ICT Infrastructure Co-Deployment with Transport and Energy Infrastructure in North and Central Asia

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Abbreviations and Acronyms

AI	Artificial Intelligence
AP-IS	Asia-Pacific Information Superhighway
BRI	Belt and Road Initiative
CASA	Central Asia South Asia
CATV	Cable Television
CCTV	Closed-Circuit Television
DSL	Digital Subscriber Line
ESCAP	Economic and Social Commission for Asia and the Pacific
FOC	Fibre-Optic Cable
GNI	Gross National Income
HICC	Highway Information and Communications Corporation (Republic of Korea)
ICT	Information and Communications Technology
IDI	ICT Development Index
IMA	Infrastructure Management Agency
IoT	Internet of Things
ITS	Intelligent Transportation System
ITU	International Telecommunication Union
JSC	Joint Stock Company
KDN	KEPCO Knowledge Data Network
KEC	Korea Expressway Corporation
KEGOC	Kazakhstan Electricity Grid Operating Company
KEPCO	Korea Electric Power Corporation
MSIT	Ministry of Science and ICT (Republic of Korea)
MTIE	Ministry of Trade, Industry and Energy (Republic of Korea)
OPGW	Optical Ground Wire / Overhead Power Ground Wire
PPP	Public-Private Partnership
RoW	Right of Way
SAMT	Special Automated Measurement Tool
SCADA	Supervisory Control And Data Acquisition
SDG	Sustainable Development Goal

Introduction

Information and communications technology (ICT) has become an indispensable tool in our daily lives. The evolution of ICT through the Internet is making the globe a community that can create, share and acquire information and knowledge across locations and time. The impact of ICT on economic and social development is what we call the Third Industrial Revolution.

With the advent of new technologies such as artificial intelligence (AI), big data analytics, cloud computing and the Internet of things (IoT), the world is experiencing a revolutionary transition from a knowledge-based society to an intelligence-based society, and we call this the Fourth Industrial Revolution.

Yet, the digital divide is widening between developed and developing countries, and between urban and rural areas in a country. If this widening digital divide is not addressed, it will adversely affect the ability of less connected countries to deliver on the United Nations Sustainable Development Goals (SDGs).

With rapid advancements in technology, there is a growing demand for fibre-optic cables (FOCs) that can ensure the delivery of broadband data. However, development of the national FOC infrastructure has been uneven. Many countries have deployed FOCs to meet telecommunications need, but some countries are still using copper-wired cables with limited bandwidth.

As the cost of building the FOC infrastructure is high, developing countries usually rely on the privatized telecom operators to build and expand the FOC network for broadband connectivity. Under such circumstances, infrastructure co-deployment is a solution to accelerating the development of the FOC infrastructure. This working paper examines ICT infrastructure co-deployment with the transport and energy infrastructure in North and Central Asia, with a focus on three countries – Kazakhstan, Kyrgyzstan and Mongolia.

In Section 1, an overview of ICT trends is presented in light of the Fourth Industrial Revolution, which calls for an urgent need to bridge the digital divide and build the ICT infrastructure in developing countries. In addition, the section provides an overview of ICT development in the three focus countries – Kazakhstan, Kyrgyzstan and Mongolia – and compares them with the Republic of Korea, a world leader in ICT development. The ICT Development Index (IDI) of the International Telecommunication Union (ITU) is used in the assessment and comparison.

Section 2 defines and discusses FOC co-deployment, and highlights the cost savings from FOC co-deployment. Section 3 presents case studies of FOC co-deployment along transport (road and rail) and energy (electricity, gas and oil) infrastructure in Kazakhstan, Kyrgyzstan, Mongolia and the Republic of Korea. This includes examining the various opportunities and challenges, as well as the legal, administrative and institutional support, and governance systems required for FOC co-deployment.

Section 4 summarizes and further analyses the common opportunities and challenges from the case studies presented in Section 3, particularly for infrastructure management agencies (IMAs), telecom operators, and legislators, policymakers and regulators. The final section offers key policy considerations and recommendations for enabling and facilitating FOC co-deployment in North and Central Asia, towards accelerating the development of the ICT infrastructure, bridging the digital divide and achieving the SDGs.

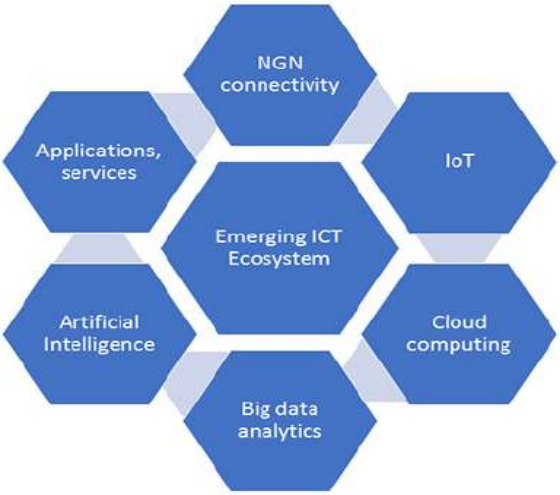
1. ICT Development in North and Central Asia

ICT connectivity is essential for infrastructure development, trade and transportation, human resources development, and economic and social cooperation among people, organizations and countries. The Asia-Pacific Information Superhighway (AP-IS), an initiative administered by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), plays an important role in bridging the digital divide among countries in the Asia-Pacific region, and developing ICT systems that contribute to socioeconomic development and achievement of the SDGs. Through the AP-IS initiative, ESCAP has been promoting the expansion and improvement of ICT connectivity in North and Central Asia, in cooperation with the transport and energy sectors.

1.1 Global ICT Development Trends

The ITU, a United Nations agency that specializes in ICT, notes ICT as an important tool for achieving the SDGs, and points to AI, big data analytics, cloud computing and IoT as new growth engine technologies. The ITU also recommends their joint use together with next-generation networks and new applications and services to enhance their potential for innovation (see Figure 1).

Figure 1: Complementary innovation in advanced ICTs



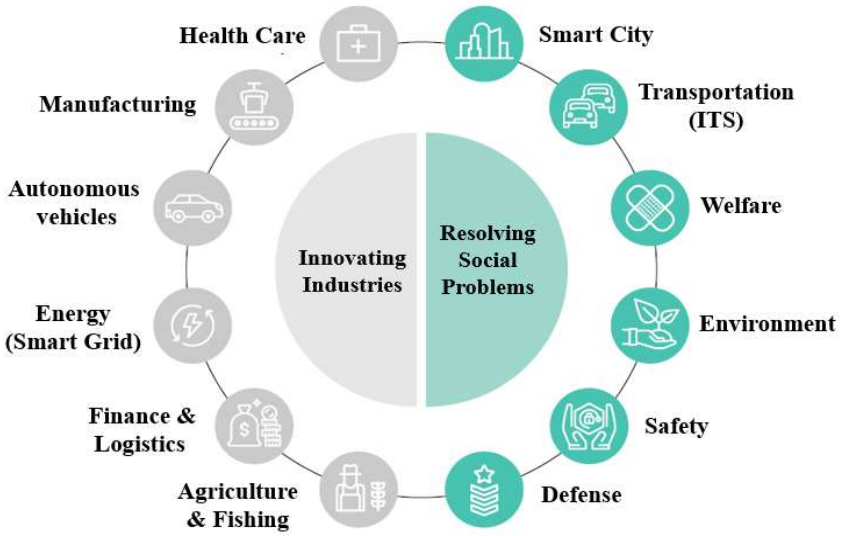
Source: ITU, *Measuring the Information Society Report 2017 – Volume 1* (Geneva, 2017), p. 105. Available at https://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2017.aspx.

The world is rapidly moving beyond an Internet-based information society into a hyper-connected society where everything is connected and intelligentized – heralding revolutionary changes across

the economy and society. For example, it is expected that productivity will increase through introduction of new technologies such as AI. The industrial landscape will be reorganized around businesses with digital capabilities, while labour market volatility will also increase. In society, the quality and convenience of individuals' lives, such as digital health care and virtual reality services, will be maximized, while demands for establishing new ethics regarding the use of AI and narrowing digital gaps will grow.

In order to prepare for such revolutionary changes, countries around the world are pushing for policies that recognize intelligent information technology as a source of national competitiveness. They are also promoting investment and innovation in the application of new technologies such as AI, big data analytics, cloud computing and IoT for economic and industrial growth and resolving social problems (see Figure 2).

Figure 2: ICT development trends with emerging new technologies over broadband network



Source: National Information Society Agency, Republic of Korea, *2018 National Informatization White Paper* (Seoul, 2018).

Some of these innovations will be discussed in this working paper, including the intelligent transportation system (ITS), smart grid and the spatial information industry that is closely related to IoT.

The ITS comprises of facilities and services that reduce traffic congestion caused by limited road networks and increasing vehicles, ensure the safety of drivers, passengers and pedestrians, and enhance the efficient movement of people and goods to destinations. The ITS is a multi-process and complex business practice that combines technologies in transportation, ICT, electronic and electrical engineering, and data collection and analysis, which can contribute to the revitalization

of the market in various industries. But in many developing countries, the difficulties in securing funding and the lack of interest in traffic operation and maintenance using ITS are barriers to the adoption of ITS.

The next-generation ITS or cooperative ITS that is being explored in advanced countries is expected to improve traffic efficiency by applying AI, big data analytics, cloud computing and IoT to existing ITS functions. For example, the installation of an auto-detection and alarm in cars can reduce traffic accidents and deaths, and the installation of an intelligent real-time electronic signboard to guide drivers can improve traffic flow. The smart traffic monitoring and signalling system that can prioritize traffic in response to demand in real time, as well as the smart highway toll collection system that allows non-stop toll collection, can also improve traffic flow.

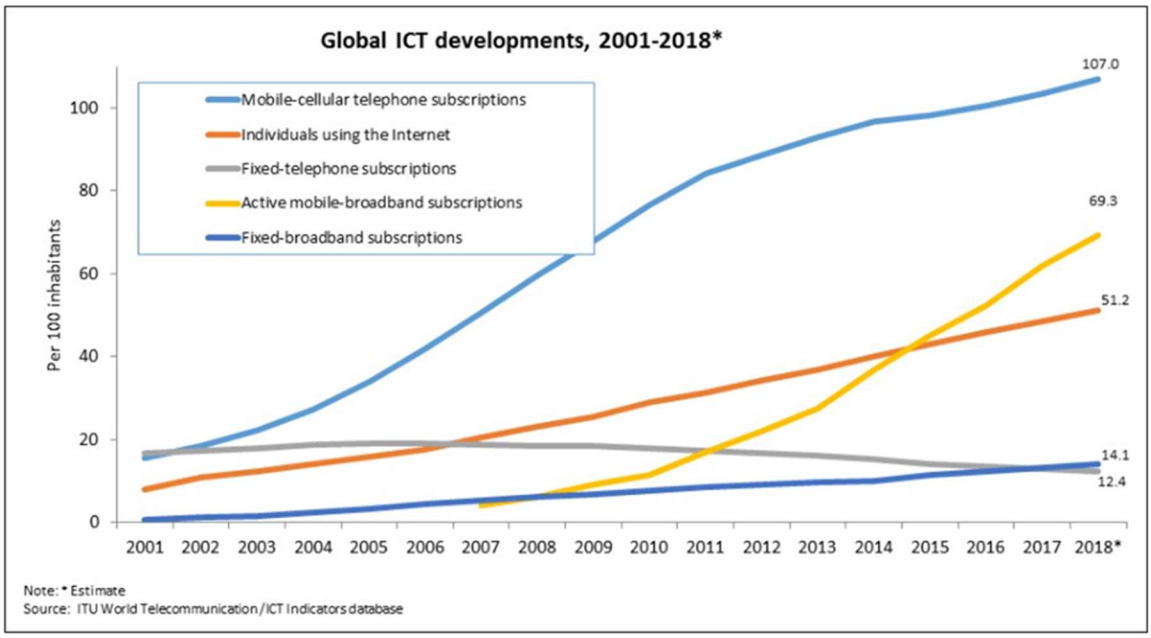
The smart grid enables real-time data collection concerning electricity supply and demand during the transmission and distribution process, making monitoring, generation, consumption and maintenance more efficient. The smart grid also promises to integrate distributed energy markets and enhance the resilience of power supply systems in case of disasters. The smart grid consists of new technologies and equipment that work together. For example, smart meters allow consumers to see in real time the amount of electricity used and its cost.

In the era of the fourth industrial revolution, the demand for various forms of geospatial information is rising beyond simple digitized maps. For example, the autonomous vehicle industry is dependent on advancements in geospatial technologies that connect vehicles with high-definition geospatial details. Three-dimensional spatial information is based on state-of-the-art technologies such as autonomous devices, unmanned aerial vehicles like drones, virtual reality, advanced reality and mixed reality. Spatial information is also being combined with big data analytics.

The establishment of a broadband ICT infrastructure is no longer an option but a necessity to support these new and emerging technologies and innovations. According to the ITU, however, only about half of the world's population are using the Internet at the end of 2018 (see Figure 3). Within the Commonwealth of Independent States, it is estimated that 71.3 per cent of its population are using the Internet.[1]

[1] ITU, "ITU releases 2018 global and regional ICT estimates", press release, 7 December 2018. Available at https://www.itu.int/en/mediacentre/Pages/2018-PR40.aspx.

Figure 3: Global ICT development trends



Source: ITU, "Statistics: Global ICT developments, 2001-2018". Available at https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx (accessed on 28 May 2019).

1.2 ICT Development Trends in North and Central Asia

North and Central Asia is home to almost 233 million people, 3 per cent of the world's population. The Russian Federation and Kazakhstan account for almost 88 per cent of subregional gross domestic product. All the countries are in the middle-income tier, while Kyrgyzstan and Tajikistan are closer to the low-income status threshold.[2] This working paper focuses on ICT development in three countries of North and Central Asia – Kazakhstan, Kyrgyzstan and Mongolia – and compares them with the Republic of Korea. Table 1 presents some key facts and the IDI ranking of the four countries.

Table 1: Key facts and IDI ranking of focus countries

Country	Population	Population Density	GNI per Capita (USD)	IDI Ranking	
				2017	2016
Kazakhstan	16,930,605	6.23	8,710	52	51

[2] ESCAP, "North and Central Asia at a Glance", June 2019. Available at https://www.unescap.org/resources/fact-sheet-north-and-central-asia-glance-2019.

Mongolia	2,963,708	1.89	3,550	91	87
Kyrgyzstan	5,795,191	29.19	1,100	109	110
Republic of Korea	49,975,765	507.64	27,600	2	1

Source: ITU, "ICT Development Index 2017: IDI 2017 Rank". Available at https://www.itu.int/net4/ITU-D/idi/2017/index.html#idi2017rank-tab (accessed on 28 May 2019).

Table 2 shows the indicators and scores for each IDI sub-index (as of the end of 2017). Among the three countries in North and Central Asia, the overall level of ICT development in Kazakhstan is the highest, followed by Mongolia and Kyrgyzstan. This order of ICT development is generally reflected in the sub-index scores, except in the skills sub-index in which Mongolia scores slightly higher than Kazakhstan, due to its higher gross enrolment ratio in tertiary education.

Table 2: IDI indicators and sub-index scores of focus countries

Sub-index	Indicators	Evaluation Score			
		KAZ	MNG	KGZ	ROK
Overall		6.79	4.96	4.37	8.85
Access	Fixed-telephone subscriptions per 100 inhabitants	**23.22**	**7.60**	**6.59**	**56.10**
	Mobile-cellular telephone subscriptions per 100 inhabitants	149.99	113.63	131.38	122.65
	International Internet bandwidth per Internet user (bits per second)	87,235	166,055	65,377	54,252
	Percentage of households with computer	76.20	23.59	21.40	75.29
	Percentage of households with Internet access	**84.38**	**23.57**	**18.76**	**99.19**
	Subtotal	7.55	4.74	4.54	8.85
Use	Percentage of individuals using the Internet	**76.80**	**22.27**	**34.50**	**92.72**
	Fixed (wired)-broadband subscriptions per 100 inhabitants	**13.68**	**7.63**	**4.08**	**41.13**
	Active mobile-broadband subscriptions per 100 inhabitants	70.99	82.00	46.11	111.48
	Subtotal	5.69	3.90	2.91	8.71
Skills	Mean years of schooling	11.70	9.80	10.80	12.20
	Secondary gross enrolment ratio	112.01	91.46	90.78	97.73
	Tertiary gross enrolment ratio	46.26	68.57	45.92	95.35
	Subtotal	7.48	7.51	6.96	9.15

Source: ITU, "ICT Development Index 2017: IDI 2017 Rank". Available at https://www.itu.int/net4/ITU-D/idi/2017/index.html#idi2017rank-tab (accessed on 28 May 2019).
Notes: KAZ = Kazakhstan; MNG = Mongolia; KGZ = Kyrgyzstan; and ROK = Republic of Korea.

Table 2 also shows noticeable differences between the three North and Central Asian countries and the Republic of Korea in fixed-telephone and broadband subscriptions, and the percentage of Internet users and households with Internet connection (highlighted in blue). The differences are due to inadequate fixed ICT infrastructure in the North and Central Asian countries.

Another important factor that affects Internet usage is its affordability. The per capita gross national income (GNI) ratio to subscribe to fixed-broadband services is 0.6 per cent for Kazakhstan, 2.1 per cent for Mongolia and 8.4 per cent for Kyrgyzstan.

1.3 FOC Networks in North and Central Asia

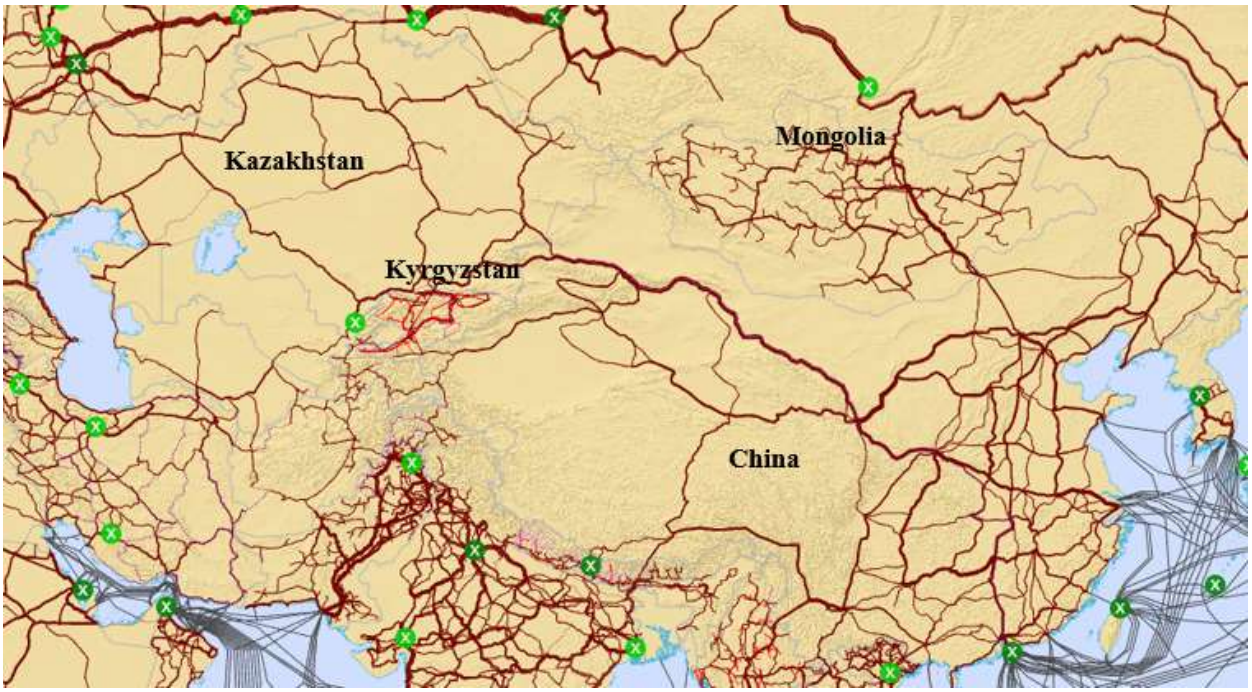
ESCAP has been promoting economic and social cooperation among its members and with the European and African regions. In China, the National Development and Reform Commission first introduced the Belt and Road Initiative (BRI) in 2013 to strengthen connectivity and economic cooperation among 60 countries in Asia, Africa and Europe. This includes cooperation in infrastructure development among the transport, energy and ICT sectors along six land and sea corridors of the BRI.

ESCAP has been working with the Government of the People's Republic of China to promote synergies between the AP-IS and BRI initiatives, to achieve mutual benefits and sustainable development, accelerate ICT infrastructure development, and strengthen economic relations between ESCAP member States.

Most countries in North and Central Asia are landlocked developing countries with dispersed settlements and harsh environments in desert and mountainous terrains. In these countries, ICT infrastructure development is particularly challenging because of the lack of economies of scale and limited investments, dependency on neighbouring countries for international connections, as well as difficulties in reaching remote and rural communities, building a resilient network and increasing bandwidth.

