS Mobile-Phone Disaster Notification Message Broadcasting System	(Mobile phone users)	Mobile phone users	Message broadcasting (Mobile phone)
Automatic Verbal (Text) Notification System	234 set nationwide	Civil official, head of government offices and specific regional residents – about 550,000 people	Guidance-information broadcasting (Wired- and mobile phones, etc.)
Automatic Rainfall Warning System	148 set nationwide	Valley, Mountain, Public places, holiday-makers, campers, etc.	Warn-alarming, guidance-information broadcasting
Disaster Notification Board System	299 set nationwide	The specific regional residents, holiday-makers, etc.	Propagation and notification of disaster by wording through electronic board
TV Disaster Warning Broadcasting System	3997 set nationwide	Disaster Prevention & Countermeasures Headquarters at each local province and each regional administrative office and its related institutes	Auto TV Power-On, Volume-Up, broadcasting the situation
Radio Disaster Warning Broadcasting System	5 areas	Residents, Holiday-makers, etc.	Auto Audio Amp Power-On, Alarming and Guidance-information broadcasting

Source: National Emergency Management Agency (2009). National Disaster Management System in Korea.

Integrated Disaster and Safety Information System

In recent years, there has been a high demand for a pan-governmental integrated information system for disaster and safety in order to cope with various disaster situations. It was necessary for the government to have a more systematic structure to share and diffuse information with partner entities as the forms of disasters became significantly diverse and complex. Accordingly, the government has been working on the mid-and long-term informatization master plan on a scale of investment of around KRW 40 billion (as of June 2017) to reshuffle the NDMS and to establish the collaborative governance for comprehensive disaster management (MPSS, 2016b). In 2015, the disaster management system which had been constructed and managed respectively by each ministry based on the form of a disaster was restructured into three portals: (a) Disaster management business portal, (b) Mobile disaster management portal, and (c) Public disaster and safety portal.

Figure 38. Safety information system architecture



Source: MPSS (2016). National Safety White Paper.

4. Resilient ICT against major disasters

China

To strengthen the management of communication network security and improve the ability of communication network security protection, the Communication Network Security Protection Measures was published on 1 March 2010. The Measures focuses mainly on the network security protection for preventing the interruption, congestion and illegal control of communication network and for preventing the loss, leak or tampering of data in the communication network.

The Supervision and Management Method of Telecommunication Network Operation has been issued by the Department of Telecommunication Administration of MIIT in May 2009. It is mainly used by MIIT and the provincial telecommunication administrations for activities such as supervision of the network operation and maintenance, network operation safety, production safety, prevention and reporting.

Technologies for resilient ICT infrastructures

Network security is an important issue in the telecommunications industry. Telecom operators ensure network operation safety mainly by strategically managing their network structure.

In recent years, the telecom operators have gradually enriched the fibre optic cable routing. The provincial transmission network and transmission network within the province should mainly be in lattice mesh structure. The provincial backbone fibre optic cable routing nodes should have three or more different cable routing exports. The backbone nodes within the provinces and cities, and the sink nodes should have two different cable routing exports. If the network failure happens in one direction, then the other routing direction could be used as a backup.

The basic principle of safe distribution of business circuit is to distribute the business load according to the different physical routing, different transmission system and different branch board, to avoid the failure of a single point resulting in the circuit failure. For the purposes of optimising the network structure, it is required to distribute the business load or avoid network node according to practical situation.

Financing mechanisms for building resilient ICT infrastructures

Funds are the foundation and prerequisite to support the improvement of emergency communication guarantee level and capabilities. However, due to the segmented administration and market competition, telecommunications operators usually focus on return on investment for the investments in emergency communications. Their investments in emergency communications is used for the maintenance and recovery of their own communication networks under normal conditions, while investment of funds in emergency communication guarantee is limited, causing long-term insufficient investments for emergency communications. Currently, the government puts less investment in emergency communication guarantee and has not established special funds for emergency communication. The fund guarantee channels are limited and there is no long-term mechanism for raising funds for guaranteeing emergency communications.

Governmental Platform Project for the Emergency Command System of the National Communication Network

The Government Platform Project for the Emergency Command System of the National Communication Network ("the Emergency Platform") is a key project of the national emergency communications. It is comprised of three levels of commands systems, including the Ministry of

Construction, provincial administration of communications of 31 provinces (autonomous regions, municipalities) and on-site command systems, and extends to telecommunications operators, and is equipped with functions as command, network operation monitoring, video conference, image transmission, analysis and decision-making. With the joint efforts, bidding, environmental reconstruction and system integration for ministerial and provincial command centres, construction of emergency command cars, and development of application software have been accomplished. Currently, the ministerial command centre, 31 provincial command centres, ministerial emergency command car, 31 provincial emergency command cars have been accomplished; the comprehensive application system has been deployed; interconnection between the ministerial command centre and provincial command centres has been implemented; the construction of the main body of the Emergency Platform has been accomplished and will be put into operation, which will greatly increase the level of emergency communication command and response speed of China and enhance the communication guarantee capability in sudden incidents and major events.

National Emergency Communication Capacity Enhancement Project

To improve the construction of emergency communication guarantee capability, the Framework also defines the National Emergency Communication Capacity Enhancement Project for improving the emergency communication capabilities. The project's objective is to strengthen the constructions of the command and dispatch, emergency communication networks, and equipment reserve, implement pilot operation support, improve the emergency communication guarantee capabilities of the country in an all-round way.

Table 32. Objectives of the National Emergency Communication Capacity Enhancement Project

1. Enhance the command and dispatch ability, realise the interconnection between local command systems and the command platform of the communication network, complete the allocation of mobile terminals for county and town governments in areas that are frequently stricken by natural disasters, and build the "Internet plus emergency communication" command and service cloud platform.
2. Improve the construction of emergency communication networks, set up the quick warning messaging system relying on public networks, promote the construction of super base stations, infrastructure and safety and protection facilities related to disaster relief, and build the emergency private satellite communication network relying on the national space infrastructure and satellite mobile communication systems.
3. Strengthen the construction of equipment reserves, update and consummate portable and car/ship/airplane carrying emergency communication equipment, promote the pilot use of drones, build the layered emergency communication reserve centre system, and realise unified management of reserves of important materials and equipment.
4. Provide supports to pilot use, develop pilot construction for emergency broadband cluster networks, portable equipment and Internet emergency information and communication technologies, and build the national supporting base for emergency communication technologies.

Source: General Office of the State Council of China (2016). National Natural Disaster Response Framework (Guo Ban Han (2016) No. 25).

Japan

Government efforts to formulate initiatives on resilient communications

Telecommunication networks play an essential role in times of disasters as a means of seamless communications for sharing real-time information between relevant entities and for ensuring the public's safety. They have been deeply deployed throughout the region, interconnecting all sectors of society. For effective disaster risk management, it is indispensable for the country to strengthen resilience of telecommunications infrastructures against the strike from disasters, in close partnership between public and private sectors.

Japan encountered massive damage on telecommunications due to the Great East Japan Earthquake in 2011. One of the most serious situations that the country has experienced during and after the earthquake was the suspension and restriction of network operation. Most of network infrastructures were destroyed and power outages were caused when the tsunami struck. 6,300 km of coastal- and aerial cables were damaged and 90 transmission routes were cut off. At the same time, around 65,000 utility poles in coastal areas were broken. While about 1.9 million subscriber lines were badly affected, around approximately 29,000 base stations stopped functioning as well due to electrical blackouts. Meanwhile, a rapid increase in phone calls during the disaster resulted in significant network congestion. More than 70 per cent of fixed-line- and mobile calls were restricted for several days, hindering people to let loved ones know that they were unharmed. Moreover, without viable backup systems, a great portion of networks had to be rebuilt after the tsunami hit. The loss of function made the proper rescue activities difficult and left people without access to necessary information. The aftermath of the earthquake presented the momentum for the government to step up efforts to develop technologies that enable networks to be viable during times of disaster.