The three focus countries are important bridges connecting Asia and Europe, as well as East and West Asia, and hence are part of the BRI, specifically along the China–Mongolia–Russia Corridor and the China–Central Asia–West Asia Corridor. Building the ICT infrastructure along these two corridors will improve connectivity in the three focus countries through connections to submarine cable landing stations and terrestrial interconnections with other countries (see Figure 4).

Figure 4: FOC route map of North and Central Asia



Source: ITU Interactive Terrestrial Transmission/ESCAP Asia-Pacific Information Superhighway Maps. Available at http://www.itu.int/itu-d/tnd-map-public/.

2. Definition and Background of FOC Co-Deployment

2.1 Background on Facilitating FOC Co-Deployment

Since the liberalization and privatization of the telecommunications sector worldwide in the 1990s, ICT has spread rapidly to become an indispensable tool for the daily economic and social activities of individuals, enterprises and governments. Contributing to this growth is the increase of Internet services over fixed and mobile telecommunications networks with the evolution of fibre-optic and wireless communications technologies, and the expansion of IP-based networks. But generally, the privatized telecommunications service market has not been able to meet the rapidly rising demands for high-speed Internet connectivity.

The copper-based telecommunications infrastructure that was built along roads and railways since the introduction of traditional telecommunications services such as telegrams and telephone, was developed and managed by the government. But following privatization, these infrastructure services had to be individually developed and managed by multiple operators. To meet the demands for high-speed broadband Internet, the legacy copper-wire system needs to be replaced with the FOC system.

Developed countries have been able to cover the high investment costs for the deployment of FOCs, but it remains a challenge for many developing countries, as evident in the latter countries' dependence on wireless networks. As developing countries roll out 2G and 3G mobile services, wireless networks have become the means to access the Internet for an increasing number of people, which affects the development of wired-broadband networks. However, with 4G, 5G and next generation mobile services, there is an urgent need to improve the wired-broadband networks that mobile networks are dependent on to meet the demands for high-speed and high-quality data transmissions. This involves building the FOC network at both inter- and intra-country levels as copper-based digital subscriber line (DSL) technology can no longer support the broadband needs of users. In fibre-rich countries, the backhaul media between mobile switching office and radio base stations is replaced by fibre-to-the-antenna (FTTA) new technology beyond end to end microwave system or fibre to the base station (FTTB). In case of fixed internet, fibre to the home (FTTH) and fibre to the desk (FTTD) technologies are becoming common, replacing copper-based cabling.

Telecom operators in developing countries recognize the need to deploy additional FOCs, but fierce competition among multiple privatized operators to attract customers makes it difficult to share their own infrastructure. Additional barriers include the high investment costs, the long construction periods, and the difficulties in obtaining permit approval for the use, occupation and excavation of roads or other infrastructure for FOC deployment.

On the other hand, in developed countries, many IMAs in various economic sectors such as road authorities and electrical operators have installed telecommunications systems for internal use to enhance the efficiency and productivity of their core businesses, and to protect, monitor and control the facilities in their infrastructure. Often, the private telecommunications networks built by the IMAs cover remote areas and routes that telecom operators do not service.

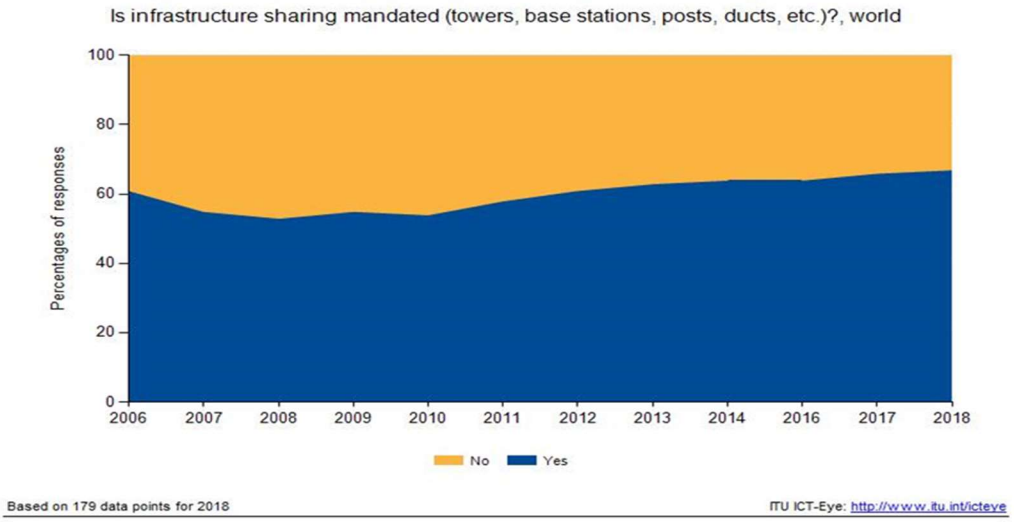
Recent development projects such as airports, seaports, new smart cities, commercial complexes, industrial complexes and inter-modal transit centres that are being implemented with private capital or through public-private partnerships (PPPs) are building not only power, gas, water and sewage systems along roads, but also FOC networks.

FOC co-deployment generally refers to the joint-construction and sharing of infrastructure (mainly real estate and fixed assets comprising land, conduits, chambers, ducts, manholes and handholes) across various sectors of the economy. For example, telecom operators could cooperate with other telecom operators or with IMAs of road, rail and electric power networks to install conduits, ducts and FOCs.

Almost all countries have experienced the co-deployment of telecommunications facilities by building owners in public and private buildings. When constructing new buildings, copper wire-based telephone lines are often installed simultaneously with electrical facilities, and water and gas pipes in the buildings. Depending on the level of ICT development in the country, the legacy copper-based in-building telecommunications facilities may be replaced with fibre-based ones for broadband Internet access. In some developed countries, when constructing or refurbishing multi-dwelling units or office buildings of a certain size, it is mandatory for public and private building owners to install broadband facilities, thus reducing the burden on telecom operators and improving the broadband Internet service penetration of the entire nation.

About 70 per cent of ITU's 176 member countries have begun to promote cross-sectoral infrastructure sharing in their telecommunications business laws, as of the end of 2018 (see Figure 5). This is an important step towards enabling FOC co-deployment, which can accelerate the roll out of a broadband infrastructure and minimize costs.

Figure 5: Global trends for mandated infrastructure sharing



2.2 Definition and Scope of FOC Co-Deployment

FOC co-deployment is defined as concomitant deployment of ducts and/or FOCs during the construction of infrastructure such as new roads, highways, railways, power transmission lines and oil/gas pipelines.

There are three potential FOC route cases:

1. Route on existing infrastructure(s) with ducts, optical ground wire or overhead power ground wire (OPGW), towers and poles;
2. Route on existing infrastructure(s) without ducts, but with towers and poles; and
3. Planned route without infrastructure(s).

FOC co-deployment is possible in all the three cases described above, except for Case 2 on existing ground-type infrastructure (such as roads, highways and railways) without ducts. For the electricity infrastructure, however, FOCs can be co-deployed along towers and poles (see Table 3).

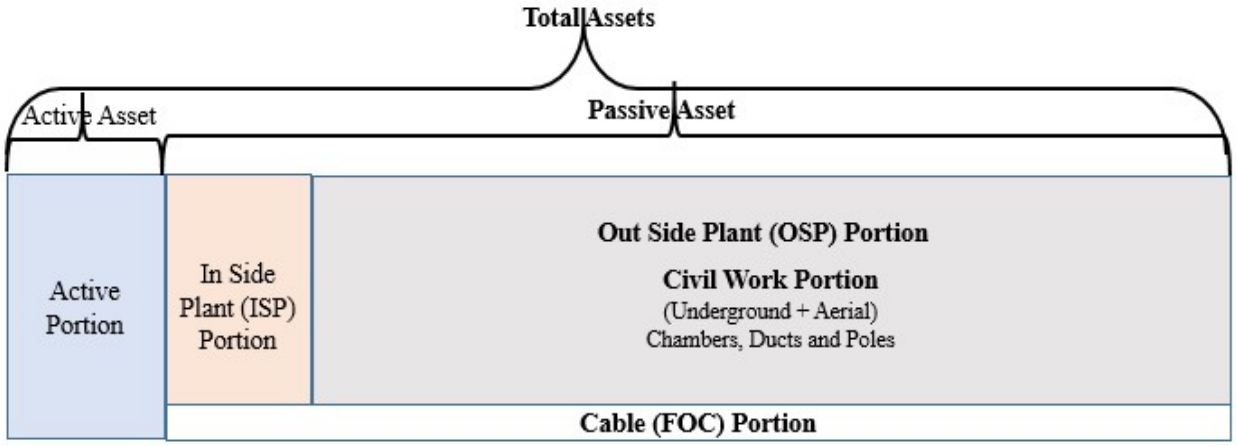
Table 3: Scope of FOC co-deployment by infrastructure type

Type	Ground Type-Infrastructure			Aerial-Type Infrastructure		
Sector	Road, Highway and Railway			Electricity		
Case	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
Available Facilities	Road with Duct	Road	None	Tower with OPGW	Tower	None
Scope of Co-Deployment	Yes	No	Yes	Yes (Fibre Lease)	Yes (New OPGW)	Yes

2.3 Cost Savings from FOC Co-Deployment

Studies have demonstrated the benefits of FOC co-deployment in both the construction and maintenance of the infrastructure. FOC co-deployment along infrastructure such as major roads, railways, power transmission lines and pipelines could save significant costs and resources as it allows one-time investment in land acquisition and construction. More specifically, FOC co-deployment could save significant costs in construction by eliminating duplicated civil works such as excavation, laying FOCs, backfilling and reinstatement, since they constitute about 70-80 per cent of investment costs (see Figure 6).

Figure 6: General assets scheme for telecom operators



Source: Author.

When civil works include materials and services (see Figure 7), the portion is almost the entire investment costs.

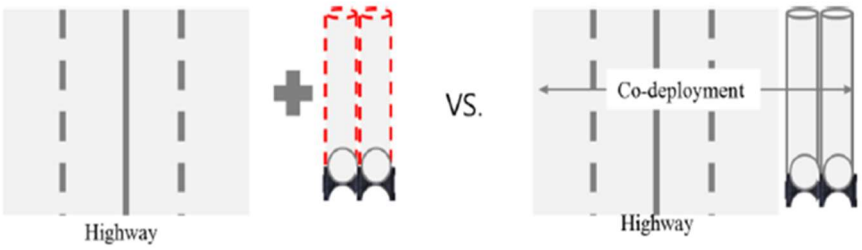
Figure 7: General scheme for infrastructure investment

Civil Materials	Civil Services
Manholes Hand-holes Duct Sub-duct Accessories	Designing Surveying Permit & Approval Excavating Chambering Ducting Backfilling Laying Warning Tape Compacting Reinstating Warning Stone & Board Sub-duct Pulling Mandrill Testing Roping As-built drawings
FOC portion Material: Cable & Accessories Service: Pulling, Splicing, Terminating & Testing and Labeling	

Source: Author.

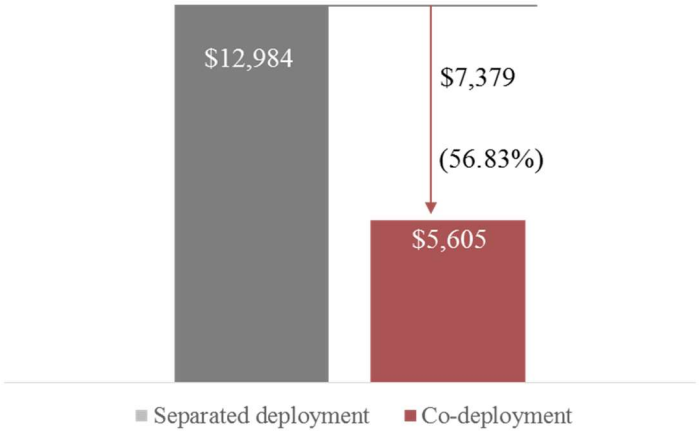
An ESCAP study that compares the cost of FOC co-deployment during highway construction with their separate deployment in Cambodia and Myanmar (Figure 8) shows that co-deployment could save USD7,379 per kilometre, or 56.83 per cent of total costs (Figure 9).

Figure 8: Separate FOC and highway deployment versus FOC co-deployment with highway construction



Source: ESCAP, "A Study on Cost-Benefit Analysis of Fibre-Optic Co-Deployment with the Asian Highway Connectivity", AP-IS Working Paper Series, April 2018, p. 16. Available at https://www.unescap.org/resources/study-cost-benefit-analysis-fibre-optic-co-deployment-asian-highway-connectivity.

Figure 9: Cost comparison between separated deployment and co-deployment



Source: ESCAP, "A Study on Cost-Benefit Analysis of Fibre-Optic Co-Deployment with the Asian Highway Connectivity", AP-IS Working Paper Series, April 2018, p. 30. Available at https://www.unescap.org/resources/study-cost-benefit-analysis-fibre-optic-co-deployment-asian-highway-connectivity.

Most of the cost savings in co-deployment are derived from eliminating overlapping civil works. Other benefits of co-deployment include the ease of obtaining rights of way (RoWs) and various other permits and approvals, minimization of disruptions to road traffic or the functioning of utilities as a result of repeated civil works, and streamlining of maintenance and repairs. For the IMAs involved in the co-deployment, it could create economic opportunities and generate additional revenues by leasing out the telecommunications ducts or FOCs, and using the FOC network to improve their business operations.

3. Case Studies of FOC Co-Deployment

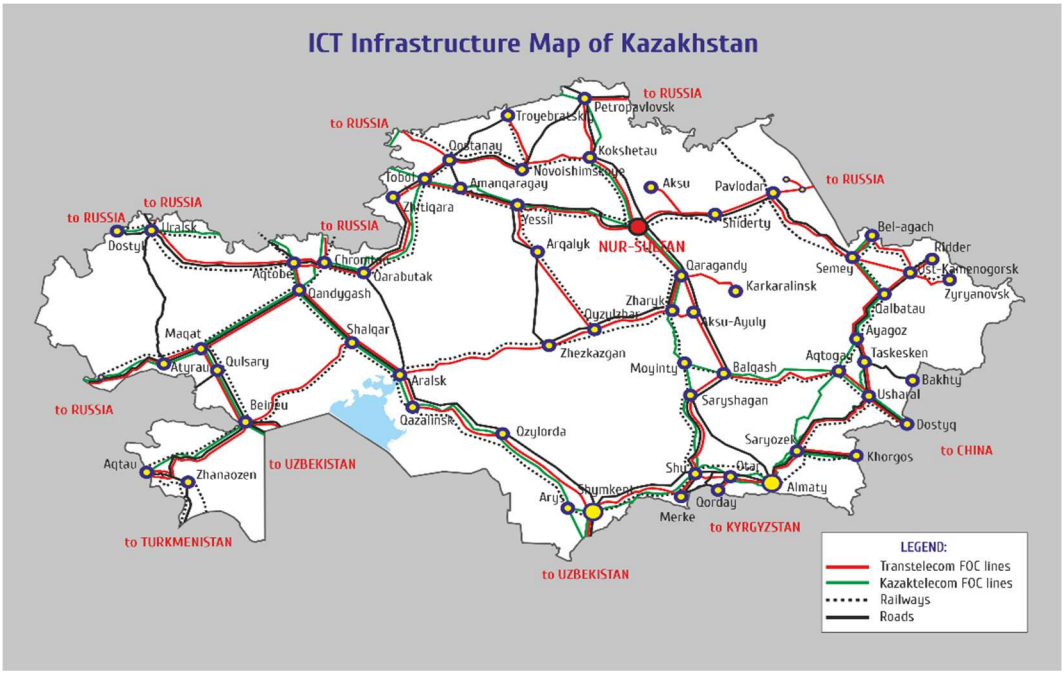
This section provides examples of FOC co-deployment with the transport and energy infrastructure, and among telecom operators in Kazakhstan, Kyrgyzstan, Mongolia and the Republic of Korea.

3.1 Kazakhstan

3.1.1 FOC Co-Deployment with Transport Infrastructure

Since independence, over 12,500km of FOCs have been laid in Kazakhstan, mostly along existing roads and railways. This includes the construction of the National Information Super Highway by the semi state-owned telecom operator, Kazakhtelecom Joint Stock Company (JSC) (see Figure 10).

Figure 10: Map of the ICT infrastructure in Kazakhstan



Source: Author based on ITU maps and open sources data.

In order to enable high-speed connection with international networks, a few "digital bridges" were put in place to connect Kazakhstan's FOC network with the ICT infrastructure of Kyrgyzstan, Russia, Uzbekistan and China. As a result of these efforts, the country's telecommunications network was fully digitized by the end of 2015.

There has also been significant progress in the development of rural telecommunications services. All rural settlements with more than 50 people have been provided with telephony services and broadband Internet access through CDMA/EVDO technology, and works are in progress to provide many of them with FOC-based Internet within a few years to help address the digital divide. These projects will deploy FOCs mostly along the existing network of local roads outside the settlements and will use as much as possible the existing underground telephonic conduits inside the settlements.

From 2010 to 2014, fibre-to-the-home FOC networks were built that provided a pool of over 630,000 ports. Today, FOC networks cover the cities of Almaty, Nur-Sultan (previously Astana), and all regional centres and cities of regional significance. As of 2017, the number of broadband subscribers using fibre-to-the-home technology was about 600,000. The deployment of FOCs inside these big cities was largely along existing underground telephonic facilities built decades ago, thus required minimum civil works.

To improve rural access to high-speed Internet, the Government of Kazakhstan placed in 2018 a contract for the deployment of 6,000km of FOCs to rural settlements under a 14-year PPP scheme. The project will be implemented by a consortium of telecom operators, including Transtelecom

JSC that already owns and operates about 16,000km of trunk FOC routes, mostly along the existing road and rail infrastructure.

This project aims to provide FOC connectivity to 5,574 rural settlements with 4 million inhabitants and 1.3 million households, about half of which are to be covered by the end of 2019.[3] If the project is implemented successfully, several thousands of government agencies and state-financed institutions such as schools, medical facilities, courts and police stations will have at least 10Mbps broadband Internet services. The project intends to deploy FOCs along existing rural roads and street networks. In the villages, the underground conduits will also be used where available, thus demonstrating a case of infrastructure sharing between various IMAs.

However, given the high cost of FOC deployment and low return on investment in small rural communities, the project does not intend to provide direct Internet connection to low-income rural households, but focus on providing public electronic kiosks and Internet access points. Alternative technologies to enable high-speed connectivity in remote villages are presently being investigated by the Government of Kazakhstan jointly with telecom operators, to enable direct Internet access in households, with service level guarantee of availability, reliability, speed and latency.

In the course of the Nur-Sultan–Shchuchinsk and Almaty–Kapchagay road reconstruction in 2010-2015, the national road operator, KazAvtoZhol JSC, laid FOCs along a few sections of the roads. These FOC routes were deployed to enable KazAvtoZhol's operation of its ITS (mainly toll collection facilities) on these roads,[4] and were not originally intended for use by telecom operators or other third-party entities. Following the success of this project, KazAvtoZhol has made plans to co-deploy FOCs in subsequent road projects that require ITS, and has become a pioneer in FOC co-deployment with the road infrastructure in Kazakhstan.

KazAvtoZhol realizes that the lease of FOCs built under these road projects to private telecom operators could be an attractive business opportunity, which could help to recover the cost of operation and maintenance of the ICT infrastructure, and generate additional revenue. However, a mechanism must be put in place with the allocation of dedicated resources and the building of competencies to manage the marketing, technical, legal and contractual aspects of the lease.

Prospective Transport Infrastructure Projects for FOC Co-Deployment

As part of the digitalization of transport and logistics in Kazakhstan, a comprehensive ITS is being created by the Ministry of Industry and Infrastructural Development, consisting of eight subsystems divided into republican and regional levels. At the republican level, the ITS comprises four subsystems, as follows:

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[3] Информация о достижениях курируемой отрасли за 25 лет Независимости Республики Казахстан, updated on 30 March 2018. Available at http://mic.gov.kz/sites/default/files/pages/prilozhenie_rus_0.docx (in Russian).

[4] Normally, the deployment of ITS in Kazakhstan uses the existing FOC infrastructure of the national telecom operator, Kazakhtelecom.

1. An integrated subsystem covering road user charges collection on toll roads, traffic information and driver warning subsystems, which have already been deployed by KazAvtoZhol on Nur-Sultan–Temirtau, Almaty–Kapchagay and Almaty–Khorgos highways with a total length of 469km.[5] Works are in progress to deploy toll collection facilities on 13 more sections (5,500km) of the republican highways with the introduction of 16 toll roads in total by 2020.
2. The special automated measurement tool (SAMT) for weighing of vehicles in motion, monitoring of traffic intensity and electronic registration of travel permits. Twelve SAMT points were commissioned in 2018 with the planned increase to 46 points by 2020.
3. The road assets management system that aims to optimize road expenses based on actual road condition data. Established in 2019, the National Centre for the Quality of Road Assets is the operator of this system. The economic effect of improved roadworks planning is estimated at USD290 million by 2025.
4. The route adherence monitoring and dispatching subsystem that aims to improve road safety for both freight and passenger traffic. This subsystem is a private financial initiative.

At the regional level (which includes cities), the ITS will be comprised of four subsystems: photo and video recording, passenger transportation monitoring and e-ticketing subsystem, traffic management system, and parking management system.

The digitalization agenda of the transport sector could promote FOC co-deployment with the transport infrastructure in Kazakhstan, and contribute to the achievement of the country's goals outlined in various policy and programme documents.

For instance, the National Plan for Infrastructural Development of Kazakhstan 2020-2025 envisions the deployment of ITS along over 6,000km of republican roads as part of the transport digitalization process in the country. The length of toll roads will double by 2025 reaching over 12,000km and many of them will require the building of new ICT infrastructure to operate the ITS. The plan further envisages rehabilitation of over 20,000km of local roads connecting rural settlements to each other and to the republican road network. FOC co-deployment with these road projects could accelerate the development of the ICT infrastructure and save costs.

An opportunity for FOC co-deployment with the railway infrastructure is in the Dostyk–Zhezkazgan–Iletsk railway project. This project aims to modernize five large railway stations along the track, including renovation and installation of auxiliary facilities such as power supply and communications lines. The overhaul of the existing passenger terminals at railway stations could also include the installation of ducts and FOCs.

Another opportunity is the planned high-speed railway project along Shymkent–Tashkent, where around 300km of new railway lines will be built by 2023 to connect the city of Shymkent with the capital city of Uzbekistan, crossing districts and rural hinterlands of the densely populated Southern Kazakhstan. FOC co-deployment along the new line could provide broadband

[5] To operate the ITS, the national road operator, KazAvtoZhol, deployed its own FOC routes along a major part of these three highways.

connectivity to many rural communities in the region, and lead to the establishment of cross-border terrestrial FOC connections.

Policy, Legislation and Governance

The national policy document on ICT development in Kazakhstan is "Digital Kazakhstan 2018-2022", approved by the Governmental Decree No. 827 in December 2017. The Digital Kazakhstan programme aims to enhance the competitiveness of the national economy and the quality of life of communities by developing a digital environment in line with the following five goals:

1. Digitization of the economy – Reorganization of Kazakhstan's economy using groundbreaking technologies and possibilities that increase labour productivity and lead to capitalization growth.
2. Transition to a digital state – **Transformation of the infrastructure** to provide services to the population and businesses that fully align with their demands and expectations.
3. Implementation of the Digital Silk Way – **Development of a high-speed and secure infrastructure** for data transfer, storage and processing.
4. Evolution of the human capital assets – Advancement of a creative society and transition to a knowledge-based economy.
5. Creation of an innovative ecosystem – Building of a favourable digital environment for high-tech entrepreneurship and innovations in industries through strong partnerships between public, private and academic actors.

The programme expects an estimated USD400 million from the National Budget of Kazakhstan and about USD470 million from quasi-governmental organizations. According to preliminary estimates, direct benefits from the digitization of the Kazakhstan economy will value around USD4.6 billion-USD5.1 billion, with a return on investment of 4.8-6.4 times the total investments (including private investments), by 2025.

The Digital Kazakhstan programme, however, does not consider FOC co-deployment with other infrastructure networks. There may be a lot more opportunities for FOC co-deployment along various infrastructure networks with the implementation of the programme, which already has around 10 ITS-related projects. This programme could be a way forward for the elaboration and implementation of relevant legislative acts to define, systematize and promote FOC co-deployment, and provide a strong kick-off for the necessary institutional reforms to make FOC co-deployment a legitimate and integral part of national infrastructure projects.

It is therefore strongly advisable that the Government of Kazakhstan incorporate FOC co-deployment in the programme, which would help to accelerate digitization and save significant costs. The introduction of provisions to support coordinated development of the ICT infrastructure with other sectors would be important.

The ICT sector in Kazakhstan is closely regulated by a variety of legislative acts comprising over 300 laws, regulations, orders, rules and standards. The main legal document regulating the

development of the ICT sector in Kazakhstan is the Law on Informatization No. 418 of 24 November 2015. The key principles of the Law on Informatization are as follows:

- Development of the ICT sector through private entrepreneurship and PPP;
- Prioritization of domestic legal entities in the development of ICT and information systems;
- Provision of incentives for the development of domestic software and applications and hardware manufacturing;
- Development of the ICT market framework; and
- Support for fair competition in the ICT market.

Measures to support the development of the ICT sector, which are based on the above-mentioned principles and stated in the Law on Informatization, include:

- Creating and enhancing the regulatory framework of the ICT sector, and implementing international standards;
- Implementing and improving governmental and quasi-governmental orders for the development and supply of innovative software and applications with local content;
- Non-budgetary financing (both repayable and non-repayable) of ICT projects to enhance local content;
- Harmonizing costs for the informatization of governmental and quasi-governmental legal entities to increase the share of informatization services;
- Creating conditions for venture financing and other non-budgetary repayable financing of ICT projects; and
- Developing proposals to stimulate development of the ICT sector and its attractiveness for investing.

These principles and measures in the Law on Informatization are declarative and do not include any concrete instruments or mechanisms that would facilitate coordination among different actors involved in the process of FOC co-deployment.

The elaboration and execution of national ICT policy are the functions of the Ministry of Digital Development, Innovation and Aerospace Industry. The Committee for Communications, Informatization and Information under the ministry is in charge of national regulation and supervision, planning and use of civilian radio spectrum, and regulation of the telecommunications services market. The committee also establishes and maintains the register of government-owned Internet resources and e-government units.

The State Technical Service under the Ministry of Digital Development, Innovation and Aerospace Industry is the body that directly implements the telecommunications policy, including direct monitoring of radio spectrum and the use of radio devices, radio-electronic contamination and transmitter misuse, as well as safety standards. It also provides technical support to the centralized management systems of the national telecommunications networks, and leads the installation of data exchange points between telecom operators.

In July 2008, the Government of Kazakhstan established the Zerde National Infocommunication Holding JSC to promote the development of the ICT sector, support the implementation of breakthrough ICT projects and develop ICT standards. Since its incorporation, Zerde has been taking the lead in advancing e-government in Kazakhstan. As part of the effort to enhance cooperation among the Commonwealth of Independent States in the field of ICT, Zerde was granted the status of a Commonwealth of Independent States organization. Furthermore, Zerde hosts the Technical Committee No. 34 for ICT Standardization established by the Committee for Technical Regulation and Metrology with the purpose to coordinate the development and implementation of technical regulations in the field of ICT, including products, services and processes.

3.1.2 FOC Co-Deployment with Energy Infrastructure

FOC Co-Deployment in the Electricity Sector

In 2010, the Kazakhstan Electricity Grid Operating Company (KEGOC) established Energoinform JSC to provide reliable and effective operation and expansion of the ICT infrastructure for the power transmission network of Kazakhstan. Energoinform is licensed by the government to provide ICT services. Moreover, the organization is licensed by the local government of Nur-Sultan to design, build and install telecommunications lines.

The KEGOC may have been motivated to adopt this business model because of the success of Transtelecom. Transtelecom was originally the subsidiary of Kazakhstan's national rail operator, Kazakhstan Temir Zholy JSC, and was responsible for building the ICT network for the rail operator until 1999. Since then, however, Transtelecom has developed into one of the largest telecom operators in Kazakhstan with around 16,000km of FOC lines.

Energoinform operates three levels of telecommunications: (1) central – national dispatch centre and head office of KEGOC; (2) regional – regional dispatch centres and branches of intersystem power network; and local – the substations.

At the central level, Energoinform uses both its own digital communications lines and leased lines, including FOC lines from Kazakhtelecom, the national telecom operator. The regional ICT network across the power grid consists of power-line communications, relay lines, cable communications, FOCs and satellite channels, owned and operated by Energoinform. For communications between regional dispatch centres and energy facilities, Energoinform leases communications lines, including FOCs, from Kazakhtelecom, Kazakhstan Temir Zholy, Transtelecom and Kaztranscom, a private telecommunications company. According to the annual report of Energoinform, all these companies charge a lease fee except for Kazakhstan Temir Zholy that leases the lines at no charge, possibly because both Kazakhstan Temir Zholy and KEGOC are subsidiaries of Samruk-Kazyna JSC or the National Welfare Fund, a sovereign wealth fund.

The KEGOC Development Strategy 2018-2028 that aims to develop a unified power grid incudes digitalization of the business, and refers to Digital Kazakhstan's programme document, the president's address entitled, "Third modernization of Kazakhstan", and the Cybershield of Kazakhstan – the country's cybersecurity action plan. Moreover, the strategy aims for KEGOC to diversify its business portfolio and receive additional income, among other things, by leasing its FOC infrastructure to other telecommunications companies for commercial purposes, through Energoinform, in line with the Law on Communications.

Currently, the lease fee per kilometre of FOC lines in Kazakhstan is USD25 per month,[6] whereas the construction of FOC lines costs more than USD6,400 per kilometre.[7] Hence, leasing FOC lines is considered a more time- and cost-effective option for telecommunications companies to expand their networks.

The government project that aims to provide FOC connectivity to rural settlements could benefit from KEGOC's FOC routes by cutting the cost of construction and accelerating ICT accessibility for the sparsely populated areas of the country. The technique used in Kazakhstan of winding the FOCs around power cables (see Figure 11), could be a cost-effective option to expand the FOC network of KEGOC both for its own use and for leasing. This option is significantly cheaper and faster than other FOC deployment options.

Figure 11: Winding FOC lines around 100kV power transmission lines in Aktau

Source: Teralink. Available at http://new.teralink.ru/news/95-vols-vl-aktay2017 (accessed on 3 September 2019).

Potential clients that KEGOC could lease their FOC lines to include the mobile network operators that are motivated to expand their network coverage and increase their mobile broadband capacity.

[6] http://repository.enu.kz/handle/data/13441 (this link is broken, please check)

[7] Kcell, "Совместное строительство ВОЛС Kcell/TNS-Plus", 23 March 2018. Available at https://www.kcell.kz/ru/purchases/show/2474?purchasesId=129&year=2018&key=purchases.list (in Russian).

The use of the fibre-to-the-antenna architecture could potentially improve access to mobile broadband services in the rural areas of Kazakhstan.

The Kazakh electricity grid is currently interconnected with Uzbek, Kyrgyz and Russian grids. However, there are no reports of intercountry FOC co-deployment plans. The obstacles include the lack of harmonization of national legislations, lack of communication and understanding among regulators, and lack of political will among the governments. Another major obstacle is the budget constraints to co-deploy FOCs across borders. A potential opportunity to promote cross-border FOC co-deployment along the electricity grid is through the Central Asia South Asia (CASA)-1000 project. Such an initiative would need to address the obstacles mentioned above.

FOC Co-Deployment along Gas and Oil Pipelines

The oil and gas sector is of a strategic importance to Kazakhstan, hence, the development and reliable operation of the oil and gas pipelines are the country's strategic priorities. It is therefore not surprising that the National Law on Main Pipelines specifically states that pipelines should have their own telecommunications infrastructure. For instance, state-of-the-art ICT technologies have been used in the construction of the Central Asia–China gas network. But currently, the FOC network along the pipelines are only being used as a monitoring system to ensure the reliable operation of the pipelines, and not for business diversification and an additional source of revenue.

Kazakhstan has pipeline connections to all countries of Central Asia, Russia and China, and thus, has significant potential for intercountry FOC co-deployment. Yet, oil and gas pipeline operators are cautious of the potential breach of the state secrecy legislation, which considers data on the utilization of subsoil assets as state secret.

Probably the most viable pipelines for FOC co-deployment are the oil and gas pipelines to China as they are co-owned by Kazakh and Chinese operators with advanced ICT technologies. Since FOC lines to China already exist with three international transit points of forty 10G channels, FOC co-deployment along oil and gas pipelines that are initiated and financed by the Chinese counterparts would be accepted by Kazakh operators. This is because it would contribute to income diversification and digitalization of the Kazakh economy, which is in line with the national strategy to diversify the economy in time of fiscal constraints. Furthermore, oil and gas operators in Kazakhstan have significant power to lobby legislative and regulatory changes to enable cross-border FOC co-deployment projects.

Prospective Energy Infrastructure Projects for FOC Co-Deployment

Within the energy sector, FOC co-deployment along the power grid appears to be the most promising as KEGOC has a strategy in place that encourages FOC co-deployment, and has established an ICT subsidiary, Energoinform. In contrast, the oil and gas pipeline operators would still need awareness raising about the potential and benefits of FOC co-deployment.

A candidate project for FOC co-deployment with the energy infrastructure in Kazakhstan is a pilot project along the 500 kV lines with OPGW connecting the North-South electric zones of Kazakhstan. As the electricity lines run across several provinces of Kazakhstan such as Pavlodar,

Karagandy, Zhambyl and Almaty, FOC co-deployment could contribute significantly to improved ICT connectivity in the rural settlements of Kazakhstan.

3.1.3 FOC Co-Deployment among Telecom Operators

The co-deployment of the ICT infrastructure among various telecom operators in Kazakhstan is present in the form of sharing of conduits, ducts, pipes and towers to save costs. Some companies cooperate more actively and share their FOC routes. For example, SvyazServisKomplekt in Almaty deploys fibre lines in existing telephone conduits and leases dark fibres to various customers, including telecom operators. The number of cores for lease is based on actual demand to avoid leasing excess capacity that can be costly and unnecessary, and allow sharing of a cable among several users.

There are, however, no regulatory requirements to share the ICT infrastructure and promote FOC co-deployment. The presence of regulations could facilitate the expansion of FOC coverage for end users while helping to preserve a reasonable level of tariffs by minimizing capital costs.

In 2016, two major telecom operators – Kcell and Beeline – launched a joint project to develop the ICT infrastructure for 4G networks nationwide. Within two years of project implementation they have significantly increased the coverage and capacity of their cooperative network at much lower cost compared to discrete deployment. Even by international standards, the project is an excellent example of joint development of the ICT infrastructure by private telecom operators, which is in fact quite rare in the North and Central Asia subregion. More commonly, different telecom operators would lay FOCs parallel with each other along the same routes, despite the presence of excess throughput capacity, and the possibility to share infrastructure.

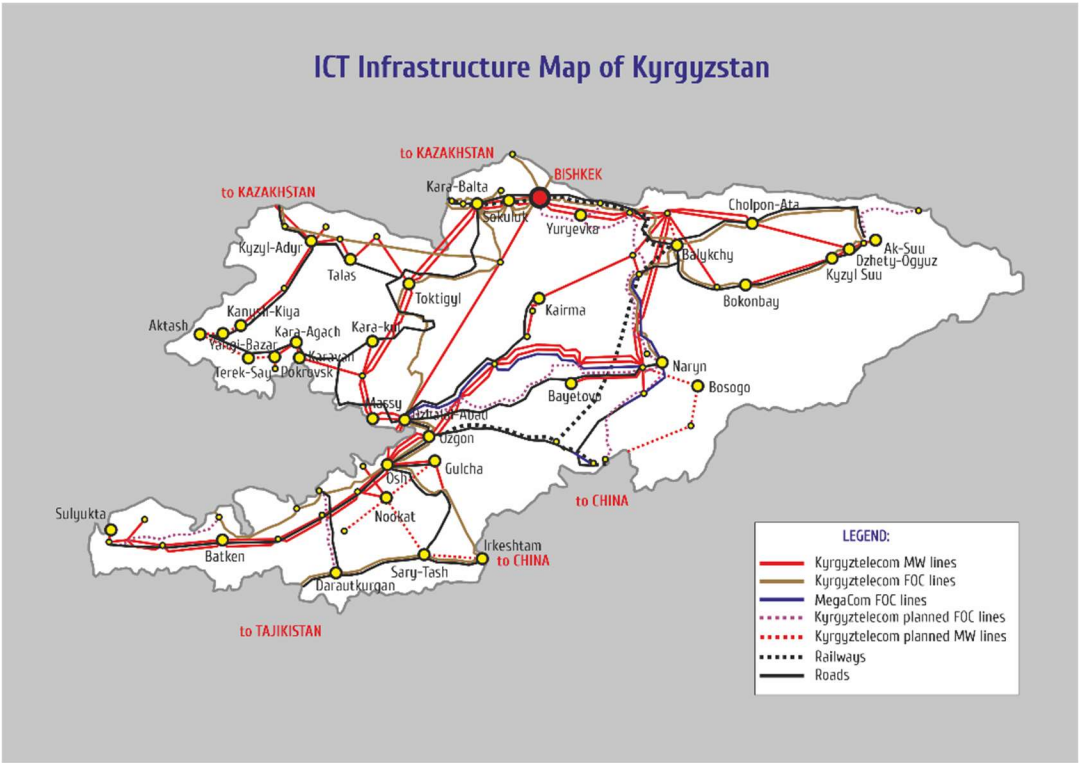
This joint project was initially designed for a 10-year period. However, with the change in the principal shareholder of Kcell in 2018 (after the purchase of 75 per cent of its shares by Kazakhtelecom), the partnership was terminated. The main cause of the termination was the fact that the new principal shareholder, Kazakhtelecom, already possesses an advanced network of ICT facilities and FOC routes that is now available for use by Kcell.

3.2 Kyrgyzstan

3.2.1 FOC Co-Deployment with Transport Infrastructure

As of the end of 2018, the total FOC network in Kyrgyzstan spanned 21,279km, of which 9,478km were trunk fibre lines (see Figure 12) mostly laid along existing road and rail networks.

Figure 12: Map of the ICT infrastructure in Kyrgyzstan



Source: Author based on ITU maps and open data.

The fixed-line market in Kyrgyzstan is divided between four top-level telecom operators – Kyrgyztelecom, Elcat, SaimaTelecom and Megaline. Each operator has its own international connection. Kyrgyztelecom is the country's incumbent operator for fixed-line connections, holds 60 per cent of market share, and is the leading investor in the FOC infrastructure. The Government of Kyrgyzstan owns 78 per cent of shares in Kyrgyztelecom.

Kyrgyztelecom has implemented several projects to build interregional FOC networks connecting the northern and southern regions of the country, which were partially deployed along the existing road network. To promote broadband connectivity in Bishkek, a nationwide FOC infrastructure was deployed by Kyrgyztelecom with the first 308km-long interregional FOC route (Bishkek–Talas) laid in January 2013.

Other providers of broadband access include ElCat, Aknet, Asiainfo, Megaline, Saima Telecom, Citynet, Homeline, Totel and Fastnet. Some of them have been able to deploy wireless broadband networks (LTE and WiMAX) to operate in areas where wire connection is not available.

Fixed-broadband access such as fibre-to-the-x and xDSL is readily available in Bishkek and Osh, the second largest city in the country where FOC lines are mostly laid along the existing underground infrastructure. In rural areas, only Kyrgyztelecom provides xDSL broadband access, which clearly shows the sharp digital divide between rural and urban areas.

Kyrgyzstan's international connectivity consists of four links to Kazakhstan (including connectivity via a tunnel under the Chu River) and two to China. Connections to Tajikistan and Uzbekistan exist but they are not widely used because of their high transit charges compared with what Kazakhstan charges. Sources have indicated that the Kyrgyztelecom link to China is now primarily used to provide transit capacity to Tajikistan.

As a landlocked country, Kyrgyzstan is dependent on terrestrial connections with neighbouring countries for access to international networks. Kyrgyz operators have 22 external gateways at the border that provide access to traffic from China, Kazakhstan, Tajikistan and Uzbekistan, but virtually all international traffic passes through Kazakhstan.

Kyrgyzstan is participating actively in the Digital CASA regional programme that aims to increase access to affordable Internet and improve the government's capacity to deliver digital government services by contributing to the development of a regionally-integrated digital infrastructure and a regionally-harmonized enabling environment. The project is expected to lead to increased economic growth, improved employment opportunities, better service delivery by government and the private sector, and overall improved investment climate, thus creating the foundations for the development of the digital economy in Kyrgyzstan and in the Central Asia region in general.

The programme supports the development of a reliable, redundant and resilient regional backbone network, consisting of both existing and new networks that provide multiple cross-border connectivity routes and reach every district and municipality within the country. This will enable telecom operators to expand and share their existing regional and domestic FOC links, establish new cross-border FOC links to strengthen connectivity with neighbouring countries, and deploy high-capacity domestic FOC networks. The programme will also support infrastructure-sharing arrangements with other IMAs, such as transport companies and electricity transmission companies (e.g., CASA-1000 and Kyrgyz National Energy Holding Company).

In the development of ITS in Kyrgyzstan, the World Bank supported a project in 2017 to equip two traffic control units at Kemin (101st km of Bishkek–Naryn–Torugart road) and Sosnovka (81st km of Bishkek–Osh road) with automatic vehicle monitoring systems. The system provides dynamic tools to measure and record axle loads and dimensions of trucks in motion. Subsequently, the World Bank supported the implementation of similar systems in the north of the country at Kara-Tai (Osh–Sary-Tash–Ishkertam road) and Zhan-Aryk (Bishkek–Osh road). There are 24 weight-checking stations in Kyrgyzstan in total scattered mostly along the backbone national highways bearing heavy transit and domestic trucking traffic.