In December 2011, a study group was formulated by the MIC to discuss how seamless communications can be maintained without being disrupted by impacts from large-scale disasters. Based on the lessons from the Great East Japan Earthquake, the MIC sought to formulate initiatives on resilient communication infrastructure to prevent repeating the same aftereffects.

The study group suggested redesigning the switching equipment to improve the capability of voice calls. Based on the Regulations for Telecommunications Facilities for Telecommunications Business, emergency priority calls, managed by many carriers, are given priority. However, during the earthquake in 2011, the final call ratio was not enough partially due to the base station being damaged. Utilisation of the LTE network was discussed to cope with the increasing volume of traffic in states of emergency and to facilitate data transmission. Moreover, by limiting the length of calls in times of disaster, it is predicted that a greater number of calls can be possible with lessened congestion. At the same time, the study group highlighted the importance of developing new technologies on data storage and information delivery to improve congestion-resistance of networks.

In addition, it was encouraged to improve the capability of means of communications in times of urgency such as text messaging, email, storage-type media and others to avoid congestion of voice calls. There have been three types of emergency message services in Japan: emergency voicemail hotlines, Internet message boards and mobile phone message boards. However, there has been an issue of linkage between three services that enable cross-services. Measures to link services remain as the tasks that the country should work on.

Once telecommunications infrastructures are damaged in the event of disaster, there were significant costs to repair them as quickly as possible. As stated above, a great number of bases- and local stations were badly affected. To prevent the recurrence of the same situation, the country makes efforts to deploy portable compact base stations based on femtocell networks. Telecommunications operators including the NTT East have been putting efforts in installing equipment necessary for emergency repairs and deploying additional mobile base stations at the same time. Transmission routes were exposed as being too fragile against the earthquake in 2011. The utilisation of satellite circuits and fixed micro-lines has been encouraged to ensure the resilience of both transmission routes that give a direct influence to the function of subscriber lines.

Following the earthquake, telecommunications operators distributed mobile phone handsets, satellite phone units and others in disaster-affected areas and evacuation centres. To enable people in evacuation centres to use the Internet, public wireless LAN was provided for free. The MIC also procured around 300 mobile satellite phones and expanded the number of satellite terminals.

To facilitate the deployment of disaster resilient wireless communications systems, the MIC designed the plans for the Development of an Environment for Realization of Innovative Community Development Employing ICT and for the Research and Development for a Disaster-Resistant Satellite Communications Network to develop a viable sensor network-, cloud service- and wireless network technologies as part of the FY2012 draft budget.

Past experience emphasised the necessity for ensuring emergency backup power generators against the long-term electric blackout of telecommunications facilities. To prevent the base station blackouts, all telecommunications carriers planned to install backup generators and deploy batteries that can power base stations for at least 24 hours in around 2,000 areas throughout the country, in partnership with the IP Network Facilities Committee.

The active use of cloud services can be regarded as another one of the government's efforts to protect public data and to flexibly maintain administrative operations without being disrupted by the disaster. By establishing the Local Government Cloud Promotion Headquarters in 2011, the MIC supported local governments to establish cloud systems that enable reliable administrative functions through advanced interoperability.

R&D for ICT resilience

Based on the lessons from the Great East Japan Earthquake in 2011, the country established the Disaster Resistant ICT Research in 2014 under the National Institute of Information and Communication Technology (NICT) to provide a basis for advanced research and development for resilient information and communications networks in close partnership with government, academia and private sector.

The centre has been providing test-bed functions of three main R&D themes, which are (a) improving resistant satellite and wireless mesh networks that enable seamless communication in disaster-afflicted or isolated areas; (b) building optical network infrastructures that can protect significant communication line in the event of a disaster; and (c) developing information distribution infrastructure that helps the relevant entities take appropriate countermeasures based on data collected and distributed through sensor networks.

MDRU (Movable and Deployable ICT Resource Unit)

MDRUs are movable and deployable ICT units for communications in times of disasters in order to secure communications networks in affected areas. They are in forms of a container, vehicle or boxes in different sizes, loaded with communications devices and information processing and storage devices. These units serve as temporary telephone or communications infrastructure in disaster-afflicted areas right after the occurrence of a disaster. Wi-Fi is usable within a radius of 500m from the location of MDRUs so that many terminal devices can use the system to grasp the disaster situations. MDRUs utilise various communications lines including satellite and surviving fibre optic lines. Some MDRUs are equipped with solar panels that can be run for around a week without external power sources. They can be used for seamless communications between disaster headquarters and disaster spots. In 2014, NTT group and Tohoku University co-developed a vehicle named ICT car that is capable of recovering communications within one or two hours after a disaster strikes.

Resilient Fibre optic networks

Fibre optic networks are deployed in most communication facilities either in buried or overhead form. When large-scale disaster strikes, physical damage to fibre optic networks can create communication failures and congestion. This malfunction presents severe obstruction of information sharing and communication in the process of rescue and recovery from a disaster. On a premise that a certain level of physical damage is inevitable, the country has been developing ways to minimise the physical impact through strengthening resilience by focusing on two themes, namely (a) damage control technologies and (b) emergency rehabilitation technologies under the leadership of NICT.

As one of the damage control technologies, the NICT has been developing an Optical Packet and Path Integrated (OPCI), which is the integration between conventional technologies and optical packet switching. While optical paths guarantee bandwidth, optical packets are for services with lower-cost and best-effort quality. In ordinary times, optical paths and optical packets are each

allocated to separate wavelengths. However, in times of a disaster, the traffic increases rapidly so that it is necessary to maximize utilisation of the network regardless of the quality. In response to this situation, the allocation is promptly switched, which enables the optical network to accommodate more users without being obstructed by congestion. This emergency operation mode of OPCI-node increases wavelength resources and secures significant communication lines through mitigating congestion.

There are three key themes of technologies for emergency rehabilitation, namely (a) temporary recovery of regional fibre optic-networks, (b) automatic reallocation of network addresses, and (c) reconnection of torn fibre optic links. NICT has strived to find ways to recover damaged regional networks by developing a control layer middleware and the temporary networks that enables interconnectivity between regional networks without the change of optical communication device specifications.

It is expected that a hierarchical IP address allocation technology (named HANA) can enable automatic reallocation of network addresses by maintaining high-order prefixes and low-order suffixes of IP addresses independently. Thus, when high-order prefixes stop working, allocation of low-order suffixes can be maintained as alternative routes.

NICT has devised a portable optical amplifier for emergency reconnection of fibre optic links in harsh environments where vehicles cannot get access to and power is barely supplied. The reply function is mostly lost due to a physical impact afflicted to the buildings, which obstructs optical signals to proceed properly. With a long-lasting battery, the amplifier provides 1-R Repeat (light amplification) at the relay point where the disconnected fibre optic links can be recovered.

Resilient wireless network systems

In the event of a disaster, it is important to protect wireless network systems against communication disruption. NICT has established a disaster-resilient wireless network in the Miyagi Prefecture as the testbed that enables a national emergency communications drill. With four designated bases, this network creates mesh-like wireless connection which allows communication lines to function without being affected by some damage.

In addition, a Wide-band Inter-Networking engineering test and Demonstration Satellite (WINDS) has been used to demonstrate satellite channels that can be operated even with existing communications infrastructure interrupted in case of an earthquake. In this process, the Miyagi mobile assessment system was used to electronically collect data on various environments at simulated shelters and transmit them to the WINDS earth stations.