Reportedly, there are over 120 enterprises active in the field of ITS in Kyrgyzstan, such as equipment manufacturers, integrators, telecom operators and resellers whose efforts, however, are not well coordinated or regulated at the macro level. As a result, each transport subsector has developed its own information system to address its internal issues and does not collaborate or co-deploy with other subsectors.

Prospective Transport Infrastructure Projects for FOC Co-Deployment

Kyrgyzstan aims to expand the network of international roads, including the construction of an alternative north-south highway and the reconstruction of the Bishkek–Osh, Tyup–Kegen, Bishkek–Naryn–Torugart, Kochkor–Aral and Osh–Batken–Isfana–Khujan routes. The construction of the Balykchy–Karakol road and Tyup–Kegen highway will continue. According to the National Action Plan for Road Sector Development 2016-2025 approved by the Governmental Decree No. 372 on 1 July 2016, 500km of national highways will become toll roads by 2025. There are three pilot projects being considered for PPP-based toll roads that could potentially include the co-deployment of FOCs:

1. Transfer of the Kuvaky Mountain Pass (25.68km-long section of Bishkek–Naryn–Torugart road rehabilitated in 2013 at USD13.1 million) to a PPP concession. The private partner is expected to supply the equipment and deploy the toll collection and weighing-in-motion system, which are expected to be repaid from tolls over the concession period.
2. Construction of the Uzgen bypass road as part of the Bishkek–Osh highway. Four alignments have been proposed by Kyrgyzdortransprojject, a road design institute, varying from USD7 million to USD15 million. A feasibility study and detailed engineering design are being developed.
3. Construction of a direct road link from Almaty (Kazakhstan) to Issyk-Kul to provide a new cross-border land corridor from Kazakhstan to the Issyk-Kul region of Kyrgyzstan, which will considerably reduce the travel distance to the world-famous Issyk-Kul lake. A pre-feasibility study was conducted in 2008 that identified three possible layouts for the new route ranging from USD91 million to USD114 million. However, an updated and expanded feasibility study needs to be conducted prior to implementation. Kazakhstan has also been considering this project for several decades, therefore, the two countries' political will to cooperate could help move the project forward. This could be a good candidate project for cross-border FOC co-deployment along the new route.

According to the Kyrgyz Ministry of Transport, implementation of the toll mechanism in the above-listed road projects, as well as the proposed PPP initiatives, will help to cover up to 30 per cent of the country's annual road maintenance budget. However, the success of the proposed road projects and PPP initiatives will depend largely on the availability of reliable ICTs, including FOCs. Hence, FOC co-deployment with these projects and initiatives should be seriously considered. Moreover, with the difficulties in executing civil works in the mountainous landscapes of Kyrgyzstan, the "dig-once" principle along roads is strongly recommended in which all utilities and FOCs are installed during road construction.

As stated in the Railway Transport Development Plan 2014-2020, the Kyrgyz Temir Zholu (Kyrgyz Railways) plans to deploy FOCs along the 347km-long Lugovoye–Bishkek–Rybachye line. The goal of the rail industry in Kyrgyzstan is to create a balanced rail network and provide seamless connection between the isolated northern and southern sections of the national rail system. The country plans to continue negotiations on the construction project of the China–Kyrgyzstan–Uzbekistan transnational rail network. These projects may be good opportunities for FOC co-deployment.

To promote urban digitalization, the Government of Kyrgyzstan has plans to implement several ICT projects during 2018-2023, including the deployment of smart city projects and ITS in the cities of Bishkek and Osh. The projects are planned as PPPs and are estimated at USD80 million. Reportedly, the FOC routes to traffic lights will be laid by Kyrgyztelecom. The co-deployment of FOCs along road and rail networks in cities could optimize the cost and time of smart city and ITS implementation.

Policy, Legislation and Governance

Prior to 2018, plans for the development and effective use of the ICT infrastructure were detailed in the National Sustainable Development Strategy 2013-2017. In December 2018, the Security Council of Kyrgyzstan approved the national concept for digital transformation entitled, "Digital Kyrgyzstan 2019-2023", which was developed in line with the National Development Strategy 2018-2040. Digital Kyrgyzstan defines the structure, management system and foundation for digitalization of the country in line with the following three goals:

1. Creating new opportunities for the population through the development of digital skills;
2. Providing high-quality digital services, improving efficiency, effectiveness, openness, transparency and accountability, fighting corruption in the public administration system, and increasing the level of citizen involvement in the processes of making state and municipal decisions through digital transformation of the state and municipal government; and
3. Ensuring economic growth through digital transformation of priority sectors of the economy, strengthening of international partnerships and creation of new economic clusters.

The Digital Kyrgyzstan further details three priority areas for reform and improvement in the medium term:

1. Digital transformation of business processes and production chains, the introduction of financial technologies, the provision of competent specialists and **the development of ICT infrastructure and digital platforms,** especially in the priority sectors of the economy, designated in the National Development Strategy 2018-2040 to improve the efficiency and competitiveness of domestic companies and strengthen the export potential of the country;
2. Alignment with the digitalization strategies of Kyrgyzstan's partner countries in the Eurasian Economic Union's digital agenda to 2025, revival of the digital Silk Road through the BRI, and other international initiatives **to develop the regional digital**

infrastructure, opening up new opportunities for the private sector to expand markets, creating new types of goods and services, and participating in the global production chain; and

3. Development of digital technologies and **reduction of barriers to their development,** which will help to create new economic clusters in the country. Providing automatized solutions to routine and repetitive tasks, ensuring complete traceability of transactions, and applying blockchain and other technologies will expand the capabilities of the private sector in developing and exporting new technological solutions, thereby creating innovative and creative clusters of the economy.

In order to support the implementation of Digital Kyrgyzstan, the President of Kyrgyzstan has declared 2019 the "Year of Regional Development and Digitalization". The ICT Council, established in 2013 under the Government of Kyrgyzstan, is coordinating the development and execution of national policies in the areas of informatization and telecommunications. The members of the ICT Council are appointed by the Prime Minister of the country.

Coordinated development of the ICT infrastructure and FOC co-deployment with the road and rail sectors are not considerations in Digital Kyrgyzstan and its implementation.

The core legislation governing the ICT sector in Kyrgyzstan is the 2017 Electronic Governance Law passed to replace the 1999 Informatization and Electronic Governance Law. The law outlines the basis for an information infrastructure, as well as associated legal, economic and institutional relationships. The 1998 Electronic and Postal Communications Law, amended as of May 2019, provides the legal grounding for communications networks, services and their providers. According to Article 33 of the law, telecom operators are mandated to provide access to their infrastructure to other telecom operators and service providers.

There are no restrictions from the current national legislation on infrastructure sharing. For example, according to Article 32 of the Telecommunications and Postal Services Law, in the planning and development of cities and other localities, including buildings and complexes, the architectural and city entities are mandated to take into consideration the telecom operator's requirements on allocation of their equipment and assets.

Telecom operators may be granted RoW to public infrastructure such as roads and tunnels for the construction of the ICT infrastructure. Telecom operators may also build and maintain the ICT infrastructure on other IMAs' networks based on signed agreements with the IMAs.

At the same time, there is no specific legal act or regulation governing the way the land area of roads should be used. This leads to uncertainties in granting RoWs for the installation and operation of the ICT infrastructure along roads, and the lack of coordination among the government agencies and state-owned enterprises.

Most recent by-laws include regulations on telecommunications licensing, rules for provision of mobile communications services and mandatory certification of communications equipment. There is also a law on licensing of the radio frequency spectrum. The variety of laws and by-laws provide the basis for media, broadcast media, access to information and protection of personal data.

But presently, the legislation of Kyrgyzstan does not contain a definition of co-deployment, nor does it provide a mechanism for coordinated development between the transport infrastructure and ICT.

The implementation of national policies and programmes in the areas of connectivity improvement and e-governance is under the responsibility of the State Committee of Information Technologies and Communications, established in June 2016. The head of this committee has two deputies who are responsible for telecommunications and the ICT infrastructure, and for e-government, cybersecurity and project implementation.

The telecommunications licensing rules in Kyrgyzstan appear to be transparent and non-discriminatory. The State Communications Agency is officially a separate legal entity with a director appointed by the Prime Minister. Although this agency performs telecommunications licensing, monitoring and analytics functions to guide and support national Internet development efforts, the level of independence is insufficient to fully qualify as a strong independent telecommunications regulator.

In addition, there are other agencies that oversee different components of the domestic Internet environment. The Antimonopoly Committee controls the tariffs of Kyrgyztelecom; the State Agency for Architecture and Construction handles permits for laying fibre and setting up ducts, poles, and mobile towers; and the Border Control Agency oversees border area construction including fibre crossing over international borders.

3.2.2 FOC Co-Deployment with Energy Infrastructure

FOC Co-Deployment in the Electricity Sector

The electricity sector is one of the most significant sectors of the Kyrgyz economy. It plays an important role in the country's development as a supplier of electricity for the domestic market as well as for some export markets. By the end of 2018, the total length of the high voltage (110/220/500kV) electricity transmission lines owned by the National Electrical Grid of Kyrgyzstan is 7,548km. The National Electrical Grid has OPGW along its electric power transmission network (24-48 fibres with STM-16 transmission systems), installed under projects supported by the Asian Development Bank and the Government of China (Datka–Kemin and Kemin–Kambarata 2) with a total length of 1,316km. As of now, the installed ICT system is only for internal use by the National Electrical Grid.

Despite the achieved improvements over the past years, the Kyrgyz energy sector still faces many systemic challenges, including its dire financial situation, inadequate reliability and poor quality of services. In order to address these challenges and facilitate the implementation of the Energy Sector Development Strategy, the Government of Kyrgyzstan opened its door for a significant inflow of foreign investments for several projects, including:

- **CASA-1000** (total investment amount of USD233 million, including USD45 million from the World Bank, USD90 million from the European Investment Bank, and USD50 million from the Islamic Development Bank) to be implemented in 2019-2022 in parallel with the construction of the 500kV power transmission line (477-km long) from Datka (Kyrgyzstan) to Sugd (Tajikistan), of which about 450km pass across Kyrgyzstan (see Figure 13).

- **Energy Sector Development Project** (with Asian Development Bank financing of USD44.8 million) implemented in 2013-2017, introducing elements of the supervisory control and data acquisition (SCADA) system, such as electricity consumption meters, and installation of new OPGW along the 220-110kV distribution line (523-km long).

Figure 13: Overview of the CASA-1000 Project

Source: CASA-1000. Available at https://www.casa-1000.org/ (accessed on 30 May 2019).

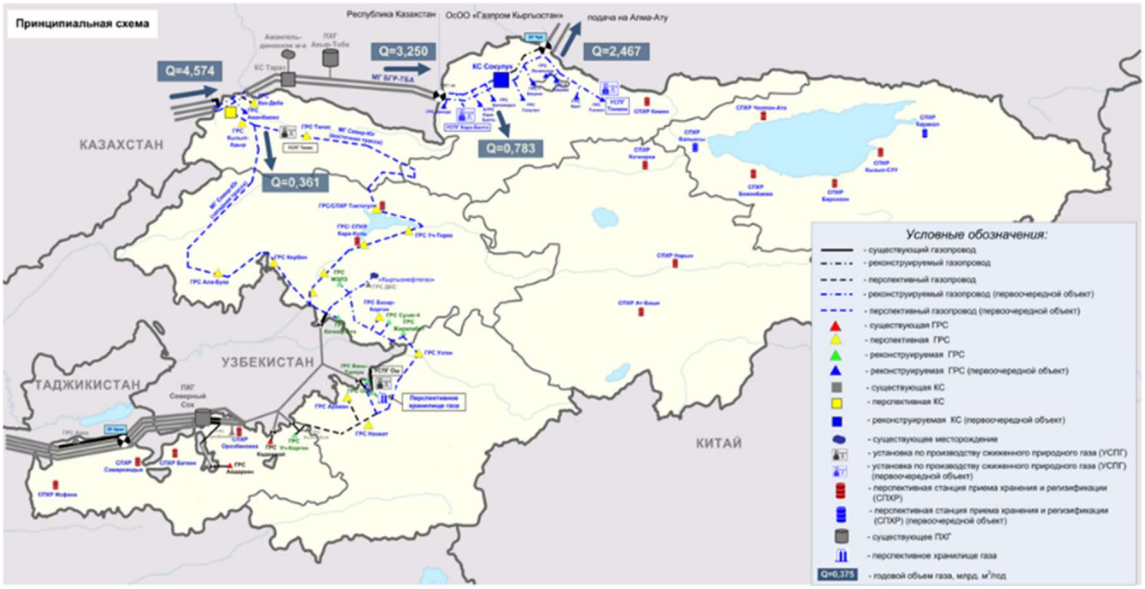
At present, FOC co-access, co-construction and co-deployment between the energy sector and telecom operators are not supported by the energy sector owners for security reasons. The only case of FOC co-deployment between the energy sector and telecom operators is the leasing of electric towers by telecom operators to install FOCs through agreements signed between telecom operators and electric companies (the agreed tariff is about KGS30 per tower). However, this arrangement is only provided by distribution electric companies and not for the high-voltage transmission electric power network. Also, the leasing applies to domestic power lines only and not to international ones.

FOC Co-Deployment along Gas Pipelines

In 2013, the governments of Kyrgyzstan and Russia signed an agreement to cooperate in the transportation, distribution and delivery of natural gas. Further to the agreement, Gazprom Kyrgyzstan was established and became a monopolist of natural gas importation into Kyrgyzstan. Gazprom of Russia holds 100 per cent shares of Gazprom Kyrgyzstan. At present, the total length of the Gazprom Kyrgyzstan gas pipeline transmission system is 4,195km (see Figure 14).

The Gasification Master Plan of Kyrgyzstan aims to increase gasification coverage from 30 to 60 per cent and raise gas transit up to 50 per cent, with more than 400 new localities and about 845,000 new households connected to the gas distribution networks. The total length of newly-built gas pipelines between localities is expected to increase by 4,400km. There will be 700km of distribution gas pipelines in 27 localities of Bishkek, Chu and Osh regions of the country, which will provide about 40,500 households with natural gas supply. The total amount of investment will exceed KGS35 billion (about USD500 million). According to the Gasification Master Plan, reconstruction of a 113-km Bukhara–Tashkent–Bishkek–Almaty gas pipeline is planned. This will enable the supply of natural gas not only to the North of Kyrgyzstan, but also to the Almaty and Taldykorgan regions of Kazakhstan. Another plan is to build a new North–South gas pipeline and develop autonomous gasification of Issyk-Kul and Naryn regions of Kyrgyzstan.

Figure 14: Map of gas pipelines in Kyrgyzstan



Source: Gazprom. Available at http://kyrgyzstan.gazprom.ru/d/textpage/58/88/osnovnye-napravleniya-razvitiya-sistemy-gazosnabzheniya-kyrgyzsk.png (accessed on 30 May 2019).

All FOC routes deployed along the gas pipelines are used for internal purposes only. The co-access, co-construction and co-deployment of FOCs are strongly prohibited by Gazprom senior management due to security reasons and corporate safety requirements and instructions.

According to Article 7 (Stabilization Reservation) of the Kyrgyz-Russian Intergovernmental Agreement, any national legislation adopted during the 25-year implementation period will not have any effect on the conditions of the signed agreement. Therefore, even in case of legislation improvement for FOC co-deployment, it will not affect Gazprom Kyrgyzstan's corporate decisions.

Prospective Energy Infrastructure Projects for FOC Co-Deployment

Given that the year 2019 has been declared the Year of Regional Development and Digitalization by the President of Kyrgyzstan, and with a view to support the implementation of Digital Kyrgyzstan Strategy and Action Plan for 2019-2023 and contribute to the outcomes of the High-Level International Conference on Development to be held in Bishkek on 28 November 2019, it will be timely for Kyrgyzstan to launch an FOC co-deployment project involving telecom operators and the electricity sector. This project could enhance broadband roll out and help achieve broadband targets, especially in the remote rural areas of Kyrgyzstan. The project should include not only hardware and software installations, but also the legislative and awareness raising components to showcase the feasibility and benefits of FOC co-deployment in the country and the region. This project could be implemented in the Issyk-Kul region, where tourism is actively developing around the Issyk-Kul lake.

3.2.3 FOC Co-Deployment among Telecom Operators

Similar to Kazakhstan's case, telecom operators may share their infrastructure (conduits, ducts, poles, etc.) with each other, based on lease agreements. However, in some cases, being competitors in the provision of services, they may apply unreasonably high tariff rates to get around the requirement for mandatory sharing established by the Telecommunications Law of Kyrgyzstan.

However, there are a few cases of ICT co-deployment between Kyrgyz and foreign telecom operators. For instance in 2018, Asia Unicom Limited, the Kyrgyz Internet service provider, was the first to build a high-speed communications line in the south of Kyrgyzstan using dense wavelength division multiplexing technology. It has a channel capacity of 100Gbps and the ability to expand to 2,000Gbps. This 272.6-km line runs from the Irkeshtam border crossing point at the Kyrgyzstan–China border to the Dostuk crossing point in Osh at the Kyrgyzstan–Uzbekistan border.

Through strategic partnerships with global telecommunications players, Asia Unicom has built direct connections with a number of Internet exchange points, including Hong Kong Internet Exchange, M9 (Moscow) and Moscow Internet Exchange, Amsterdam Internet Exchange, DE-CIX (Frankfurt), and DATA-IX, without intermediate caching or proxy systems. The response time to well-known Russian-language sites is less than 90ms and to European site it is no more than 120ms.

The network of Asia Unicom has multiple connections with national telecom operator, Kyrgyztelecom, and foreign operator, Uzbektelecom, which makes it a highly reliable system backed up at every segment. In Kyrgyzstan, the networks are backed up by alternative routes through both underground and overhead lines. To ensure the reliability of the network in China, it has connections with two major operators – China-Unicom and China-Mobile – with each of them having their own communications lines to M9 (Moscow) and Hong Kong Internet Exchange.

Generally, Kyrgyzstan's ICT infrastructure needs further development, especially in the fixed-broadband segment. Internet services also need to be more affordable, and the increase and diversification of international communications channels is needed. This requires significant investment in the digital infrastructure, such as FOC and fifth-generation networks. The co-deployment of the ICT infrastructure and services among telecom operators in Kyrgyzstan could accelerate its transition to a digital economy and achieve the goals of the National Development Strategy 2018-2040.

3.3 Mongolia

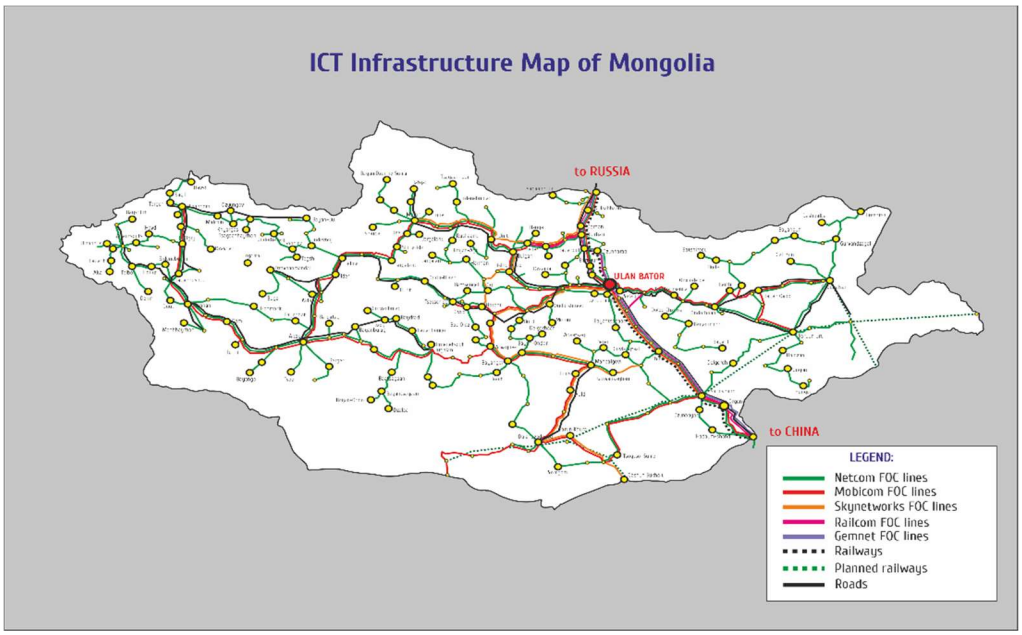
3.3.1 FOC Co-Deployment with Transport Infrastructure

Mongolia's domestic FOC network is over 38,900-km long with FOC deployment increasing 2.5 times from 2001 to 2017. The government-owned Information Communication Network Company accounts for around half of the country's total FOC deployment, mostly laid along existing roads. In addition, four very small aperture terminal operators are authorized to work in rural areas.

International connectivity is achieved through connections to China and Russia, and from there traffic is routed to overland Asia–Europe networks and through submarine cables. The Mongolian Internet Exchange was established in 2001 and had around 32 participants by the end of 2017.