Republic of Korea

Korea Safe-Net

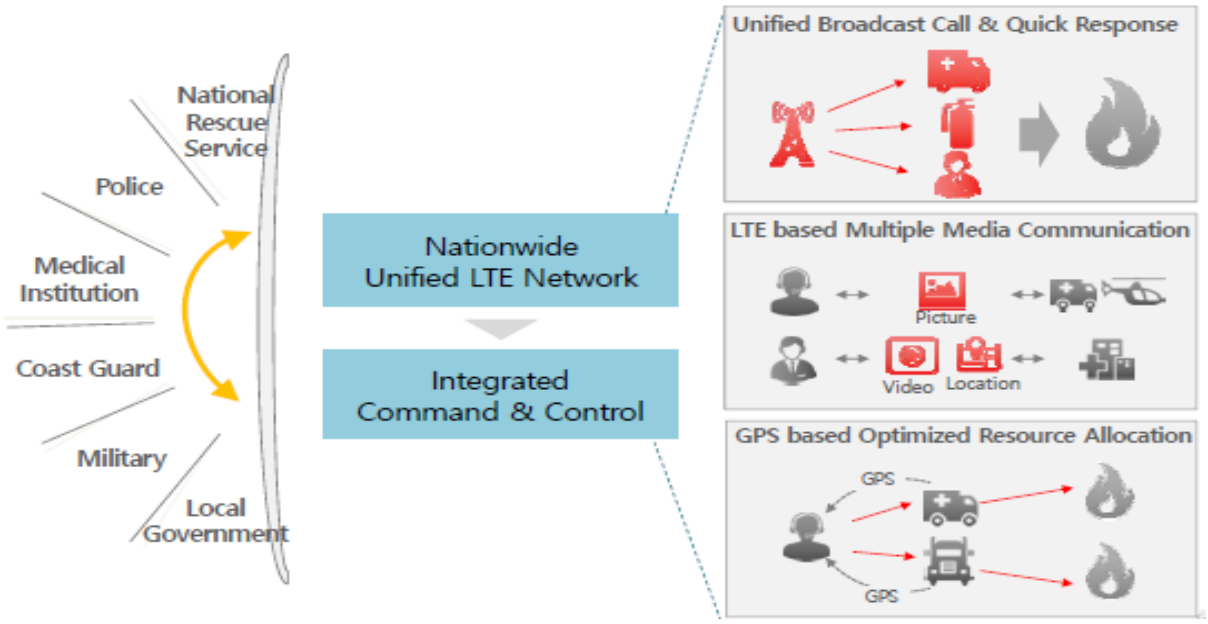
Given the failure to establish an integrated wireless network in the early 2000s, the government developed and implemented an integrated wireless communication network in the form of Digital Trunked Radio System (TRS) from 2005 to avoid the duplication of investment and to have a unified command structure between dispatched staff from different agencies at a disaster site. However, it eventually ended up as a failure in 2008 due to various reasons such as the monopolistic supply system, insufficiency of economic feasibility, the lack of interoperability between different systems and voice communication-oriented methods.

Following the failure stated above, the government re-initiated its plan to construct the nationwide safety network from 2014 by granting major roles to the MSIP (selection of the next generation technology solution, provision of frequency) and MSPA (implementing the plan). After it was decided to use LTE based technology (called PS (Public Safety)-LTE) and 700MHz in September 2014, the Information Strategy Planning (ISP) which includes Standard Operation Protocol (SOP) was completed by October 2015.

The Republic of Korea's Safe-Net is a specialised nationwide unified network that will be utilised for public safety activities including not only usual duties and prevention services but also integrated command, control and assistance among all agencies in disasters. Through the technology of PS-LTE, multimedia and GIS data can be transmitted in real time to be used for relief operations. The Safe-Net is expected to be used by 330 agencies in 8 departments, namely National Rescue; Police; Coast Guard; Military; Local Government; Medical facilities; Electricity providers; and Gas providers.

In order to verify the effectiveness of PS-LTE technologies, the Pilot project has been implemented from November 2015 to June 2016 and includes two sub-projects in parallel. The government has invested KRW 43.6 billion (USD 37 million) on these projects. KT was chosen as the first operator for the construction of a network in PyeongChang and Seoul, while SKT was in charge of the GangNeung and JungSun areas as the second operator. After the completion of the Pilot Project, the Government has launched its plan to construct a nationwide network by the end of 2019.

Figure 39. Structure of the Safe-Net



Source: MPSS (2016). Korea Safe-Net based on ICT.

In usual situations, the Safe-Net conducts seven main duties as follows:

- Fire and Rescue: facilities information, routing
- Police: security screening, CCTV
- Coast Guard: ship information inquiry
- Integrated Defense: Joint military service
- Safety management: inspection record and registration
- Medical: remote diagnosis, patient record
- Electric/Gas: Remote monitoring

In emergency situations, the network is designed to undertake the following functions:

- Rapid situation assessment: video of site, GPS information, simultaneous propagation of the situation
- Simultaneous command: management of communication groups
- Integrated control: Group call, emergency call
- Cooperation between agencies: video conference, resource requests

Communication failure management system

The Framework Act on Telecommunications stipulates that the Emergency Communication Countermeasures Headquarters should be operated under the leadership of the Minister of MSIP for comprehensive government-led actions in case of a large-scale communication failure; and the Emergency Communication Countermeasures Situation Room is required to be managed in case of a regional level of communication disruption. The major roles of the headquarters are: (a) the emergent recovery of communications in major telecommunications service providers; (b)

mobilization of necessary facilities; and (C) roles and assignments of major telecommunications carriers and others. Below are the major roles and activities of relevant agencies for managing communication problems.

Table 33. The major roles and activities of relevant agencies for managing communication disruption

Classification		Main function
Communication failure management agency	Ministry of Science, ICT and Future Planning	Communication failure management (on a national level)
	National Information Society Agency	Construction and operation of the communication failure management system
	Central Radio Management Office	Communication failure management (on a local level)
	Telecom operators	Communication failure management
Disaster management agency	Ministry of Public Safety and Security	
	Ministry of the Interior	
	National Security Council	
Disaster-related agency	Korea Meteorological Administration	Provision of weather information
	Korea Electric Power Corporation	Provision of information on power failure
	Korea Red Cross	Provision of information on the victims

Source: Lee, Joo Ho (2011). Analyzing the Emergency Traffic for Crisis and Emergency Management in Korea and USA.

Technical specification for resilient ICT infrastructure

Article 22 and 27 of the Regulation on Technical Specifications for Broadcasting and Telecommunications Facilities, enacted by the National Radio Research Agency (partial amendment on 2 June 2016), are relevant to the provision of stable and reliable telecommunications services. The regulation outlines the construction standards to ensure telecommunications facilities to provide non-disruptive services in the event of unexpected accidents or disasters.

In preparation for the malfunctioning of a connection or system between two major communication stations, a roundabout connection system should be prepared with alternative switching networks that pass through other communications stations. At the same time, facilities require multiple transmission lines with different geographical routes. Also, broadcasting and telecommunication lines should be dispersed to prevent imbalanced communication traffic. When it is difficult to fully rely on key facilities, it is required to install reserve facilities that can be called upon to bridge any communication gap.

When outdoor facilities are installed in the area susceptible to flood damage, flood control measures are necessary as follows:

- Establish a separate concrete ground plate in case of installation in the areas with weak sedimentary layers; and
- Install a protective wall or guardrail between the outdoor facility and mountainsides in case the facility is constructed more than two meters lower than surrounding grounds.

The regulation requires the telecommunications facilities to be constructed in the areas where there is not much influence from storm and flood damage and electromagnetic interference. Moreover, the locations should be those that are the least affected by vibration from surrounding areas. Machine rooms have to be exclusively built with resilient interior materials not to be influenced by accidents.

In terms of data management, the facility should be equipped with secondary storage so that key data can be restored in case of destruction. In addition, essential data is kept in special archives with fire prevention equipment. In preparation for malfunction from disasters, alternative cables must be prepared for emergency recovery. When errors occur in mobile base stations, it should be possible to use communications circuits through mobile base stations. Regulation has been reinforced in the Republic of Korea as the frequency of serious natural disasters has increased. In 2007, the telecommunications facilities under the Basic Law of Telecommunication were also required to be earthquake-resistant under the protection law against natural disasters.

Chapter 3. Conclusion

This report was developed to respond to calls from ESCAP member countries to analyze the elements of broadband policies, regulations, initiatives and programmes of China, Japan and the Republic of Korea which enabled their broadband network development. The report also aimed to identify elements which helped distinguish these three countries as global leaders in broadband development and which help replicate to other countries and contexts across the region. The elements identified in this report are by no means exhaustive or comprehensive, but aimed to explain the contexts and reasons why certain policies, regulations and programmes were introduced.

In this concluding chapter, the report findings are summarized into two inter-linked categories of broadband development and e-resilience.

Broadband development

The above chapters illustrated the pathways China, Japan and the Republic of Korea have taken in developing broadband networks in the specific country contexts. The pathways included policies, regulations, institutional setups, programmes and initiatives which form the broadly defined broadband ecosystems. The development of dynamically evolving broadband ecosystem has evidently enabled the three countries to develop broadband networks, inclusive broadband access and usage for socioeconomic development and become the global leaders in respective areas.

In addition to the broadband ecosystem as a while, the elements of the ecosystem may be of interest to the ESCAP member countries. The report identified well-functioning and effective financing mechanisms as a driving force behind the rapid expansion of broadband networks, supported by encouraging competition and fair and transparent regulations in particular infrastructure sharing and co-deployment. Targeted interventions and programmes to develop institutional and individual capacity also helped accelerate the expansion of demand for services and usage.

E-resilience

In parallel to the broadband development, it is noted that China, Japan and the Republic of Korea are prone to natural hazards which damage broadband infrastructure and disrupt services. As the dependency on broadband services deepens, how to protect the broadband networks as a critical infrastructure and ensure 24/7 services at a time of disasters have become a critical imperative in society, based on the experiences from major disasters.

After going through a series of structural reforms, the countries have experienced a huge improvement from the aspect of the disaster management based on the lessons learnt from the previous disaster management mistakes. At the same time, along with the growing importance of ICT resilience, the countries have been seeking to design more concrete safety strategies to

maximize the use of ICT for disaster risk mitigation and to strengthen the resilience of ICT infrastructure. From these objectives, diversified approaches have been explored to develop new viable technologies that can be practically applied to disaster management.

Despite the current positive outcomes that the countries have achieved so far, there are still some suggestions from various relevant sectors on the future path of ICT-integrated disaster management. It has been observed disaster management systems in place are still more focused on the stage of response after the occurrence of disasters rather than on securing enough efficiency of functions for all stages of disaster management. Due to this, there are some limitations to minimise the scale of disaster destruction in advance.

To overcome these limitations, more integrated ICT-based disaster information systems that can swiftly and holistically cope with all data run by each agency are needed. Also, there is a need for an advanced management platform that encourages the active participation of the general public with the use of ICT beyond the level of a one-sided system solely managed by the governments. It is necessary for the governments to expand the scope of collaboration with the private sector on disaster management.

There is also a need to plan active governmental investments in R&D of new ICT that can fully utilise and analyse the large-scale disaster information accumulated. The use of big data allows the countries to take better precautionary measures with more accurate prediction. However, even though the governments have been gradually increasing the budget for R&D on ICT-integrated disaster and safety management along with a series of master plans and policies, the issue of effectiveness has been constantly raised. In final, closer partnership between the public and the private sector should be established and strengthened for sustainable R&D initiatives. Also, the communications channel should be improved to clarify each ministry's role in ICT resilience.

Annex 1. Key statistics of telecommunications industry in China

The Fortune Global 500 rankings of China Telecom, China Mobile and China Unicom have improved from 221st, 81th and 333rd in 2012 to 132nd, 45th and 207th in 2016, respectively.

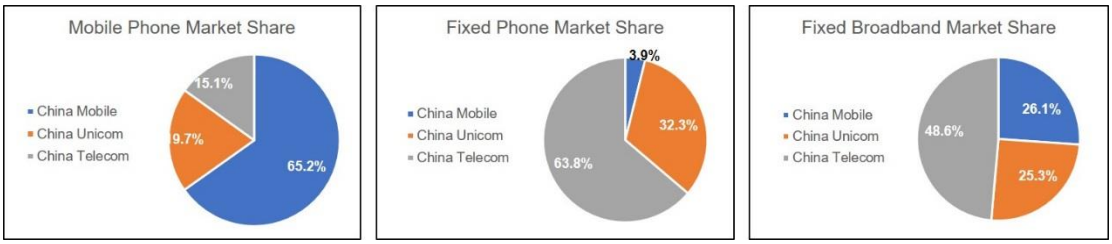
Fortune Global 500 ranking of China telecom operators, 2012-2016

	2012	2013	2014	2015	2016
China Telecom	221	182	154	169	132
China Mobile	81	71	55	55	45
China Unicom	333	258	210	227	207

Source: Fortune website.

Market share by service type

Percentage



Source: MIIT (2016).

Subscribers by telecom operators, 2016

Thousands of subscribers

	China Mobile	China Unicom	China Telecom	China
Mobile phone	862,556	259,818	199,561	**1,321,935**
- **3G service**	103,369	31,734	35,702	**170,805**
- **4G service**	533,211	102,966	133,772	**769,949**
Fixed phone	8,247	66,649	131,729	**206,625**
Fixed broadband access	77,642	144,347	75,236	**297,225**
- **FTTH/O**	56,570	53,566	117,520	**227,656**

Source: MIIT (2016).

China Mobile

China Mobile Communications Corporation ("China Mobile") was founded on 20 April 2000 with the registered capital of CNY 300 billion and the asset size of over CNY 1.6 trillion. China Mobile has more than 500,000 employees, over 2.6 million base stations and more than 820 million clients. It is a telecommunications operator with the largest network and largest customer base in China. It ranked 21st[27] in the world in terms of market value. China Mobile Hong Kong (BVI) Limited is a wholly-funded subsidiary of China Mobile, and China Mobile Limited which is held by China Mobile Hong Kong (BVI) Limited operates wholly owned subsidiaries in 31 provinces (autonomous regions, municipalities) in Mainland China and Hong Kong and has been listed on the New York Exchange Stock and the Exchange Stock of Hong Kong. China Mobile focuses on the operation of mobile voice, data, broadband, IP telephone and multimedia services and has the

[27] Forbes website. Available from https://www.forbes.com/companies/china-mobile.

operating rights of international Internet connection and international entry and exit. With 862.56 million wireless customers and 65.2 per cent share of the domestic market at the end of 2016, China Mobile is the largest cellular telecommunications company in China.

China Unicom

China United Network Communications Limited ("China Unicom") was founded on 6 January 2009 by combining China Netcom and former China Unicom. It has established subsidiaries in 31 provinces (autonomous regions, municipalities) in Mainland China and various countries and regions in the world. It is the only telecommunications operator which is listed on the New York Exchange Stock, the Stock Exchange of Hong Kong and Shanghai Exchange Stock.

China Unicom focuses on operation of fixed communication businesses, mobile communication businesses, domestic and international communication facility service, satellite international private line business, data communication business, network access business, value-added telecommunication businesses, and system integration services related to communication business. On 4 December 2013, China Unicom was granted the LTE/TD-LTE operating license by MIIT. Later, on 27 February 2015, it was granted the LTE FDD operating license by MIIT. China Unicom is a telecommunication operator with both TD-LTE and LTE FDD licenses which joined the new era of 4G communications.

China Telecom

The wholly state-owned China Telecommunications Corporation (“China Telecom”) holds 70.9 per cent stake in China Telecom Corporation Limited, which directly owns all of the group’s domestic telecoms units and international telecoms divisions, including China Telecom Global and China Telecom Americas.