Private operators – Mobicom and Skytel – each operate networks of approximately 7,000km in length. Railcom, a subsidiary of the Mongolian Railway Authority, operates a 1,400-km FOC network along the country's primary north-south railway corridor (see Figure 15). G-Mobile, Mobicom, Telecom Mongolia and Unitel are the clients of Railcom's domestic leased-line service.

Figure 15: Map of the ICT infrastructure in Mongolia



Source: Author based on ITU maps and open data.

Telecom Mongolia is the country's incumbent operator and largest fixed-line carrier. It was partly privatized in 1995 when a 40 per cent stake was sold to Korea Telecom. Later, the Government of Mongolia bought the share back.

Unlike most developing nations, there is a relatively high degree of competition in the fixed-line market, with five operators. Nevertheless, Mongolia's fixed-line penetration is low, owing to the popularity of mobile telephony. Fixed-line subscriptions are now largely bundled into triple play offers (broadband Internet, telephone and television). Fixed-broadband choices include DSL, optical fibre and WiMAX, with optical fibre accounting for the largest share of subscriptions.

Mongolia is in a prime geographic position to capture Europe-to-Asia traffic. It benefits from some of the lowest latencies between East Asian and European markets. Consequently, multiple Russian operators such as TransTelekom, MegaFon and Rostelecom, as well as Chinese operators such as China Unicom and China Telecom, have formed partnerships with Mongolian operators Railcom, Gemnet and Mobicom to provide Europe-to-Asia connectivity. There are international FOC connections at Sukhbaatar on the northern border with Russia, and Zamiin-Uud in the southern border with China, which form part of a relatively low-latency terrestrial path between Europe and Asia via national networks in Russia and China.

In 2004, Russian TransTelekom, in collaboration with Railcom and China Unicom, implemented the shortest FOC path between Europe and Asia. This 11,500km-long Europe–Russia–Mongolia–China line (including 1,300km within Mongolia) extends from London passing through Stockholm, Moscow, Ulaanbaatar and Beijing to Hong Kong, following the Mongolia–Russia railway line (part of Trans-Asian Railway Network), providing an alternative path to submarine communications cables.

As part of its digitalization strategy, Ulaanbaatar city deployed an urban ITS in 2010 with a traffic signal control system and traffic control centre, vehicle detectors, closed-circuit television (CCTV) cameras and variable message signs. However, the system has not been expanded and upgraded to match the growing travel demand and geographical coverage, and only serves the central business district of Ulaanbaatar. Although there is a need for a well-integrated ITS to create new services, jobs and growth in the transport and ICT sectors, the deployment of ITS beyond the capital city has been hindered by the inadequacy of the ITS infrastructure. Besides the ITS in Ulaanbaatar city, there are 16 toll gates currently operating on the roads and highways in Mongolia.

The Ministry of Road and Transport Development of Mongolia aims to implement a comprehensive national ITS programme in 2019, including the establishment of a national integrated transportation information centre, which will require availability of the FOC infrastructure for operation. Therefore, due consideration should be given by relevant authorities to FOC co-deployment to enable efficient and smooth implementation of the ITS programme.

Prospective Transport Infrastructure Projects for FOC Co-Deployment

Mongolia's potential for FOC co-deployment along road and rail networks, both domestically and on cross-border routes, is high.

Under the Government of Mongolia's 2016-2020 Action Plan, the road and transport sector's objective is to expand and develop transport and logistics networks that support economic improvement, meet social needs and requirements, and provide safe and comfortable service to users. To achieve the objective, the network of paved roads will be extended to link every provincial centre with Ulaanbaatar, at a total length of 5,100km. The co-deployment of FOCs along this network of paved roads will help to improve broadband coverage in rural areas.

For the rail sector of Mongolia, the Action Plan envisages the construction of several large rail projects along the following lines: Tavantolgoi–Gashuun Sukhait, Khuut–Bichigt, Oyu Tolgoi, Shivee Khuren–Sekhe, Zuunbayan–Khangi, Erdenet–Ovoot and Bogd Khan. These rail projects are good opportunities for FOC co-deployment to enhance broadband access in Mongolia.

Policy, Legislation and Governance

In recent decades, the country has continuously liberalized the ICT sector and developed legal and regulatory frameworks to support the expansion of high-speed broadband networks. The State Policy on the Development of ICT 2017-2025 was approved in 2017 by the Cabinet of Mongolia. It was developed in conjunction with new laws, such as the Law on Development Policy Planning and the General Law on Administration and the Sustainable Development Vision 2030.

The State Policy on the Development of ICT 2017-2025 comprises of eight goals to enable universal accessibility of ICT advancements, develop knowledge-absorbed, high-tech and export-oriented national industry, support human development, and increase competitiveness to accelerate the development of Mongolia, as follows:

1. Create a favourable environment for sectoral development by optimizing the legal system and organization of the ICT sector;
2. Set up the national backbone network and infrastructure of ICT to meet increasing needs and demands for universal ICT services with government support and PPPs;
3. Increase ICT service types, and their accessibility and quality, based on advanced technology;
4. Create an integrated innovation and research-development system by accelerating ICT research and development activities and setting up a science and technology park;
5. Increase competitiveness in the global market by developing ICT products, supporting the national digital content and software industry, and introducing ICT in industry automation, control and monitoring;
6. Promote PPPs in building a pilot plant to manufacture ICT products and install high-cost and efficient equipment;
7. Protect information security by ensuring national interests, safety and authenticity of information of state, citizens and organizations; and
8. Develop e-governance by increasing productivity and efficiency of operations of public organizations, enhancing democratic, non-bureaucratic, transparent and accountable governance, and supporting innovation.

Measures to implement the State Policy on the Development of ICT are reflected in the Government Action Plan and Annual Guidelines for Socioeconomic Development in Mongolia, and funding is allocated from national and local budgets, foreign loans and assistance, as well as foreign and domestic investment sources. In addition, the national administrative body in charge of ICT conducts biannual monitoring and evaluation of policy implementation, including an independent evaluation every four years.

In 2013 the Communications Regulatory Commission approved the Information and Communication Network Regulation of Mongolia to develop communications network in an integrated way, improve long-term economic efficiency of the sector, reduce network duplication, interconnect with other networks and provide network security.

The Policy Document on Telecommunications Interconnectivity and Competition was approved by the Chairman of the Communications and Information Technology Authority in 2016 (Decree A/67). It defines policy directions and regulatory principles to be pursued in supporting telecommunications interconnectivity and service competition, and distributing limited reserves of telecommunications such as radio frequency and numbering.

In the same year, the Chairman of the Communications and Information Technology Authority also approved an e-government policy (Decree A/61) that defines the direction for developing an integrated system for exchanging public sector information.

Unlike Kazakhstan and Kyrgyzstan, the incumbent telecom operator in Mongolia is legally bound to lease its ICT facilities to other telecom operators. The network owner is prohibited to create local networks and provide services to end users, and must follow a transparent process in

providing its network services. The service tariff, lease terms and conditions, and the procedures of the lease (reference unbundling offer and leased line reference offer) need to be summarized in written form, pass the established validation process and be published in media. The Special-Purpose Commission controls and approves the tariffs of the incumbent operator.

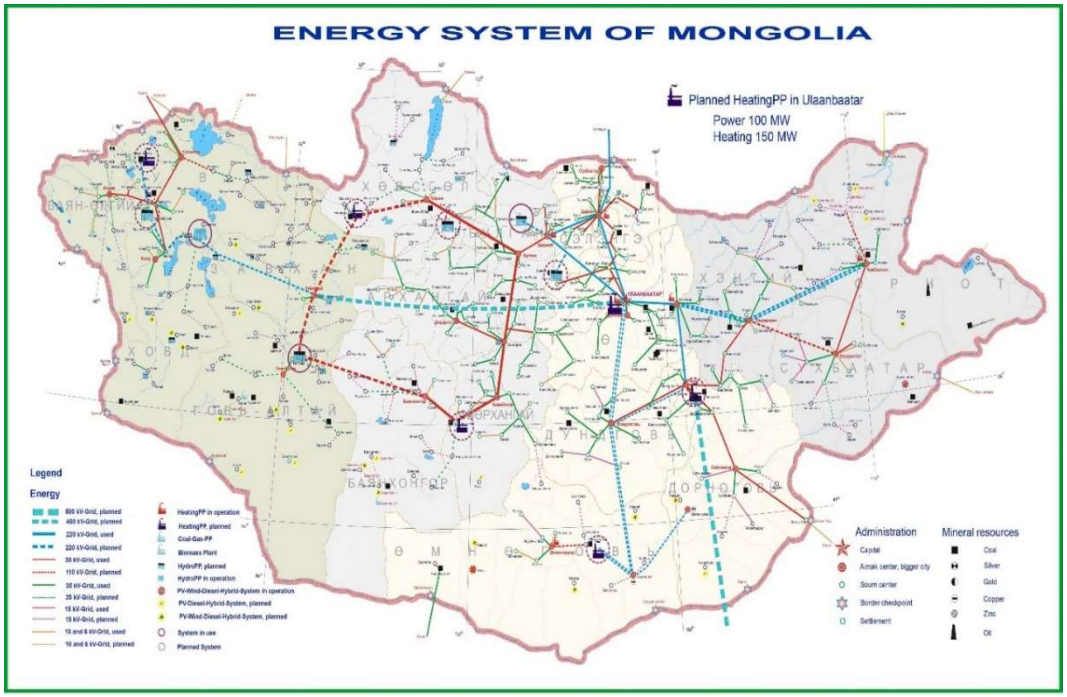
3.3.2 FOC Co-Deployment with Energy Infrastructure

The total length of power lines in Mongolia is around 32,000km, of which 5,280km are 110 kV and higher voltage lines. The energy infrastructure system consists of four unconnected energy systems: Central Energy System, Western Energy System, Eastern Energy System and Altai-Uliastai Energy System. The power generation system includes a combined heat and power plant at Dalanzadgad, as well as diesel generators and renewable energy sources. As such in Mongolia, there is no united energy system, which presents a certain complexity for FOC co-deployment along power lines.

The supply of electricity to off-grid districts and remote settlements is based on diesel generators. Heat is provided through heat-only boilers. However, the high fuel costs and the low financial ability of consumers hamper the generation of electricity. To overcome this, the Government of Mongolia aims to extend the national grid (220 kV and 110 kV transmission lines, as well as 35 kV distribution lines) and connect off-grid districts to the national distribution system. The project will be financed by the national budget and the Development Fund of Mongolia.

Presently, around 330 districts and 200 settlements are connected to the grid, while 12 district centres are supplied through decentralized renewable energy sources. The original grid extension programme includes the construction of 7,000km of power lines, of which 2,300km have been built. In some areas, the transmission lines have been built but not yet commissioned due to missing connections to power generating plants. The construction of the missing power transmission and distribution lines can include FOC co-deployment.

Figure 16: Energy system of Mongolia



Source: http://www.miniih.com/miniiblog/myagmardorj/files/shugam.JPG (accessed on 30 May 2019)

All Mongolian power plants are state-owned and equally divided among the Ministry of Energy, the Ministry of Finance and the State Property Committee. Several companies are in charge of operating and managing the power plants and the transmission and distribution grids. These operating companies are mainly state-owned and some are based on PPPs.

The Energy Authority was established in March 2009 to promote efficient operation and management of power plants and installations, and ensure their proper maintenance. The Energy Authority is not only responsible for the operation of all power plants in Mongolia, but also supervises all operating companies.

Since the establishment of the Energy Regulatory Authority in 2001, energy regulation has been in place for over a decade. In the amendment to the Energy Law in December 2012, the Energy Regulatory Authority was expanded and renamed Energy Regulatory Committee. The number of regulators increased to five and external representatives were included to strengthen its autonomy.

The Energy Law defines the rights and duties of the Energy Regulatory Committee, and focuses specifically on the regulation of prices and licensing. For instance, 23 articles deal with prices and tariffs, including the principles for determining tariffs, agreements and other general directions. The Ministry of Energy has the authority to develop policies in the sector, approve investment plans in electricity transmission and distribution and gas transportation and distribution, and review investment decisions. The electricity market in Mongolia is monopolized and tariffs are politically determined at very low rates, making it difficult for utilities to work profitably.

Prospective Energy Infrastructure Projects for FOC Co-Deployment

The North-East Asia Regional Power System Interconnection Project, initiated in Ulaanbaatar in March 2019, aims to establish an interconnected power grid between five countries including China, Japan, Republic of Korea, Mongolia and Russia. It is envisioned that by 2025, wind power plants will be constructed in the Gobi Desert and the following five interconnection projects of 11.75 GW will be completed: (1) Mongolia–North China; (2) North-East China–Democratic People's Republic of Korea–Republic of Korea; (3) North China–Republic of Korea–Japan; (4) Russian Far East–Japan; and (5) North-East China–Democratic People's Republic of Korea.

FOC co-deployment can be incorporated in the framework of the subproject, Mongolia–Tianjin 660 kV DC Transmission Project, with a total investment of USD1.7 billion. The goal of the project is to deliver electricity from Mongolia to North China.

Moreover, the Ministry of Energy is planning to build two coal-fired power plants (24 MW and 40 MW) covering the Western Energy System. Also, Chinese investors plan to develop a 4,800 MW coal power station in southern Mongolia during the next decade. It will be supplied with coal from Mongolia, but the generated electricity will be transmitted exclusively to China. With the construction of these power plants, FOC co-deployment could be a cost-effective approach to improving ICT connectivity.

3.3.3 FOC Co-Deployment among Telecom Operators

Mobicom, G-mobile, Skytel, Unitel and Telecom Mongolia are the major telecom operators in Mongolia. Many telecom operators leases FOC lines from Railcom, but there are no known examples of FOC co-deployment among telecom operators.

3.4 Republic of Korea

Initially, the Korean government allowed IMAs such as the Korea Expressway Corporation (KEC) and the Korea Electric Power Corporation (KEPCO) to build and operate their own private telecommunications facilities to meet their internal communications needs and manage their various ICT systems. These ICT systems include the ITS, SCADA system, energy management system, business telephone system, the Intranet and groupware. Although the IMAs own the private telecommunications facilities, most of them established ICT-specialized subsidiaries for facility construction management, operation and maintenance.

As the demand for Internet services grows and in the effort to develop the nation’s broadband infrastructure, the Korean government amended the relevant legislations and regulations to allow

IMAs to lease their spare ICT facilities and dark fibres to telecom operators. As a result, some IMAs had telecommunications business licenses to lease their spare facilities to telecom operators. But later, the legislations and regulations were further amended, making it mandatory for IMAs to cooperate with telecom operators in the development of the broadband infrastructure in order to meet the continued increase in demand for high-speed and high-quality data transmissions.

Therefore, in the case of the Republic of Korea, FOC co-deployment was promoted by the Korean government, but the IMAs did not object to the mandatory co-deployment of FOCs along their infrastructure since they were able to easily deploy additional FOCs in their existing conduits, chambers, poles and towers.

In order to facilitate and coordinate FOC co-deployment among telecom operators, the Korean government established and operated the Consultative Council for Co-Deployment under the Korea Telecommunications Operators Association. The Consultative Council for Co-Deployment also worked with various IMAs on behalf of the telecom operators in FOC co-deployment along the transport and energy infrastructure.

To further promote the rapid spread of broadband Internet services, the Korean government introduced the Broadband Building Certification System that requires all new buildings over a certain size to install FOC facilities.

The major legislations that have enabled FOC co-deployment in the Republic of Korea include the Framework Act on Informatization Promotion[8] enacted in 1995 (renamed the Framework Act on National Informatization), the Telecommunications Business Act enacted in 1996 and the National Transport System Efficiency Act enacted in 2011. Under the Framework Act on Informatization Promotion, the relevant articles for FOC co-deployment along the road, railway, subway and electricity infrastructure are Article 30 (Provision of Own Electric Communications Equipment, etc.) and Article 32 (Cooperation for Expansion of Super-High Speed Information and Communications Network).

The subsections below explore in further details FOC co-deployment with the transport and energy infrastructure, FOC co-deployment among telecom operators, and FOC co-deployment in new buildings.

3.4.1 FOC Co-Deployment with Transport Infrastructure

The Republic of Korea has a small land area (99,720km^2) with 70 per cent of its land in mountainous terrains. Population migration to urban areas along with economic growth have

[8] Republic of Korea, Framework Act on Informatization Promotion, No. 04969, 4 August 1995. Available at https://www.lawnb.com/Info/ContentView?sid=L0009F5944C3AA0C_0_R10.

resulted in 22.6 million people living in metropolitan areas, as of 2018. In 2018, there were 23 million vehicles registered nationwide, half of which were passenger cars. Economic growth and the rapid increase in the number of vehicles has called for the continued construction and expansion of expressways and highways.

Under the Road Act,[9] roads in the Republic of Korea are divided into seven types: (1) national expressways (including their branch lines); (2) general national highways (including their branch lines); (3) special metropolitan city roads and metropolitan city roads; (4) local highways; (5) *si* roads (managed by cities), (6) *gun* roads (managed by counties); and (7) *gu* roads (managed by districts in metropolitan cities).

National expressways and general national highways are managed by the central government. In particular, the management of national expressways is entrusted to the KEC, which was established in 1969. The national expressway is a road used for automobile-only high-speed transportation, and the general national highway connects major cities, designated ports, important airfields and tourist destinations. Together they form the backbone of the Korean road network.

Most sections of the expressways charge tolls. Expressways in the Republic of Korea have excellent road facilities for automobiles, and auxiliary facilities such as rest areas, maintenance facilities and gas stations for drivers and passengers. Some sections of the expressways are designed as emergency runways, allowing aeroplanes to take off and land. Most expressways are national expressways that connect major cities, but in some big cities, such as Busan, some places have urban expressways to facilitate traffic in the city.

The national expressways were built between 1967 and 1976, and they have been undergoing a process of re-establishment and route expansion since the mid-1980s. The construction of the expressway on the Gyeongin Line (Seoul-Incheon) began in 1967 and was completed at the end of 1968, and the Gyeongbu Line (Seoul-Busan) started in 1968 and was fully operational by the mid-1970s. In 2001, the Jungang Line, West Coast Line, and Seoul External Circulation Line were opened.

In addition, as of 2019, 27 private expressways are operating, based on the build-transfer-operate partnership contract, which connects the Incheon International Airport to Seoul. Unmanned speed meters and CCTV cameras are installed along the expressways.

About KEC

KEC at a glance (as of 2018)

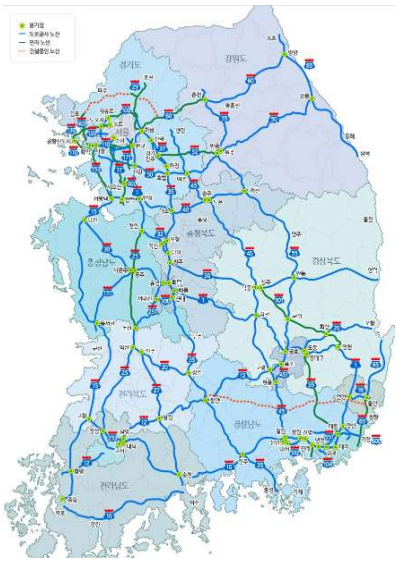
[9] Republic of Korea, Road Act, No. 15115, 28 November 2017. Available at http://www.law.go.kr/LSW/eng/engLsSc.do?query=15115.

- Sales Volume: KRW 4 trillion
- Total Assets: KRW 57.6 trillion
- Number of Employees: 6,334

To expand its ITS and manage the various systems for toll collection, traffic control, emergency communications, unmanned speed meters and CCTV cameras, the KEC built conduits and chambers for FOCs during expressway construction. The Highway Information and Communications Corporation (HICC) was established in 1992 as a subsidiary of KEC, specializing in ICT to operate and maintain the ITS and private telecommunications facilities. Since the HICC was privatized in 2002 and operated by the Daebo Group, the coverage of the ITS has expanded not only to expressways but also to all national and metropolitan urban roads across the country.

As of the end of 2017, the KEC operates a total of 4,717km of expressways (including private expressways) with FOCs laid out along its entire route (see Figure 17 and Table 4).