China Telecom established subsidiaries in 31 provinces (autonomous regions, municipalities) in Mainland China and in Americas, Europe, Hong Kong and Macao. The company owns the communication and information service networks covering the entire country, the largest coverage in China, and the world’s largest CDMA 3G network.

China Tower

In October 2008, the MIIT requested China Mobile, China Unicom and China Telecom to jointly construct core passive infrastructure to achieve increased investment efficiency. In July 2014, the trio agreed to create the infrastructure management firm named China Tower, which was renamed as China Tower Corporation in September 2014. The company was created with share capital of CNY10 billion, with China Mobile subscribing to 4 billion shares, China Unicom to 3.01 billion and China Telecom to 2.99 billion, equating to shareholdings of 40.0 per cent, 30.1 per cent and 29.9 per cent respectively. In early 2015, the trio began transferring assets to the new company and stopped erecting their own towers. In November 2015, the transfer of their tower portfolios to China Tower was completed. Financial terms of the deal took several more months for the operators to finalise.

The main business scope of China Tower is construction, maintenance and operation of towers, and engaged in the construction, maintenance and operation of base station room, power supply, air conditioning, indoor distribution system and other supporting facilities, and maintained the base station equipment for telecom operators. At present, except for base station, the construction, maintenance and operations of other infrastructure is still being managed by operators.

Annex 2. e-government services in Japan

Kasumigaseki Cloud

Cloud computing and big data have been emerging keywords that can facilitate the advancement of functions of e-Government since the 2010s. The legacy system has been renovated, integrating separated pension-, registration- and patent information systems. The whole Government information systems have been updated as well along with the social security and tax number system. The gradual decrease of the expense for Government information systems can be observed, which implies the growth of efficiency of e-Government. Since 2013, the Government has sought to encourage the renovation of the Government information systems by consolidating scattered systems through cloud technologies. As a part of Digital Japan Creation Project, the Government has set a target to reduce the numbers of the information systems to 619 by 2018 by establishing the shared system platform, "Kasumigaseki Cloud" which started operation in March 2013.

Kasumigaseki Cloud, which is a cross-ministry platform, enables adoption of cloud services for office tools and virtualization of a PC environment. The system configuration is processed based on open source software (OSS). This Government Common Network (G-Net) contributes to reduction of cost and unification and standardisation of transactions. Wherever people are, they can do decision-making by accessing public data through smartphone or tablet. The platform makes it possible to plan advanced administrative measures through big data analysis. Moreover, wireless LAN and Web conference allow paperless administrative operations. Also, even in times of emergent situations, business can be continued.

My Number and My Portal system

The Government has introduced My Number system, assigning a twelve-digit reference to each citizen. An assigned number is used for various administrative procedures. With the assigned number, people are able to examine their personal information that is used by the Government through My Portal. Additionally, the portal enables people to submit forms and fees at once without acquiring additional documents from multiple departments. People can also enjoy the Push-type Service so that they can receive necessary information easily by selecting desired topics.

Pension-Net: Provision of pension data for each citizen

Pension-Net provides payment records and benefit estimates for each citizen. Thanks to this new system, the citizens have access to a **customise**d service. Moreover, people over 20 years old are

covered which represents approximately 106 million people. This system aims to provide the benefit estimate, based on the payments in the past as well as a payment record to each citizen. This policy makes the pension system much more transparent.

Provision of medical payment data

With its universal coverage of Health Insurance, Japanese government provides big data on medical payment records for academic purposes upon request. This system enables the coverage of almost all residents, which represents approximately 113 million people. It also provides big data for academic research and policy-making (open data) but more than that it contributes to Evidence-Based Policy in public health so the Government is able to know what kind of heath policy they want to implement, toward what kind of population and what they need to improve.

Local Government Wide Area Network (LGWAN) and Basic Resident Register (BRR) Network

All municipal and prefectural governments are connected through the LGWAN, which was established in 2003. The network has facilitated the information sharing between local governmental entities throughout the region. It has enabled better communication between the national- and local government agencies through connection to Kasumigaseki WAN. LGWAN has utilised the Public Key Infrastructure (PKI) to improve security in terms of information collection and exchange. It has also enabled the public identity authentication service. In addition, in times of disasters, the network becomes more helpful for residents from the aspect of disaster information provision. The LGWAN council exists to cope with management of the network, financially operated by each local government participating.

In the meantime, to manage the BRR data (name, date of birth, sex, address) in the form of a network, the common BRR Network that link all local governments has been developed. Any changes in the resident's information can be modified simply through the network. Since 2003, a BRR Card has been available for people requesting it. This IC card is one of the services of BRR network offered to residents. Certificates including personal seal registration can be issued automatically for example, through the BRR Card.

Official websites and Local-government SNS

All local governments at prefectural level in Japan have managed their official websites. Most of their websites provide the online platform for residents to discuss community matters with officials concerned. Citizens can download various types of forms to make applications and retrieve information on local bylaws, regulations and policies.

The local government SNS was first introduced in 2004 and has been utilised by several regions in order to complement existing limitations on e-bulletin boards of the websites. The system is the channel for residents to obtain information from local governments and to raise their voices in decision making on local issues. It also plays a significant role in delivering real-time information to people when natural disasters occur.

The local government cloud

Under the leadership of the LAB under the MIC, the local government cloud system is being promoted to share and manage information efficiently among local public agencies. Unlike data management within the respective local government office, the country seeks to advance one integrated data centre shared by prefectures that can contribute to reduction of data management expenses and standardisation of administrative procedures with resilience against physical damage.

Annex 3. Key events and examples of open governments in Japan

Year	Key events
2009	Open Govern Project Plan was initiated
2009	“Idea Box” (website for public discussion) was established
2010	“Open Government Lab” was launched
2011	“Setsuden.go.jp” was set up (able to find real data on the actual electricity usage)
2012	“Recovery and Reconstruction Support Program Database” began (one-stop service site)
2012	Data METI Plan (Open Data Initiative) was set up
2012	Public Sector Information Working Group was established
2013	Open DATA METI」-βversion was made (public data possessed by METI)
2013	Open data policy was proposed by METI to open data council
2013	“Data.go.jp” was open (Government open data website)

Source: METI.

Idea Box

Idea Box is the web-based discussion platform, made by METI, to provide a public discussion arena on open data. Citizens can freely post ideas on the government’s administrative ICT services on the website. Then these opinions are actively referred to in various projects for promoting open data**.**

Open Government Lab

Open Government Lab is the test-bed website in order to experiment suitable measures to operate open Government with accumulated information. It offers consultation for public agencies that contribute to the advancement of implementing open Government.

Setsuden.go.jp

This website provides real data on the actual electricity usage to the public. It was created as a response to difficult electricity supply-demand situations caused by the termination of operation of nuclear power plants after the earthquake in 2011.

Data.go.jp

Data.go.jp was launched as the Government data catalogue site to provide more than 1200 datasets from each ministry and government agency to the people. It is open for people to post opinions and receive feedbacks.