Figure 17: Map of expressways in the Republic of Korea



Source: KEC, Expressway route guide available at http://www.ex.co.kr/site/com/pageProcess.do

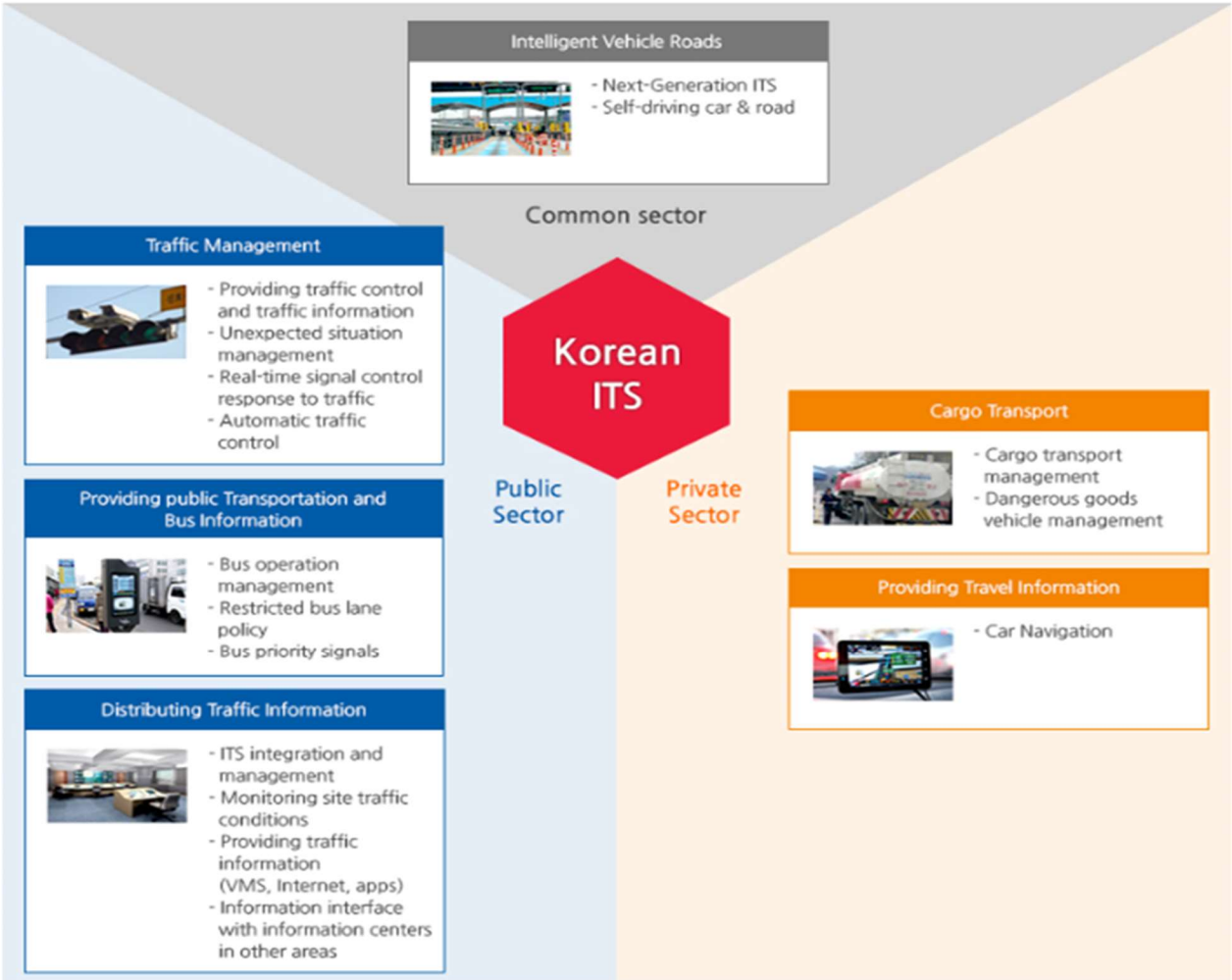
Table 4: Roads and FOC lengths in the Republic of Korea

Division		Road Length (km)	FOC Length (km)	Authority	Remarks
National Expressway	Public	3,948	3,948	KEC	
	Private	769	769	PPP	
National Highway		13,983	7,683	Ministry of Land, Infrastructure and Transport	
Metropolitan City Road		4,886		Local Government	Metropolitan Cities
Provincial Road		18,055		Local Government	Provinces/ Cities
Local Road		68,450		Local Government	Cities/ Counties
Total		**110,091**	**12,400**		

Intelligent Transportation System

The major business domains of the KEC are expressway construction and maintenance, and ITS. The ITS refers to an intelligent transport management system that applies advanced technologies, such as highway traffic management system, tunnel traffic management system, ITS quality control, traffic centre operation, toll collection system, emergency management services and traffic information management system, over its telecommunications network.

Figure 18: Korean ITS service categories



Source: National Transport Information Centre, "ITS Architecture". Available at http://www.its.go.kr/Eng/overview/overview06.jsp (accessed on 30 May 2019).

Services provided by the Korean ITS in the public and private sectors are summarized in Figure 18. These services can be categorized as follows:

- **Traffic management service for fast, safe and smooth passage –** The system collects, communicates and uses real-time incident-related information to improve traffic flow and safety.

- **Electronic transportation fare payment using digital cash –** This reduces congestion and improve convenience by automating fare payment.

- **Nationwide traffic information service –** The National Transport Information Centre plays the role of a hub that links, integrates and manages information systematically and efficiently, so that information collected from all types of transportation (e.g., car, plane, ship, train, bus, subway) and transportation facilities (roads, airports, seaports, train stations, bus shelters, subway stations) in the country can be shared.

- **Intelligent vehicles** – The use of advanced technologies to assist drivers by enhancing handling, safety, efficiency and comfort of driving. Intelligent vehicles are able to detect road and traffic conditions (e.g., fog, snow and sharp curves), and risk factors (e.g., sleepiness, drunk driving, lane departure or speeding), and notify the driver, as well as drive itself to avoid dangerous situations.

The National Transport System Efficiency Act[10] supports and promotes the development of ITS to enhance transportation facility investments, develop connected transport systems such as transportation logistics hubs, intelligentize transport systems and advance transport technology.

In the National Transport System Efficiency Act, the articles related to the intelligentization of transport systems include the following:

- Formulation, etc. of master plans for ITS by central and local governments
- Formulation, etc. of implementation plans for ITS and implementation of ITS establishment projects
- Guidelines for implementing ITS establishment projects
- Formulation, approval, etc. of implementation plans
- Authorization, permission, etc. deemed granted under other Acts
- Pre-use inspections of ITS
- Standardization, standards certification and quality certification of ITS
- Revocation of designation as standards certification institution and quality certification institution for ITS
- Evaluation of performance and safety control of ITS
- Provision, etc. of transport information using ITS
- Establishment, etc. of the National Transport Information Centre
- Establishment and functions of the Korea ITS Association

According to Article 73 on Formulation, etc. of Master Plans for ITS, the Korean government needs to develop a national master plan every 10 years to promote the development and distribution of intelligent land, marine and air transport systems. This master plan needs to be reviewed every five years to ensure its relevance and effectiveness. Furthermore, Article 90 calls for the establishment of a National Transport Information Centre to facilitate the collection, analysis,

[10] Republic of Korea, National Transport System Efficiency Act, No. 15344, 16 January 2018. Available at http://www.lawnb.com/Info/ContentView?sid=L000BC4F4DF6A4BF_0_R10.

management and dissemination of transport information using the ITS. In doing so, various customized real-time traffic information services are provided to end users through car navigators, navigation apps on smart phones, and Internet over fixed and mobile telecommunications networks.

Legal Background on FOC Co-Deployment with Expressway Infrastructure

Box 1: Legal basis for KEC to install ITS and its ICT facilities along expressways
Article12 (Work) in the Korea Highway Corporation Act
Article 11-2 (Works for the Use of Road Sites and Facilities) in the Enforcement Decree of the Korea Highway Corporation Act
Article 64 (Installation of Private Telecommunications Equipment and Facilities) in the Telecommunications Business Act

As shown in Box 1, Article 12 of the Korea Highway Corporation Act and Article 11 of its Enforcement Decree enabled KEC to develop the ITS, and Article 64 of the Telecommunications Business Act[11] enabled KEC to install its own private telecommunications equipment and facilities, including FOCs. According to this latter act, those who intend to install their own private telecommunications facilities in the Republic of Korea are required to report to the city or provincial governors, such as special mayors, metropolitan mayors, mayors and governors, who have jurisdiction over the location of the office where the main facilities are installed.

Box 2: Legal basis for KEC to lease its ICT facilities to telecom operators
Article 30 (Provision of Own Electric Communications Equipment, etc.) in the Framework Act on Informatization Promotion
Article 21 (Registration of Special-Category Telecommunications Business) in the Telecommunications Business Act

According to Article 30 of the Framework Act on Informatization Promotion, IMAs with private telecommunications facilities that meet the technical standards defined in the Enforcement Decree of the Telecommunications Business Act,[12] could register as special-category telecom operators in accordance with Article 21 of the Telecommunications Business Act. The special-category telecom operator must separate its telecommunications business account with that of its core

[11] Republic of Korea, Telecommunications Business Act, No. 14113, 29 March 2016. Available at http://www.law.go.kr/LSW/eng/engLsSc.do?query=14113.

[12] Technical standard for grounding facilities, in-building telecommunications facilities, duct, wiring and conduit facilities in: Republic of Korea, Enforcement Decree of the Telecommunications Business Act, No. 29886, 25 June 2019. Available at https://www.lawnb.com/Info/ContentView?sid=L00016F788827564_0_R6 (in Korean).

business, as stated in the Enforcement Decree of the Telecommunications Business Act.[13] In addition, the Enforcement Decree of the Telecommunications Business Act outlines the conditions of provision and calculation of the lease price.

The Ministry of Science and ICT (MSIT), in receipt of registration for the special-category telecom operator, may impose necessary conditions to facilitate fair competition, protect users, improve service quality and efficiently utilize ICT resources.

Box 3: Legal basis for KEC to cooperate with telecom operators in FOC co-deployment
Article 32 (Cooperation for Expansion of Super-High Speed Information and Communications Network) in the Framework Act on Informatization Promotion
Article 68 (Installation of Conduits, Ducts, etc.) in the Telecommunications Business Act

Under Article 32 in the Framework Act on Informatization Promotion and Article 68 in the Telecommunications Business Act, as shown in the Box 3, the IMAs of roads, railways, urban railroads, industrial complexes, free trade complexes, airports and harbours, including KEC, are required to take into consideration the requests and opinions of the telecom operators on the installation of telecommunications ducts and conduits.

In the event that the IMAs are unable to incorporate the requests and opinions of the telecom operators in the installation of telecommunications ducts and conduits, the IMAs are required to notify the telecom operators of the reason within 30 days of receiving the requests and opinions. Where the IMA and telecom operator fail to reach an agreement, they may request the MSIT for mediation.

3.4.2 FOC Co-Deployment with Electricity Infrastructure

About KEPCO

KEPCO at a glance (as of 2018)

- Assets Volume: KRW 185.3 trillion
- Sales Volume: KRW 60.6 trillion
- Electric Power Sales Volume: 526 billion kWh
- Number of Employees: 22,272

[13] Standard for accounting division of telecommunications business in: Republic of Korea, Enforcement Decree of the Telecommunications Business Act, No. 29886, 25 June 2019. Available at https://www.lawnb.com/Info/ContentView?sid=L00016F788827564_0_R6 (in Korean).

Electricity service in the Republic of Korea commenced in Seoul in January 1898 by Hansung Electric Company. In 1982, the company became a wholly government-owned entity and was renamed KEPCO. KEPCO is a market-type public corporation under the Ministry of Trade, Industry and Energy (MTIE). With the revision of the Korea Electric Power Corporation Act in 1989, some of its shares were listed on the Korea Stock Exchange. The government owns a 51 per cent share of KEPCO, and the MTIE exercises the government's shareholder rights in consultation with the Ministry of Economy and Finance.

FOC Co-Deployment with Electricity Infrastructure by KDN

KDN at a glance (as of 2017)

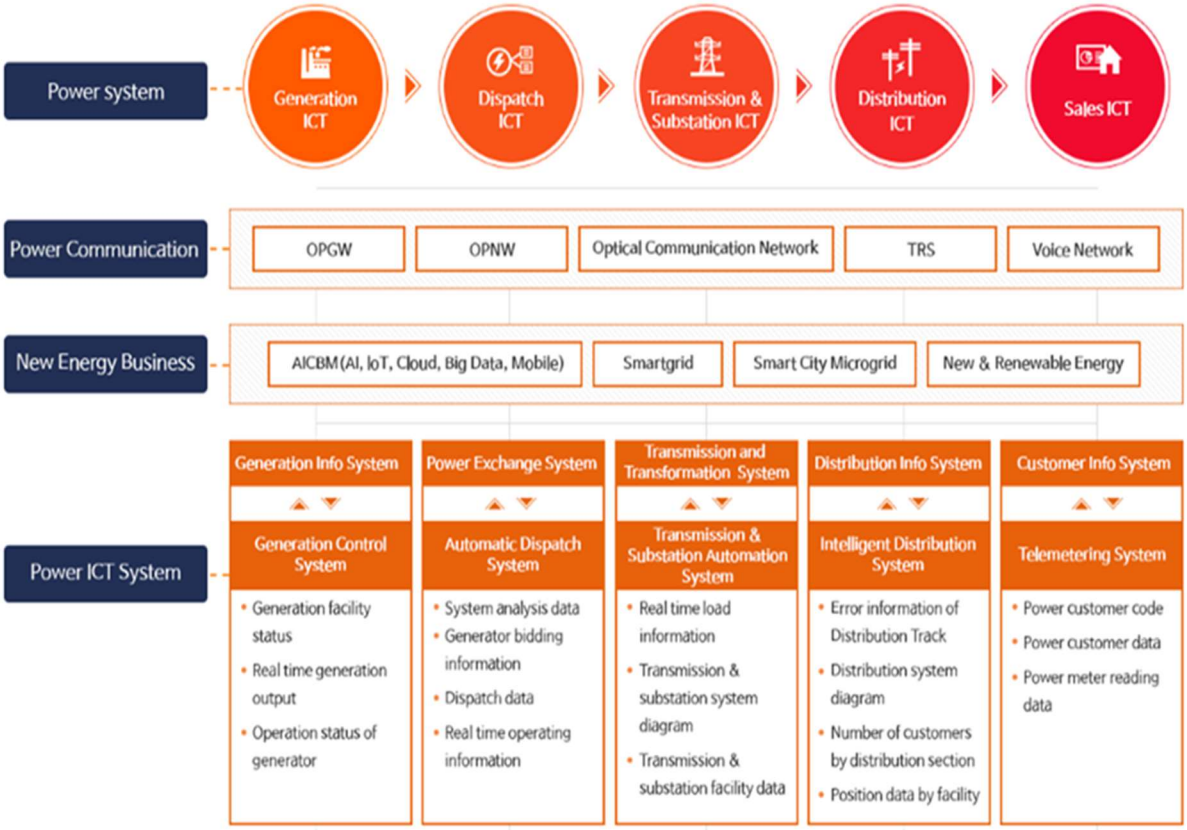
- Sales Volume: KRW 619 billion
- Capital Authorized: KRW 100 billion
- Paid Capital: KRW 64 billion
- Number of Employees: 2,554 (2018)

The KEPCO began operating its private telecommunications network including its OPGW and SCADA system in 1986 for efficient management of its power plants, substations and power transmission infrastructure scattered across the country. In 1992, KEPCO established Seil ICT Corps, a subsidiary company that specializes in ICT to manage the telecommunications network. Renamed as KEPCO Knowledge Data Network (KDN) in 2000, the company uses advanced ICT to reduce power loss rate, increase voltage and frequency retention rate, and prevent power outages with the aim to provide high-quality, safe and cost-effective electricity services.

The Korean government passed the Act on the Creation and Facilitation of Use of Smart Grids[14] in 2011 to enable the creation of smart grid business entities and promote private investments in the smart grid industry. As part of building an advanced metering infrastructure, the Republic of Korea is in its final stage of automatic meter reading deployment where smart KWh meters are installed in homes nationwide, allowing subscribers to check their electricity usage and charges online.

[14] Republic of Korea, Act on the Creation and Facilitation of Use of Smart Grids, No.10714, 24 May 2011. Available at https://www.lawnb.com/Info/ContentView?sid=L00020492A440009_0_R10

Figure 19: Overview of the energy industry's use of ICT



Source: KDN, Power ICT business structure available at https://www.kdn.com/menu.kdn?mid=a20101000000

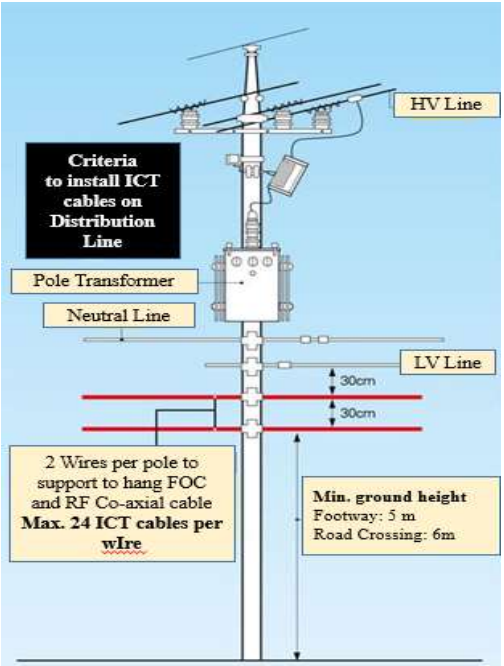
KEPCO's ICT infrastructure was initially shared with cable television (CATV) operators, and not with telecom operators. While satellite television is prevalent in Central Asian countries, many other countries, as well as the Republic of Korea, have adopted the CATV system. The CATV system has the advantage of generating additional revenue for CATV operators by adding local broadcasting channels and home shopping channels to popular global channels that are supplied by programme providers from around the world.

In the Republic of Korea, there are four television broadcasting service operators (KBS, MBC, SBS and EBS) using public radio waves. But because of the country's predominantly mountainous terrain, television broadcasting services could not reach many areas. To address this issue, the government granted licenses to CATV operators to retransmit television broadcasting channels. CATV operators launched commercial broadcasting services in 1995 and expanded related markets by adding broadband Internet services and voice-over-Internet-protocol telephone services.

KDN leases out its ICT facilities, including exclusive domestic dedicated line services to power-related companies (KEPCO and subsidiary regional power plants) and CATV operators. KDN also provides Metro Ethernet services to fixed telecom operators, and hybrid fibre coaxial cables to

Internet service providers. Additionally, KDN constructed hybrid fibre coaxial cables for CATV services along the electricity distribution infrastructure, and leases them to CATV operators in accordance with technology standards (see Figure 20).

Figure 20: Criteria to install ICT cables on distribution lines



Source: KEPCO, "Hankook Times", 21 March 2019. Available at https://news.v.daum.net/v/20190321044222003?f=m.

Legal Background on FOC Co-Deployment with Electricity Infrastructure

Box 4: Legal basis for KEPCO to install its ICT facilities along the electricity infrastructure
Article 64 (Installation of Private Telecommunications Equipment and Facilities) in the Telecommunications Business Act
Article 9 (Licenses, Approval, Registration, etc.) in the Broadcasting Act
Article 12 (Registration of Transmission Network Business) in the Enforcement Decree of the Broadcasting Act

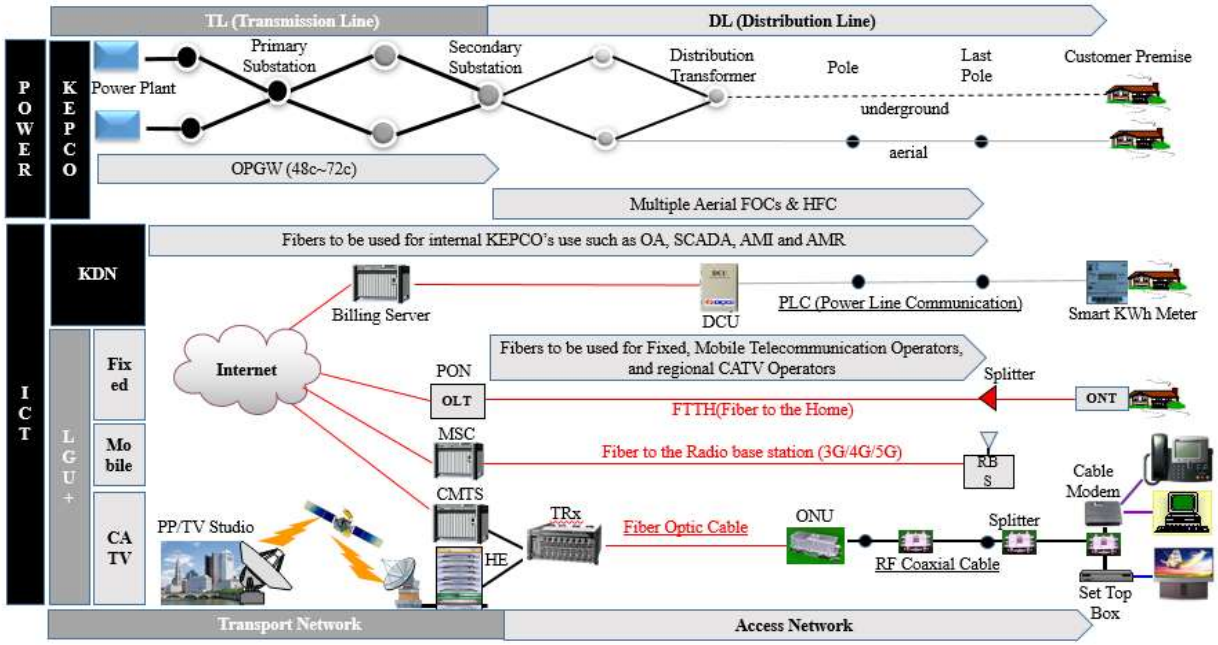
The KEPCO developed its own telecommunications facilities along its power grid in accordance with Article 64 of the Telecommunications Business Act, and was issued a broadcasting business operator license in accordance with Article 9 of the Broadcasting Act and Article 12 of the Enforcement Decree of the Broadcasting Act (see Box 4).