Annex 4. Disaster management laws in Japan

Type	Prevention	Emergency Response
Earthquakes and Tsunamis	- Act on Special Measures Concerning Countermeasures for Large-Scale Earthquakes - Act on the Promotion of Tsunami Measures - Act on Special Financial Measures for Urgent Earthquake Countermeasure Improvement Projects in Areas for Intensified Measures - Act on Special Measures for Earthquake Disaster Countermeasures - Act on Special Measures for the Promotion of Nankai Trough Earthquake Disaster Management - Act on Special Measures against Tokyo Inland Earthquake - Act on Special Measures for Promotion of Disaster Management for Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches - Act on Promotion of the Earthquake-proof Retrofit of Buildings - Act on Promotion of Disaster Resilience Improvement in Densely Inhabited Areas - Act on Development of Areas Resilient to Tsunami Disasters	- Disaster Relief Act - Fire Service Act - Police Law - Self-Defense Forces Act
Volcanic eruptions	- Act on Special Measures for Active Volcanoes	-
Windstorms and Floods	- River Act	- Flood Control Act
Landslides	- Erosion Control Act - Forest Act - Landslide Prevention Act - Act on Prevention of Disasters Caused by Steep Slope Failure - Act on Promotion of Sediment Disaster Countermeasures in Sediment Disaster Hazard Areas	-
Heavy snowfall	- Act on Special Measures for Heavy Snowfall Areas - Act on Special Measures Concerning Maintenance of Road Traffic in Specified Snow Coverage and Cold Districts	-
Nuclear power	- Act on Special Measures Concerning Nuclear Emergency Preparedness	-

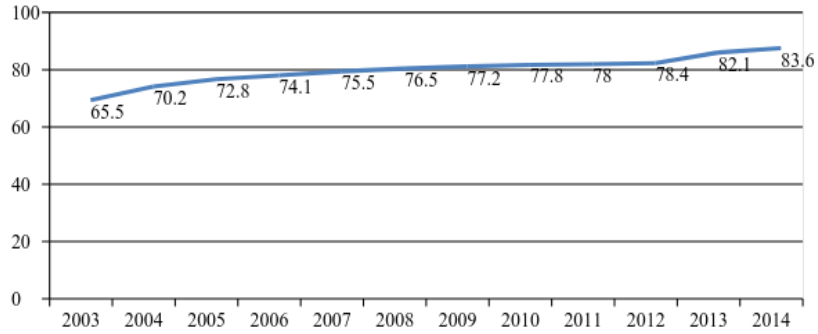
Source: Cabinet Office Japan (2016 & 2017). White Paper on Disaster Management.

Type	Recovery / Reconstruction
General Relief	- Act on Special Financial Support to Deal with Extremely Severe Disasters
General Relief and Support Measures	- Small and Medium-sized Enterprise Credit Insurance Act - Act on Financial Support of Farmers, Forestry Workers and Fishery Workers Suffering from Natural Disaster - Act on Equipment Installation Support for Small Enterprises - Act on Provision of Disaster Condolence Grant Employment Insurance Law - Act on Support for Reconstructing Livelihoods of Disaster Victims - Japan Finance Corporation Act
Disposal of Disaster Waste	- Waste management and Public Cleansing Act
Disaster Recovery Work	- Act on Temporary Measures for Subsidies from National Treasury for Expenses for Project to Recover Facilities for Agriculture, Forestry and Fisheries Damaged by Disaster - Act on National Treasury's Sharing of Expenses for Recovery of Public School Facilities Damaged by Disaster - Act on Special Measures concerning Reconstruction of Urban Districts Damaged by Disaster - Act on Special Measures concerning Reconstruction of Condominiums Destroyed by Disaster
Insurance and Mutual Aid System	- Act on Earthquake Insurance - Act on Compensation for Agricultural Loss - Government Managed Forest Insurance Act
Laws relating to Disaster Taxation	- Act on Reduction or Release, Deferment of Collection and Other Measures Related to Tax Imposed on Disaster Victims
Other	- Act on Special Measures for the Preservation of Rights and Interests of the Victims of Specified Disasters - Act on Special Financial Support for Promoting Group Relocation for Disaster Mitigation - Act on Special Measures for Land and Building Leases in Areas Affected by Large-scale Disaster

Source: Cabinet Office Japan (2016 & 2017). White Paper on Disaster Management.

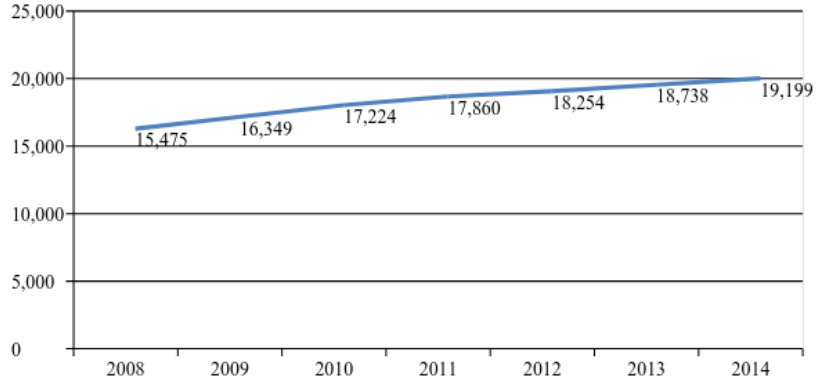
Annex 5. Key statistics of telecommunications industry in the Republic of Korea

Internet usage rate (percentage), 2003-2014



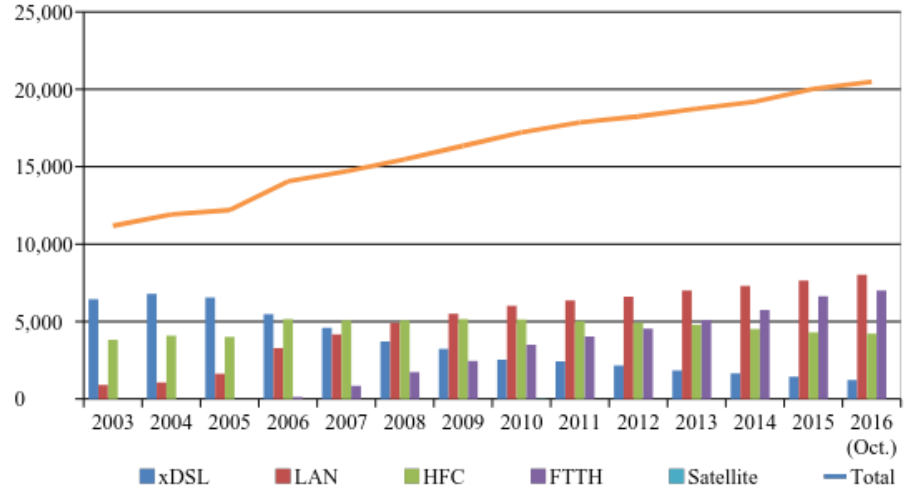
Source: KISA (2014).

Broadband Internet service users (thousand persons), 2008-2014



Source: MSIP (2014).

Fixed broadband Internet subscribers (thousand persons) by technology, 2003-2016



Source: Korea Information Society Development Institute (KISDI).

Bibliography

Arai, Yoshio, Sae Naganuma and Yasukazu Satake. Local government broadband policies for areas with limited Internet access. *Netcom*, 26-3/4 | 2012, 251-274.

Asia-Pacific Telecommunity (APT) (2015). Lastest ICT Strategies and Telecommunications Policy in Japan. 15th APT Policy and Regulatory Forum, Document PRF-15/INP-15. Available from http://www.apt.int/sites/default/files/2015/07/PRF-15-INP-15-Japan-Latest-ICT-STrategy-Policy.pdf.

Asian Development Bank (2017). Meeting ASIA's Infrastructure Needs. Available from https://www.adb.org/publications/asia-infrastructure-needs

Atkinson, Robert D., Daniel K. Correa and Julie A. Hedlund (2008). Explaining International Broadband Leadership. The Information Technology and Innovation Foundation (ITIF). Available from https://itif.org/publications/2008/05/01/explaining-international-broadband-leadership.

Bourna, Maria and M. Hitoshi (2014). Understanding broadband under-utilisation in Japan. 20th ITS Biennial Conference: The net and the internet: Emerging markets and policies. Graduate School of Asia-Pacific Studies, Waseda University. Available from http://itsrio2014.com/public/download/Maria%20Bourna%20-%20Understanding%20broadband%20under-utilization%20in%20Japan.pdf.