Box 5: Legal basis for KEPCO to lease its ICT facilities to telecom operators
Article 30 (Provision of Own Electric Communications Equipment, etc.) in the Framework Act on Informatization Promotion
Article 31 (Use of Transmission or Line Equipment and Facilities, etc.) in the Telecommunications Business Act
Article 21 (Registration of Special-Category Telecommunications Business) in the Telecommunications Business Act

The IMAs, including KEPCO, are permitted to lease their ICT facilities to telecom operators under Article 30 of the Framework Act on Informatization Promotion and Article 31 of the Telecommunications Business Act. KEPCO was issued a special-category telecom operator license under Article 21 of the Telecommunications Business Act, and must separate its telecommunications business account with that of its core business, as stated in the Enforcement Decree of the Telecommunications Business Act.

In 2010, KEPCO's telecommunications business was separated, with KDN managing the FOCs for KEPCO's internal use, and the transfer to telecom operator, LGU+, the use of KEPCO's FOCs for external fixed-line, wireless and CATV services. In turn, LGU+ pays the FOC lease charges to KEPCO on an annual basis (see Figure 21).

Figure 21: ICT services over KEPCO's infrastructure



Source: Author.

The KEPCO has been installing two lines of OPGW on both sides of the same transmission tower as shown in Figure 22, to keep up with the continuous increase in demand for FOCs, and has been increasing the OPGW's fibre capacity from 48 fibres up to 72 fibres, even in rural areas.

Figure 22: Photos of OPGW and multi-FOCs in rural areas in the Republic of Korea

2 OPGW lines over the same transmission line and Optical Splicing Enclosure

Multi FOCs deployment over the distribution line and Optical Splicing Enclosure in rural area

Source: Author.

Although KEPCO's ICT infrastructure has contributed greatly to the expansion of broadcasting and broadband services nationwide, it has also resulted in some negative effects such as degradation to the urban landscape by reckless telecom operators and CATV operators in the old downtown areas where power distribution facilities are not underground yet. To address this issue, a Council for Maintenance of Aerial Cables was established, as prescribed under Article 35(2) of the Telecommunications Business Act in 2015 to impose aerial cable maintenance obligations.

Box 6: Legal basis for KEPCO to cooperate with telecom operators in FOC co-deployment
Article 46 (Cooperation, etc. for Expansion of Broadband Integrated Service Digital Networks) in the Framework Act on National Informatization

Under Article 46 of the Framework Act on National Informatization (Article 32 of the Informatization Promotion Act enacted in 1995), the Korean government promotes cooperation among IMAs, including telecom operators, in the efficient expansion and management of the broadband ICT infrastructure. In the case that an agreement among the entities cannot be reached, they may request the MSIT for mediation.

3.4.3 FOC Co-Deployment among Telecom Operators

For telecom operators to deploy FOCs, the coordination and cooperation of relevant authorities in granting RoW permissions is important because without them, delays often occur. Thus, legislations and regulations to facilitate the granting of RoW permissions to deploy FOCs are needed to accelerate the development of the FOC network.

Box 7: Legal basis to guarantee RoW for telecom operators
In the Road Act: • Article 61 (Permission to Occupy and Use Roads) • Article 62 (Safety Management, etc. for Occupancy and Use of Roads)
In the Telecommunications Business Act: • Article 72 (Use of Land, etc.) • Article 73 (Temporary Use of Land, etc.) • Article 74 (Entrance to Land, etc.) • Article 75 (Requests for Removal of Obstacles, etc.) • Article 76 (Obligation for Reinstatement) • Article 80 (Relocation, etc. of Equipment and Facilities)

In FOC deployment along roads, telecom operators need to seek approval from the relevant road management authority, in accordance with Articles 61 and 62 of the Road Act, and must prepare measures to prevent accidents by installing safety facilities or safety signs. Articles 61 and 62 of the Road Act clearly provide the steps required for approval of excavation works.

Telecom operators may also use other people's land or buildings and structures to deploy FOCs, as stated under Articles 72, 73, 74, 75, 76 and 80 of the Telecommunications Business Act. In such a case, the telecom operator must consult the owner or occupier. And, the telecom operator may temporarily (not exceeding six months) use public or private telecommunications facilities and land. Following usage, the telecom operator must restore the land, buildings or structures to their original condition, or compensate the owners or occupiers for the losses incurred.

According to the Telecommunications Business Act, individuals cannot obstruct the measurement of lines, installation and maintenance of telecommunications facilities, and the temporary use of telecommunications facilities without any justifiable reasons. Moreover, the telecom operator could request owners or users of gas pipes, water pipes, sewer lines, electric lines and plants to relocate, refurbish or repair their facilities to prevent any disruptions to the installation or maintenance of telecommunications facilities, including FOCs.

Box 8: Legal basis for facilitating FOC co-deployment among telecom operators

Article 63 (Joint Installation of Telecommunications Equipment and Facilities) in the Telecommunications Business Act

As specified in Article 63 of the Telecommunications Business Act and Enforcement Decree of the Telecommunications Business Act, [15] the Korean government designated the Korea Telecommunications Operators Association as the specialized agency for FOC co-deployment. The Consultative Council for Co-Deployment was established under it to ensure the efficient use of national telecommunications resources through the minimization of overlapping or excessive deployment costs by individual telecom operators. It has developed a cooperative system and information management system for information sharing and planning purposes. It also continuously surveys telecom operators' deployment plans, analyses the performance of FOC co-deployment projects, provides information on potential FOC co-deployment projects, and supports the improvement of laws and regulations to enable FOC co-deployment.

3.4.4 FOC Co-Deployment in New Buildings

The Korean government introduced the Broadband Building Certification System that requires all new buildings over a certain size to install FOC facilities. This initiative has been led by the Broadband Building Certificate Authority and the FOC installation costs have mainly been borne by the construction sector.

The cost of FOC co-deployment with building construction is relatively low,[16] compared to the installation of utilities such as water or gas. Furthermore, the cost savings from FOC co-deployment with building construction compared with separate deployment are estimated to be up to 60 per cent.[17]

But generally in North and Central Asian countries, it is up to the developers to formulate such requirements in the terms of reference issued to the designer of the building. Since high-speed Internet connection has become an integral part of everyday life, it is normally considered in new

[15] The establishment and operation of the consultative council for FOC co-deployment in: Republic of Korea, Enforcement Decree of the Telecommunications Business Act, No. 29886, 25 June 2019. Available at https://www.lawnb.com/Info/ContentView?sid=L00016F788827564_0_R6 (in Korean).

[16] The estimated cost of FOC co-deployment during building construction was EUR20,000 for a Western European building with 20 units in 2012.

[17] Source: 72 page, European Commission, Support for the preparation of an impact assessment to accompany an EU initiative on reducing the costs of high-speed broadband infrastructure deployment (2012). Available at https://ec.europa.eu/digital-single-market/en/news/support-preparation-impact-assessment-accompany-eu-initiative-reducing-costs-high-speed.

residential and commercial properties today. However, unlike the case of the Republic of Korea, this process is driven by demand resulting from growing expectations of the property owners, and not by regulators.

Box 9: Legal basis for FOC co-deployment in new buildings
Article 17 (Support for Informatization of Private Sectors) in the Framework Act on National Informatization
Article 23 (Connection to Sectors Related to National Informatization) in the Framework Act on National Informatization
Article 69 (Establishment of Building Telecommunications Cabling Systems, etc.) in the Telecommunications Business Act
Article 2 (Definitions) paragraph (2) subparagraph 2 and 14 in the Building Act
Article 8 (Building Permission) in the Enforcement Decree of the Building Act

The Broadband Building Certification System was established since 2000 in accordance with Articles 17 and 23 of the Framework Act on National Informatization, and targets residential buildings with more than 20 units and office buildings with a total floor area of 3,300m^2 or wider. The Broadband Building Certificate Authority[18] grants certificates to these new buildings equipped with broadband facilities, as stipulated in the Building Act.[19] The certification system is divided into three grades – special grade, first class and second class (see Figure 23), and the certified buildings can use the emblems for the marketing and sales of building units.

[18] The Broadband Building Certificate Authority was created by the National Information Society Agency of the Republic of Korea and is operated by the Korea Association for ICT Promotion under the MSIT. For more information on the certification system and criteria, and the application process, see: http://www.bica.or.kr/standard/facilities.do (in Korean).

[19] Republic of Korea, Building Act, No. 14792, 18 April 2017. Available at http://www.law.go.kr/LSW/eng/engLsSc.do?query=14792.

Figure 23: Emblems of the broadband building certified system

Emblems for special grade | first class | second class

The application for certification can be submitted following receipt of the building permit, as stated in Article 8 of the Enforcement Decree of the Building Act.[20] Table 5 shows the criteria for certifying a special grade office building equipped with fibre-to-the-desk cabling system.

Table 5: Criteria for a special grade broadband office building

Certified Items			Criteria
Wired Facilities	Wiring Topology		Star Type
	Cables	Building to Building	[More than 12 optical fibres (minimum SMF 8 cores)] + [More than 8 optical fibres, or More than Cat 3 UTP per unit area]
		Vertical	More than 12 optical fibres (minimum SMF 8 cores) + More than 1 Cat5e UTP cable
		Horizontal	More than 2 optical fibres per unit area + More than 2 Cat5e UTP cables
	Connectivity Materials		Higher than equal performance of wired cables to be installed
	Outlets	Numbers/ Unit Area	More than 3 holes (2 Cat5e and 1 fibre)
		Type	8 pin RJ45 modular jack or fibre-optic connector
Duct Facilities	Topology		Star available
	Spare Ducts	Location	Building-to-building and in-building vertical wiring field
		Numbers	More than 2 ducts
		Specification	Bigger than outer diameter of the biggest duct to

[20] Republic of Korea, Enforcement Decree of the Building Act, No. 28211, 26 July 2017. Available at http://www.lawnb.com/Info/ContentView?sid=L0005713512FBDDC_0_R10.

			be used
ICT Rooms	MDF	Minimum Area	More than 1 room larger than 15m^2
			Adding 3m^2 when installing digital broadcasting equipment
		Location	Located over the ground
	IDF	Minimum Area	(1) Larger than 1,000m^2 of floor area: Larger than 10.2m^2 (2) Larger than 800m^2 of floor area: Larger than 8.4m^2 (3) Larger than 500m^2 of floor area: Larger than 6.6m^2 (4) Larger than 500m^2 of floor area: Larger than 5.4m^2
		Location	Located at each floor in principal. More than 2 IDFs with 1 Possible to unite more than 2 IDFs with 1 when the total area of each floor is less than 1,000m^2 Possible to locate more than 2 IDFs on the same floor (In this case, minimum size should be larger than 5.4m^2)
	Door		Larger than 0.9m(width) x 2m(height) with door-lock and firewall, and signboard indicating "no entry without permission"
	Environments		Constant temperature and humidity Dedicated power supply
Performance of In-Building Wires	Building to Building		Higher than the performance of optical fibre channel
	Vertical Wires		Higher than the performance of optical fibre channel
	Horizontal Wires		Higher than the performance of optical fibre channel + Higher than the performance of Cat5e channel
Drawings Management			Drawings and table for wire, duct and IDF/MDF

Source: Broadband Building Certificate Authority. Available at http://www.bica.or.kr/standard/facilities.do (in Korean) (accessed on 30 May 2019).

Notes: IDF = intermediate distribution frame; MDF = main distribution frame; SMF = single-mode optical fibre; and UTP = unshielded twisted pair.

3.4.5 Coordination Systems for FOC Co-Deployment

In the Republic of Korea, effective coordination and cooperation in FOC co-deployment is encouraged and stipulated in a number of legislations, particularly related to road opening or excavation, and the establishment of an infrastructure management system.

Coordination System for FOC Co-Deployment along Roads

The road opening permit process can be divided into five stages before and after construction (see Table 6).

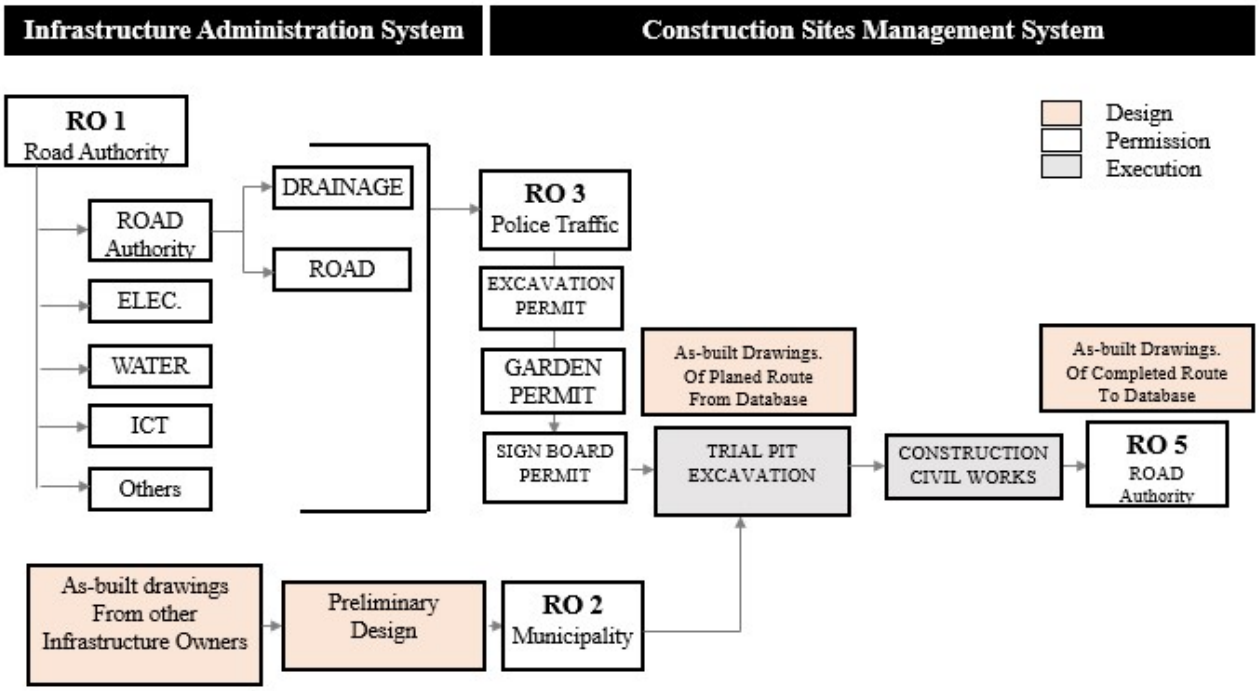
Table 6: Example of the road opening stages

Division	Stage	Responder	Permit Process	Remarks
Before Construction	RO 1	All Utilities	Design enquiry and approval	Check for any disruptions to other existing infrastructure
	RO 2	Municipality	Road opening and construction	
	RO 3	Police Traffic Department	Road opening and safety	
After Construction	RO 4	Police Traffic Department	In emergency	Operation and maintenance stage
	RO 5	Public Road Authority	Final acceptance (site clearance)	Reinstatement of the road surface

Note: RO = Road Opening.

As shown in Table 6 and Figure 24, FOC co-deployment along roads requires a working cooperative system among the municipality, road authority, police and IMAs, together with an information management system in which the relevant players' short-term facility plans and status of construction can be shared and adjusted in real time to support cooperation.

Figure 24: Example of road opening permit procedure



Source: Author.
Note: RO = Road Opening.

Prior to approval of road opening, cooperation is required to ensure that it will not affect existing infrastructure in the area (particularly the underground electric power lines, water pipes and sewerage system), and be an inconvenience and danger to vehicles and citizens. Relevant actors also need to ensure traffic control, compliance with construction site safety rules, and installation of sign board and construction plan. It is important that the entire process is transparent and efficient. The process of reporting on roadwork and safety measures is clearly outlined in Article 69 of the Road Traffic Act.

When the chief of a police station determines that traffic in the area surrounding a construction site has become heavily congested, and is hampering the safety and smooth control of traffic, the chief may request the relevant work contractor to shorten the working hours and/or take other necessary measures. Upon completion of the civil works, the road must be reinstated and restored to its pre-construction state, as prescribed by the Ordinance of the Ministry of Interior and the Telecommunications Business Act.

The Korean government established a web-based system to manage the application for road opening, and ensure that information on the applications, the excavation permit, the excavation reinstatement, the approval details and the procedural status are readily available online to the relevant government entities, as well as to the applicants (see Figure 25). This web-based road

opening permit management system has been built on top of an infrastructure management system (see subsection below).

Figure 25: Road opening permit management system

Source: https://hidigp.seoul.go.kr/ (accessed on 30 May 2019).

Centralized Infrastructure Management System for Coordination with Related Players

Box 10: Legal basis for establishing the infrastructure management system
Article 24 (Establishment and Operation of the National Geospatial Programme) in the National Spatial Data Infrastructure Act
Article 25 (Establishment of National Spatial Data Centre) in the National Spatial Data Infrastructure Act
Article 31 (Establishment of Cooperative System) in the National Spatial Data Infrastructure Act

Contributing to the effective coordination and cooperation of players involved in FOC co-deployment are the Electronic Government Act[21] and the National Spatial Data Infrastructure Act.[22] These acts stipulate the basic principles, procedures and methods for electronic processing

[21] Republic of Korea, Electronic Government Act, No.14914, 24 October 2017. Available at http://www.lawnb.com/Info/ContentView?sid=L000FE184D6AFC0D_0_R10.

[22] Republic of Korea, National Spatial Data Infrastructure Act, No. 12736, 3 June 2014. Available at

of administrative affairs, and enable the establishment of a national spatial data system.

The spatial data system is a framework of computer hardware, software, databases and human resources that are interactively connected with one another to collect, store, process, analyse and present spatial data in an efficient way.

This system aims to be used to manage the national infrastructure such as national roads, highways, railways, electricity lines and ICTs, and efficiently support the administration processes of central government and municipalities, including the applications for infrastructure access.

The Ministry of Land, Infrastructure and Transport may establish or operate the system with various actors, or request them for materials or data in order to establish the system, according to Articles 24 and 25 of the National Spatial Data Infrastructure Act. Additionally, according to Article 31 of the National Spatial Data Infrastructure Act, the head of a management institution may establish a cooperative system among management institutions, or among management institutions, industries and academia for the construction, management and utilization of a spatial data system.

Such a national spatial data system is critical to identifying FOC co-deployment opportunities, to short- and long-term infrastructure planning, and to the management of the national infrastructure in an integrated manner.

Figure 26: Infrastructure management system

http://www.lawnb.com/Info/ContentView?sid=L00074BBAC1D1FEE_0_R10.

4. The Opportunities and Challenges of FOC Co-Deployment

4.1 Opportunities and Motivations for FOC Co-Deployment

As shown in the case studies of the three focus countries – Kazakhstan, Kyrgyzstan and Mongolia – there are a number of opportunities to initiate FOC co-deployment with the transport and energy infrastructure, which could significantly accelerate broadband connectivity and contribute to narrowing the digital divide.

For example, the Digital Kazakhstan and Digital Kyrgyzstan initiatives could be a way forward for the elaboration and implementation of relevant legislative acts to define, systematize and promote FOC co-deployment. These initiatives could provide a strong kick-off for the necessary institutional reforms to make FOC co-deployment a legitimate and integral part of national infrastructure projects.

In Mongolia, the national ITS programme, the power grid extension programme, and the planned construction of 5,100km of paved roads and implementation of several large rail projects in the Government of Mongolia's 2016-2020 Action Plan, are opportunities for FOC co-deployment to enhance broadband access in Mongolia.

However, to reap these opportunities, stakeholders will need to make significant efforts to collaborate and create a co-deployment culture through the adoption of effective legislations and regulations, and leadership in coordinating and implementing FOC co-deployment initiatives.

The opportunities and motivations for FOC co-deployment for different stakeholders are presented below, including for IMAs, telecom operators, and legislators, policymakers and regulators.

4.1.1 Infrastructure Management Agencies

Infrastructure Management Agencies can get very significant additional revenue from leasing out spare conduits, ducts, pipes and dark fibres to interested telecom operators.
The motivation factor for all IMAs is also priority access to ICT services and infrastructure developed by co-deployment on possibly favourable conditions with telecom operators.

Increasing investment attractiveness and creating good opportunities for business companies by provision of resilient and reliable ICT infrastructure for ITS, SCADA systems, signalling, train operation control, predictive maintenance systems, passenger entertainment, information management systems, and deployment of ICT applications (in details please see Table 7).

Business interest on the side of IMAs to provide access to their infrastructure can be increased with the assist of economic incentives in the form of a fair and reasonable rate of return on investment.

Enhanced sharing can play role of a factor that helps in reducing the investment amortization time and improving the investment over revenue ratio.

At the same time, it reveals opportunities for the energy sector to deploy faster and cheaper smart grids, increase core business efficiency and assets management, and also presents a business case for energy operators to enter the telecommunications market and introduce more competition. Co-deployment approach also is a business case for energy operators to enter the telecommunications market and introduce more competition.