Cabinet Office, Japan (2015). White Paper: Disaster Management in Japan 2015. Available from http://www.bousai.go.jp/kaigirep/hakusho/pdf/WP2015_DM_Full_Version.pdf.

_____ (2016). White Paper: Disaster Management in Japan 2016. Available from http://www.bousai.go.jp/kyoiku/panf/pdf/WP2016_DM_Full_Version.pdf.

Cha, D.H., D.Y. Gwak, J.S. Lee and Y.R. Kim (2014). The status of constructing public safety network based on mobile communications. Seoul: KICS.

Chung, Y.H (2002). Korean national policies to close the digital divide (August). MIC. Available from http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN006369.pdf.

Fujinami, K. (2014). Keynote address on LAP 10 Tokyo: Telecommunications policy in Japan. MIC.

Fujino, M. (2010). Law & Policy for Broadband Deployment in Japan. Available from http://www.soumu.go.jp/schresult.html?q=Expert%20Evaluation%20Committee.

_____ (2010). National broadband policies: 1999-2009, Japan. Embassy of Japan, USA

General Office of the State Council, People's Republic of China (2016). National Natural Disaster Response Framework (Guo Ban Han (2016) No. 25).

Government of Japan (2013). Outline of the rules for co-location in Japan. 2013/TEL47/LSG/014 Agenda Item: 7.2. APEC. Available from http://mddb.apec.org/Documents/2013/TEL/TEL47-LSG/13_tel47_lsg_014.pdf.

Iida, Yoichi (2012). Japan's Telecom Policy and Infrastructure. Available from http://www.jointokyo.org/files/cms/news/pdf/Presentation_Mr_Yoichi_Iida.pdf.

International Telecommunication Union (ITU) (2003). Broadband Korea: Internet case study. ITU. Available from http://www.itu.int/ITU-D/ict/cs/korea/material/CS_KOR.pdf.

_____ (2003). Promoting Broadband: the case of Japan. Workshop on promoting broadband Document: PB/07, 7 April 2003. Available from https://www.itu.int/osg/spu/ni/promotebroadband/casestudies/japan.pdf.

_____ (2002). Creating trust in critical network infrastructure: Korea case study. CNI/05. ITU. Available from https://www.itu.int/osg/spu/ni/security/docs/cni.05.pdf.

IT Strategic Headquarters, Japan (2003). e-Japan Strategy II.

IT Strategic Headquarters, Japan (2009). i-Japan Strategy 2015.

IT Strategic Headquarters, Japan (2013). Declaration to be the World's Most Advanced IT Nation.

Japan Meteorological Agency website. Earthquakes and Tsunamis. Available from http://www.jma.go.jp/jma/en/Activities/brochure_earthquake_and_tsunami.pdf.

KCC and Korea Internet & Security Agency (KISA) (2011). Korea Internet White Paper.

Kim, J.H. (2014). Technology trends of disaster emergency systems based on ICT (September). 28-5. Korea Institute of Illuminating and Electrical Installation Engineers (KIIEE).

Kim, J.M. (2016). Management of ICT based disaster responding SOC facility. Water for Future, Vol.49 No 2. Available from http://www.kwra.or.kr/wonmun/KWRA_1_2016_02_29(C).pdf.

Kim, N. and S.G. Park (2014). The present status and prospect of disaster communications network. Seoul: Korea Institute of Communications and Information Sciences (KICS).

Korea Agency for Digital Opportunity and Promotion (KADO). Introduction of KADO. Available from http://unpan1.un.org/intradoc/groups/public/documents/UNPAN/UNPAN028063.pdf.

Korea Communications Committee (KCC) (2009). The mid to long-term development plan of broadcasting and communication network.

_____ (2010). Broadband for rural areas and schools in Korea.

Korea Disaster Prevention Association (KDPA) (2015). Journal of disaster prevention (May), Vol.17 No.2. Available from http://www.kodipa.or.kr/HyAdmin/download.php?&bbs_id=bo01&page=&type=1&doc_num=99&PHPSESSID=8079d20cc931025d9acbe28c3436be45.

Korea Institute of Public Finance (KIPF) (2004). The study for establishing the mid-to-long term operation plan on informatization promotion fund. Seoul: KIPF. Available from http://www.itfind.or.kr/Report01/200611//IITA/IITA-0149/IITA-0149.pdf.

Korea Institute of Science & Technology Evaluation and Planning (KISTEP) (2016). The approach for ICT-converged disaster safety R&D in the era of the 4th Industrial Revolution. Issue Paper 2016-06. Seoul: KISTEP. Available from http://www.kistep.re.kr/c3/sub3.jsp?.

_____ (2014). Improvement of disaster safety R&D promotion system based on the establishment of Ministry of Public Safety and Security. Issue Paper 2014-14. Seoul: KISTEP. Available from http://www.kistep.re.kr/c3/sub3.jsp?.

_____ (2014). Trends and Implications of ICT-based disaster management in major countries. Issue Paper 2014-11. Seoul: KISTEP. Available from http://www.kistep.re.kr/c3/sub3.jsp?.

_____(2016). The approach for ICT-converged disaster safety R&D in the era of the 4th Industrial Revolution. Issue Paper 2016-06. Seoul: KISTEP. Available from http://www.kistep.re.kr/getFileDown.jsp?fileIdx=6415&contentIdx=10213&tbIdx=BRD_BOARD

Lee, Joo Ho (2011). Analyzing the Emergency Traffic for Crisis and Emergency Management in Korea and USA.

Lee, Y.R., B.C. Kim, S.U. Rha and J.H. Hur (2007). Policy of upgrading the analysis of Korea's IT infrastructure. Informatization Policy, Vol 14 No.4 (December), pp. 38-59. Seoul: National Information Society Agency (NIA).

MIC, Japan and CTI Engineering Co., Ltd. (2014). The Booklet of Best Practices of resilient ICT systems in Japan. Available from http://www.soumu.go.jp/main_content/000372211.pdf.

Ministry of Economy, Trade and Industry (METI), Japan (2014). E-Government, Open Government and Open Data in Japan.

_____ (2015). IT Policy in Japan.

Ministry of Education (MIE) and Korea Education and Research Information Service (KERIS) (2006). White Paper on ICT in Education Korea. MIE and KERIS. Available from http://lib.keris.or.kr/bbs/list/6?pn=2.

Ministry of Economy, Trade and Industry (METI), Japan (2014). E-Government, Open Government and Open Data in Japan

Ministry of Industry and Information Technology (MIIT), People's Republic of China (2016). Telecom Business Category (2015 edition).

Ministry of Information and Communication (MIC), Korea (2007). BcN Initiative II.

_____ (2004). BcN Initiative I.

_____ (2003, 2004). Annual report on the management of Information Promotion Fund.

_____ (2003). Korea informatization strategy.

Ministry of Internal Affairs and Communications (MIC), Japan (2016). Broadband policy in Japan.

_____ (2011). Broadband competition policy in Japan.

_____ (2007). Universal Service Policy in Japan.

_____ (each year). Information and Communications in Japan: White Paper (each year)

_____ website. http://www.stat.go.jp/english.

Ministry of Public Safety and Security (MPSS), Korea (2016a). Korea Safe-Net based on ICT. 2016/SOM3/EPWG/020, Agenda Item: 9.10. Asia-Pacific Economic Cooperation (APEC). Available from http://www.apec-epwg.org/public/uploadfile/act/ee519d6b5f21c15aaf7044507fba62ee.pdf.

_____ (2016b). National Safety White Paper 2016. Available from http://www.mpss.go.kr/home/policy/policy/dataBoard/0001/?boardId=bbs_0000000000000041&mode=view&cntId=8615&category=%EA%B8%B0%ED%9A%8D%EC%A1%B0%EC%A0%95%EC%8B%A4&pageIdx=.