Table 7: Telecommunications needs of IMAs

IMA's Core Business	Telecommunications Needs of IMAs
Roads and highways	• ITS • Signalling • Traffic monitoring • Dynamic signage and road user information • Connectivity to public safety and work crews
Railways	• Signalling • Switching • Rail track safety management and train control • Internal voice and data links • Wireless connectivity to rolling stock
Electric power	• Network protection • SCADA systems • Load management • Outage detection and self-healing grids • Management of bi-directional electricity flows • Video surveillance and security • Smart metering • Internal voice and data links • Connectivity to line crews
Water and sewerage system	• Connectivity to pumping, treatment and control facilities • SCADA systems
Oil and gas pipelines	• SCADA systems • Connectivity to well head, control points and delivery points

Source: World Bank, "Toolkit on Cross-Sector Infrastructure Sharing", February 2017, p. 40. Available at http://pubdocs.worldbank.org/en/307251492818674685/Cross-Sector-Infrastructure-Sharing-Toolkit-final-170228.pdf.

4.1.2 Telecom Operators

For telecom operators use co-deployment gives improved financial performance of ICT projects based on the concepts of "single installation, multiple use" and "dig once, use many times". At

the same time, fair access to, and transparent sharing of infrastructure increase a competition among telecom operators give them equal opportunities for expansion of coverage and increase of market share.

Also the significant potential for reduction of civil works costs stemming from a systematic policy envisaging additional spare capacity for future broadband network in performing public works. In particular direct reductions in the range of 10 to 50% for trenching costs, as well as social benefits stemming from reduction of works and extension of covered areas, with limited additional costs in the performance of public works.

List of motivation and opportunities can include the creation of a market for passive infrastructure, the generalization of mandated access to suitable ducts; the development of a wholesale model, with clear definitions of cost items and cost models, defining in particular maximum values; reciprocal exchange of services between telecom operators and IMAs; bigger cost and time saving potential in urban areas.

Besides, better use would lead to favourable urban planning, less digging and less nuisance, thus presenting significant social and environmental benefits. Enhanced sharing of infrastructure would lower barriers to entry and foster infrastructure competition.

Of course, there are environmental benefits, in terms of reduction of need for civil works and better coordination, as well as administrative benefits with regard to the management of permit granting procedures. Also, the benefits of systematic knowledge of networks' infrastructures in order to improve disaster management.

4.1.3 Legislators, Policymakers and Regulators

Co-deployment assists government agencies address social challenges. For example, it helps with faster deployment of FOCs in rural areas, contributing to the narrowing of the digital divide and improved living standards of rural inhabitants. Besides, this will result to expansion of broadband coverage in rural areas, allowing greater access to e-government services.

The most important thing increased broadband penetration contribute to sustainable development and economic growth of individual countries and the entire Central Asian region. This in turn leads for creation of new jobs in the ICT sector and in related service subsectors.

Also, when using this approach, the budget for social issues is saved due to efficient coordination of civil works by local authorities, enhancing efficiency and cost-effectiveness.

Development of fair competition among telecom operators, minimizing increase of tariffs and preventing social discontent with government’s policy another important reason for the interest of the government in the development of co-deployment in the field of energy, transport, road construction and the development of the ICT sector.

Most public authorities would welcome a more coherent regime of infrastructure sharing as it would create a favourable investment environment, improve the competitiveness and contribute to the single market.

Beyond that, development of legislations and regulations for infrastructure sharing could encourage co-deployment and partnerships in other sectors.

4.2 Challenges and Constraints of FOC Co-Deployment

Although FOC is the globally-preferred technology for extending high-speed broadband to end users for backhaul and access networks, multiple challenges related to RoW, lack of standards and unavailability of data mapping impede FOC co-deployment.

Table 8 below provides a comparison between a few most prominent challenges of separated deployment versus possible benefits of co-deployment. To a lesser or greater extent, these are is relevant for all three target countries of the present study.

Table 8: Comparisons between separated deployment and co-deployment

Factors	Separated deployment	Co-deployment
Land acquisition	Installation of ICT infrastructure on private land entails significant acquisition costs for telecom operators	Land within RoW can be used free of charge
Utility relocation	Cost of relocation of existing utilities coming in the way of FOC deployment may be very high	Few to none existing utilities in the RoW, no extra costs for deployment projects
Property and utilization	Land outside RoW may be exposed to encroachment	RoW provides clear demarcation of land boundaries and prevents encroachment
Financial performance	Telecom operators bear all installation and maintenance costs of ICT infrastructure and are therefore reluctant to deploy FOC over long distances to rural areas due to low return of investments	By providing primary infrastructure for FOC deployment the owners of transport infrastructure share the capital costs and improve the economy of deployment projects
Operation and maintenance	Application of PET entails high vulnerability of FOC to damages and limited space for expansion	Heavy duty concrete conduits provide reliable protection, require less maintenance and enable virtually unlimited space for expansion
Safety and security of FOC lines	Passing across third party's land FOC lines are exposed to high risk of damage by civil works / land cultivation activities	Risk of damage minimized as RoW is secured against uncontrolled works and closed for farming

Resource sharing	Competing telecom operators are generally reluctant about sharing their facilities and prefer to build own ICT infrastructure	Owners of transport infrastructure can provide equal access to ICT infrastructure to all interested telecom operators ensuring transparency and fair competition
Time Performance	Digging and excavation works in "green fields" require significant time, especially in the hard-soiled mountainous areas	Putting FOC inside existing underground infrastructure can be completed very quickly at almost no cost compared with "full-cycle" separate deployment

In rural areas of the target countries the penetration of FOC-based telecommunication and ICT services is rather low primarily due to shortage of long-haul FOC backbone routes and difficulties in the organization of the last-mile access whereas the affordable services are required in rural sector with generally low per capita incomes. As a result, most of villages in all three countries still lack adequate ICT infrastructure to enjoy the benefits of high-speed internet over FOC and become full-fledged members of the digital community.

The challenges and constraints of FOC co-deployment for different stakeholders are presented below, including for IMAs, telecom operators, and legislators, policymakers and regulators.

4.2.1 Infrastructure Management Agencies

At present, in all three countries there is a widespread lack of awareness among IMAs of the benefits and advantages of co-deployment and infrastructure sharing. As a result, IMAs have little incentive for the provision of utility ducts and conduits to telecom operators.

No institutional mechanisms exist at country level to enable an effective coordination between different IMAs and telecom operators in the planning and execution phases to enable co-deployment. Growing number of organizations needing to develop their FOC networks along the same routes contributes to the lack of physical capacity of the infrastructure.

The calculation of tariffs for different types of leasing services (e.g., leasing towers, FOC capacity, indefeasible right of use, etc.) is restrained with the absence of proper methodology.

Construction, operation and maintenance cost in co-deployment projects cannot be adequately apportioned due to lack of transparent rules. For example, the cost of civil works (such as expensive concrete ducts) cannot be shared by IMAs with other stakeholders (co-construction) due to absence of institutional and regulatory mechanisms.

IMAs have a generic shortage of professional human resources, including relevant decision makers, with appropriate competencies and influence to streamline the co-deployment in an effective and sustainable manner.

Telecom operators have little interest to provide FOC connectivity to remote rural areas with low population at their own expense expand their services to the low-populated areas with low income residents. As a result, the pace of FOC deployment may be insufficient and cost may be too high for the countries to catch up with the growing demand and the plans to bring the promised FOC connectivity to the villages.

4.2.2 Telecom Operators

The fast-growing demand for high-speed telecom services over fibre aggravates the shortage of both coverage and capacity of FOC routes which worsens the quality and stability of services on the one hand and may trigger the growth of tariffs on the other hand slowing down the evolution of the "FOC to desk" which is nowadays available nearly to all subscribers in the developed countries.

The permit-obtaining process for telecom operators is lengthy, uncoordinated and non-transparent involving multiple entities such as local governments and their authorized subsidiaries, national road and rail authorities, architectural and environmental control authorities, utility owners etc.

Lack of uniform and transparent pricing policy for land acquisition and lease fees;

Inadequate documentation and location data (such as as-built drawings and spatial maps) of the existing FOC networks deployed along the RoW of the transport infrastructure;

As a result of transport infrastructure deterioration, transport accidents and natural calamities telecom operators often suffer from extensive damage to FOC infrastructure deployed along with the land transport routes. The safety and security of FOC infrastructure, including inside utility ducts, is also exposed to risk of damages during operation and maintenance activities.

There are obstacles in accessing existing infrastructure by telecom operators and public authorities due to complexity, technical incompatibilities, and risks related to network security and integrity complicated by the lack of legal obligation to share and have the right to access passive infrastructure.

4.2.3 Legislators, Policymakers and Regulators

Presently none of the regulators in three countries have a clear mandate to coordinate and support co-deployment across various sectors. Their functions are mostly focused on shaping and enforcement of the policies none of which however refers to co-deployment as a concept for action. Similarly, none of the bodies have a function to support a cross-sectoral planning of ICT development in alignment with the other infrastructure management agencies. To address this either a new government body must be established or one of the existing bodies must be empowered with an appropriate mission and functions. The experience of South Korea might be a

good example of cross-sectoral coordination and state support of co-deployment among various infrastructure management agencies outlined in several acts and laws.

The national legislation, policies and regulations of the target countries lack any relevant vocabulary, definitions or processes that would be associated with the concept of co-deployment.

None of the ICT sector development plans and digitalization programmes and policies of the focus countries – Kazakhstan, Kyrgyzstan and Mongolia – consider FOC co-deployment with the transport or energy infrastructure.

Even though FOC design guidelines recommend laying FOC over the existing roads and railways where it is physically possible and economically justifiable, there is no requirement that the development of ICT and transport infrastructure be implemented on a mandatory basis thus contributing to the lack of cross-sectoral coordination of infrastructure development projects.

The rights and responsibilities among the governmental regulating agencies, such as telecommunications regulator, road regulator, rail regulator, energy regulator and antimonopoly regulator, are not clearly delineated. There is a lack of a uniform regulatory framework and standardization policy regarding FOC co-deployment and infrastructure sharing that are acceptable to all utility owners, government authorities and IMAs.

No PPP models were revealed during the study for FOC co-deployment initiatives.

Given the increasing demand for ICT infrastructure by the numerous upcoming ITS initiatives and projects in the countries, addressing the above challenges could significantly facilitate the implementation of the co-deployment concept in sub-region. As a starting point, to mainstream a step-by-step inculcation of the “co-deployment culture” a proper legal coverage must be created within each participating subsector with an adoption of a global policy / legislative act to bring the individual efforts of each participating stakeholder into a common focus.

5. Major Legal, Regulatory and Policy Considerations and Recommendations

5.1 Major Considerations

To promote FOC co-deployment and the joint use of telecommunications facilities, an enabling environment is important in motivating IMAs and telecom operators to cooperate with each other. This may include adopting legislations and regulations to facilitate the granting of RoW permissions to deploy FOCs. Additionally, technical and accounting standards need to be set for FOC co-deployment, including the establishment of separate accounts for telecommunications businesses, standards for the calculation of lease price, and standards for ICT infrastructure development.

But even more fundamentally, national development strategies and plans need to promote cross-sectoral and cross-border cooperation in the development of infrastructure, and incorporate "single installation" and "dig once" principles. This is because in many developing countries, infrastructure planning and development are carried out in institutional and sectoral silos, and thus, a mechanism for joint planning and construction should be established.

Seeking FOC co-deployment opportunities in the public and private sectors through identification of upcoming infrastructure, industrial and housing projects could help jumpstart a co-deployment culture. Table 8 provides a sample table that could help better understand FOC demands and the business environment of the IMAs.

Table 9: FOC demands as per the application over various infrastructure networks

Division			Transport Network			Access Network	Owners
			International	Nationwide	Metro		
ICT infrastructure	FOC	Bandwidth					FOC owner
		Wavelength					
		Fibre					
		Cable					
	Ground type	Sub-duct					Road Railway Pipeline
		Duct					
		Chamber					
	Aerial type	Transmission					Power grid
		Distribution					

Based on the case of the Republic of Korea, FOC co-deployment can be divided into four phases, and depending on the phase a country is at, different legal and regulatory measures are required to promote and support FOC co-deployment (see Table 9). For each country, the legislative and regulatory measures to adopt will depend on national objectives and funds available.

Table 10: Possible legal and regulatory measures by phase

Phase	Business Environment of IMAs	Legislations to be Supported	Regulations to be Supported
Connectivity to be provided by telecom operators	The IMA leases telecommunications line facilities for the installation and operation of ITS, smart grid and SCADA system to monitor, control and protect its core facilities.	Revision or establishment of legislation to develop ITS to improve the efficiency of road and transportation facilities. Revision or establishment of legislation to develop smart grid to modernize and improve the efficiency of power facilities.	Conditions for providing telecommunications facilities and criteria for calculating lease price.
Installation of private telecommunications facilities	The IMA has installed and is operating its own telecommunications facilities to meet its higher and more complex demands.	Revision or establishment of legislation on the installation of private telecommunications facilities by the IMAs.	Technical standards for grounding facilities, in-building ICT facilities, connectivity facilities, conduits and joint areas of telecommunications on electrical poles.
Cross-sectoral infrastructure sharing	Opportunities arise to lease the spare capacity of installed private telecommunications facilities to telecom operators and the relevant rental	Revision or establishment of legislation to allow IMAs to lease their private telecommunications facilities to telecom operators.	Standard for accounting division of telecommunications business. Conditions for providing telecommunications

	business is activated.		facilities and criteria for calculating lease price.
FOC co-deployment	Awareness that the increasing demand for FOCs can be cost-effectively addressed through FOC co-deployment, in cooperation with IMAs.	Revision or establishment of legislation to promote national informatization and digital transformation to integrate advanced digital technologies into all sectors. Revision or establishment of legislation to develop the national spatial information management system for the efficient management and utilization of land, territories and resources. Revision or establishment of legislation that mandates IMAs to cooperate with telecom operators in FOC co-deployment.	Formation and operation of a consultative council for FOC co-deployment and designation of dedicated institutions.

5.2 Recommendations

Based on the experience of the Republic of Korea, this subsection provides recommendations for changes to legislations, policies, regulations and governance structure that could enable FOC co-deployment with other infrastructure systems.

5.2.1 Legislations

A phased approach could be taken in revising or establishing legislations that:

- **Promote national informatization and digital transformation to integrate advanced digital technologies into all sectors;**
- **Introduce a national spatial information management system for the efficient management and utilization of land, territories and resources;**
- **Introduce ITS to improve efficiency of road and transportation facilities;**
- **Introduce smart grid for the modernization and efficiency improvement of power facilities;**
- **Allow IMAs to install private telecommunications facilities (the business or corporation acts for these IMAs should be revised to include this supplementary duty);**
- **Allow IMAs to lease their private telecommunications facilities to telecom operators;**
- **Mandate the installation of broadband communications facilities in new public and private buildings;**
- **Mandate FOC co-deployment among telecom operators and guaranteeing RoW for FOC co-deployment;**
- **Establish a consultative council specializing in FOC co-deployment under a telecom operators association; and**
- **Mandate IMAs to cooperate with telecom operators in infrastructure planning and construction.**

5.2.2 Policies

There should be a national ICT policy and development agency to oversee the national ICT policy, ICT infrastructure and platform strategy, e-government development, and public sector and ICT convergence. There should also be a public-private cooperation system for FOC co-deployment. In addition, there should be a Chief ICT Officer in every government ministries to coordinate and review e-government development and interministerial policies for ICT co-development.

FOC co-deployment requires the collation and sharing of information on existing and planned transport, energy and ICT infrastructure. To enable cooperation among different sectors, the national government should formulate and implement a national spatial data policy with mid-term and long-term plans to facilitate the development and use of a national spatial data system. This could include: the acquisition and management of fundamental spatial data; research and development of the national spatial data system; fostering of professional human resources related

to spatial data; utilization of the national spatial data system and distribution of spatial data; a financial plan for the construction, management and distribution of the national spatial data system; research and dissemination of national standards for the national spatial data system; and management of technical standards and matters concerning the fostering of spatial data industries.

Detailed status of the as-built construction of various infrastructure networks, including the ICT infrastructure, could be established in a two-dimensional or three-dimensional spatial data system. Through this system, the cooperation plans among all IMAs could be established for sharing infrastructure. The administrative process could also be standardized so that the approval process for the use, occupancy, excavation and completion of construction (e.g., clearance and reinstatement of the road after construction) could be quickly, transparently and fairly achieved through the Internet.

In order to build the technical capacity for the ICT industry, the government should implement policy measures to: promote ICT courses in educational institutions at all levels, expand ICT education to the general public; establish institutions or courses to provide specialized training in specific ICT subjects prioritized in national development strategies; and development of a qualification system for ICT professionals.

5.2.3 Regulations

Depending on the local conditions of each country, the following regulations for promoting FOC co-deployment could be introduced in stages or simultaneously:

- **Standard for accounting division of telecommunications business.**

When IMAs lease their own ICT facilities to telecom operators, these enforcement rules provide the IMAs with criteria for the separation of accounts by telecommunications service, such as assets used in telecommunications business.

- **Conditions for providing telecommunications facilities and criteria for calculating lease price.**

When a telecom operator provides ICT facilities to another telecom operators, or when an IMA with private ICT facilities provides its own ICT facilities to telecom operators, the conditions and calculation criteria for lease price need to be provided. The calculation criteria could be based on the standard cost method, which reflects the cost of capital and operating expenses, the responsibility for maintenance, and the compensation for damages.

- **Technical standards for grounding (or earthing) facilities, in-building ICT facilities,**

connectivity facilities, conduits and joint areas of telecommunications on electrical poles.

Detailed technical standards for smooth installation, operation and maintenance of the ICT facilities, such as the protecting facilities, grounding facilities, cable facilities, conduits and other ICT facilities to be installed by the network operator on electrical poles need to be provided.

- **Regulations on intervention in arbitration by the national ICT regulator.**

The procedures and scope to address any conflict of interest between the stakeholders that requires intervention in arbitration by the national ICT regulator need to be provided.

- **Regulation on the formation and operation of a consultative council for FOC co-deployment and the designation of dedicated institutions.**

Matters concerning the establishment and operation of a consultative council, including areas and facilities, tasks and procedures need to be specified for the smooth facilitation of FOC co-deployment among telecom operators.

- **Criteria for joint use of telecommunications facilities.**

Matters concerning the scope, conditions, procedures, methods, price and considerations for access or joint use of telecommunications facilities need to be specified. Joint use could be for the installation or operation of telecommunications facilities required for interconnection between networks.

5.2.4 Governance

Depending on the local conditions of each country, the following governance system for promoting FOC co-deployment could be introduced in stages or simultaneously:

- **Reorganization or establishment of an ICT specialized agency for promoting national ICT development.**

There should be a national ICT policy and development agency to oversee the national ICT policy, ICT infrastructure and platform strategy, e-government development, and public sector and ICT convergence.

- **Establishment and operation of the National Spatial Information Centre.**

This centre could serve as a national hub for spatial information to collate and share spatial data and information developed by both the public and private sectors. This centre is critical for facilitating and supporting e-government services, urban and infrastructure planning, and joint projects among various industries, academics and research institutions.

- **Establishment and operation of the National Transportation Information Centre.**

With ITS facilities installed, a National Transportation Information Centre would be necessary to collect, analyse, manage and provide national transport information in land, marine and air transport sectors, and promote the distribution of traffic information. It could also be responsible for developing ITS-related policies, technology development, standardization, training and statistics.

- **Governance changes in a large corporation may be the easiest path to promote FOC co-deployment.**

In the case of Kazakhstan, one way to promote FOC co-deployment could be through Samruk-Kazyna JSC or the National Welfare Fund, a sovereign wealth fund in which the sole shareholder is the Government of Kazakhstan. Samruk-Kazyna owns enterprises in all major industries, including oil, logistics, communications, mining and energy. The largest telecom operator, two mobile operators and IMAs are part of Samruk-Kazyna. FOC co-deployment by telecom operators and the IMAs could be promoted through Samruk-Kazyna's corporate governance.

- **Establishment and operation of a consultative council of the public and private sectors to promote FOC co-deployment.**

This specialized consultative council for FOC co-deployment could reduce overlapping or excessive deployment costs by individual telecom operator, promote the efficient utilization of national ICT financial resources, and improve the management environment of telecom operators. The roles of the consultative council could include surveys of telecom operators' deployment plans, analysis of co-deployable zones, facilitation and promotion of FOC co-deployment initiatives, and provision of support to improving laws and regulations to enable FOC co-deployment.

- **Reorganization or establishment and operation of an ICT Contractors Association.**

An ICT Contractors Association could conduct research on statutes, systems and initiatives of ICT projects, as well as ICT construction technology, labour market price, standard design drawings and standard market unit price system, and provide education and training to ICT personnel.

- **Establishment and operation of a Broadband Building Certification Authority.**

A Broadband Building Certification Authority could establish a broadband building certification system and grant certificates to new buildings equipped with broadband facilities that have been installed according to the standards set by the authority. Certified buildings can use the certification for the marketing and sales of building units.

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