_____ website. Statistical yearbook of natural disaster. Available from http://www.mois.go.kr/frt/bbs/type001/commonSelectBoardList.do?bbsId=BBSMSTR_000000000014

Ministry of Science and ICT and Future Planning (MSIP) and Korea Internet & Security Agency (KISA) (2016). The report on the survey of the Internet usage.

_____ (2016). 2016 Korea Internet White Paper. MSIP and KISA. Available from http://www.kisa.or.kr/eng/usefulreport/whitePaper_List.jsp

_____ (2015). 2015 Korea Internet White Paper. MSIP and KISA. Available from http://www.kisa.or.kr/eng/usefulreport/whitePaper_List.jsp

_____ (2014). 2014 Korea Internet White Paper. MSIP and KISA. Available from http://www.kisa.or.kr/eng/usefulreport/whitePaper_List.jsp.

Ministry of Science and ICT and Future Planning (MSIP), Korea (2017). Press release 13 April 2017. Available from http://www.msip.go.kr/web/msipContents/contentsView.do?cateId=mssw315&artId=1338035

Implementing social safety network based on new ICT and digital humanism (December). 14-60.

Ministry of Science and ICT (MSIP) and Korea Information Society Agency (NIA) (2014a). 20 years of record of national informatization in Korea. Available from http://www.kdbf.or.kr/index.php?module=Board&action=SiteBoard&sMode=VIEW_FORM&iBrdNo=14&iBrdContNo=67&sBrdContRe=0&sSearchField=&sSearchValue=&CurrentPage=4.

_____ (2014b). Achievement of national informatization for two decades in Korea. MSIP and NIA. Available from http://www.kdbf.or.kr/index.php?module=Board&action=SiteBoard&sMode=VIEW_FORM&iBrdNo=14&iBrdContNo=67&sBrdContRe=0&sSearchField=&sSearchValue=&CurrentPage=4.

_____ (2014c). The past, present and future of Korea's informatization. MSIP and NIA. Available from http://www.kdbf.or.kr/index.php?module=Board&action=SiteBoard&sMode=VIEW_FORM&iBrdNo=14&iBrdContNo=67&sBrdContRe=0&sSearchField=&sSearchValue=&CurrentPage=4.

Mitomo, H. (2014). Optical Fiber Unbundling and NGN Interconnection in Japan: Policy Advancement and Impediments to the Deployment in a Competitive Environment. Journal of Asia-Pacific Studies, No.23 (June 2014). Waseda University. Available from https://waseda.repo.nii.ac.jp/?action=repository_uri&item_id=25422&file_id=162&file_no=.

Nakao, Yasuhisa (2017). Disaster Risk Financing and Insurance Policies of Japan. Presentation at the APEC Workshop on Disaster Risk Financing & Insurance Policies. Nha Trang, 21 February 2017. Available from http://mddb.apec.org/Documents/2017/FMP/SEM1/17_fmp_sem1_007.pdf.

National Computerization Agency (NCA) (2007). National Informatization White Paper. Daegu: NIA. Available from http://www.nia.or.kr/site/nia_kor/ex/bbs/List.do?cbIdx=44086.

_____ (2006a). National Informatization White Paper. Daegu: NIA. Available from http://www.nia.or.kr/site/nia_kor/ex/bbs/List.do?cbIdx=44086.

_____ (2006b). The progress and outcomes of Korea's informatisation. NCA Issue Report, No.06-07.

_____ (2006c). The trace of Korea Infrastructure Initiative.

_____ (2005). 2005 Korea Internet White Paper. NCA.

_____ (2005). National Informatization White Paper. Seoul: NIA. Available from http://www.nia.or.kr/site/nia_kor/ex/bbs/List.do?cbIdx=44086.

National Emergency Management Agency (NEMA) Korea (2009). Disaster Management System and Status Control System of Korea.

_____ (2009). National Disaster Management System in Korea.

National Institute of Information and Communications Technology (NICT), Japan (2015). NICT NEWS: Toward Resilient ICT, No. 452. Available from http://www.nict.go.jp/en/data/nict-news/NICT_NEWS_1506_E.pdf.

OECD (2007). OECD Review of Regulatory Reform. Korea : Progress in Implementing Regulatory Reform.

_____ (2000). OECD Review of Regulatory Reform. Regulatory reform in Korea.

Oh, Kuk Ryul & Chang Hee Lee (2014). A Study on Building Public Broadcast System for Disaster. Journal of Korean Society of Hazard Mitigation. Available from http://dx.doi.org/10.9798/KOSHAM.2014.14.4.155

Oh, J.Y. (2006). Development process and achievement of Korea's informatization policy. NCA Issue Report, No.06-07. National Computerization Agency (NCA). Available from http://www.changhak.kr/sboard/bbs_file_download.php?bbs_id=pds&bbs_num=22.

Oh, J.Y. and H.J. Hong (2004). Achievement and impact of Korean national informatization. NCA Issue Report 2004. NCA.

OVUM (2009). Broadband policy development in the Republic of Korea. A report for the global information and communications technologies department of the World Bank, October 2009. Available from http://www.infodev.org/infodev-files/resource/InfodevDocuments_934.pdf

Park, M.K., J.K. Ryu, M.S. Shin, D.G. Oh, H.D. Lee and N.D Ju (2012). Technology trends in satellite communication for disaster. 2012 Electronics and Telecommunications Trends. Daejeon: Electronics and Telecommunications Research Institute (ETRI). Available from http://www.kipo.go.kr/club/file.do?attachmentId=9147.

Prime Minister of Japan and His Cabinet website. Available from http://japan.kantei.go.jp/it/network/0122full_e.html

Sakamoto, Yasuo (2015). Japan's international contribution in the field of ICT for disaster risk reduction. Available from http://www.soumu.go.jp/main_content/000391490.pdf.

Sakurai (2008). Japan's best practice for telecommunications market. Ministry of Internal Affairs and Communications (MIC), Japan.

Seiji, T (2016). Broadband Policy in Japan, September 2016. Global ICT Strategy Bureau, MIC. Available from http://www.cto.int/media/events/pst-ev/2016/broadbandasia/Broadband%20Policy%20in%20JapanSeiji%20Takagi%20Broadband%20Policy%20in%20JapanSeiji%20Takagi%20v1.pdf

Shinohara, H. (2011). FTTH in Japan: Strategy, Technology and Implementation. ECOC 2011. NTT.

Song, K.S., D.S. Seo, W.C. Chung and M.W. Seo (2014). A smart disaster management based on intelligent. Convergence R&D Lab, KT. Available from http://www.kics.or.kr/storage/paper/event/20160118_winter/publish/10A-4.pdf.

The Government of Korea (2012). Strengthening disaster risk assessments to build resilience to natural disasters. Improving the assessment of disaster risks to strengthen financial resilience, Chapter 12. World Bank. Available from http://www.preventionweb.net/publications/view/29011.

United Nations Department of Economic and Social Affairs (2018) The United Nations E-Government Survey 2018: Gearing E-Government to Support Transformation towards Sustainable and Resilient Societies at https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2018-Survey/E-Government%20Survey%202018_FINAL%20for%20web.pdf

United Nations Economic and Social Commission for Asia and the Pacific (2017): Artificial Intelligence and Broadband Divide: State of ICT Connectivity in Asia and the Pacific 2017 at https://www.unescap.org/resources/artificial-intelligence-and-broadband-divide-state-ict-connectivity-asia-and-pacific-2017

Tsuji, M. and Y. Akematsu (2008). A penal data analysis of diffusion of Japanese FTTH (Aug.2009). University of Hyogo. Available from https://ssrn.com/abstract=1999840.

Yoo, In Sool (2015). Disaster Management Planning in Korea.

Zhang Wei, "Flood scene in Hebei, the official representative of the Party Central committee!", Best China News, 24 July 2016. Available from http://www.bestchinanews.com/Domestic/326.html