Pakistan National ICT Industry Development Whitepaper
Ministry of Information Technology & Telecommunication
China Academy of Information and Communication Technology
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1. Executive Summary

The world is entering the era of digital economy and society. Information and communications technologies (ICTs) are increasingly integrated into and enabling every economic and social aspect. The COVID-19 pandemic once again reminds us how digital readiness could better equip a country with resources to cope with crisis and resilience for future recovery. It is highly imperative for Pakistan, therefore, to adopt ICTs as a key growth engine to drive forward its national development efforts.

This whitepaper is to provide a review of Pakistan’s ICT development progress and map out its way forward towards national digital transformation. It consists of six chapters.

Chapter 2 reviews and measures Pakistan’s digital journey, from the overall socio-economic dimension down to its digital economy and ICT sectoral development. An outlook is also provided for its future journey in this chapter.

Chapter 3 designs Pakistan’s national transformation roadmap. A three-level digital economy framework consisting of Foundation, ICT infrastructure and Sectorial Digitalization, is outlined. Development goals are also proposed regarding the improvement of the digital transformation ecosystem, and enhancing the role of digital transformation in driving GDP growth and promoting SDG implementation.

Chapter 4 reviews the current status of Pakistan’s ICT development, with focus on the IT & Telecom sector (mobile broadband, fixed broadband, data center, and IoT), the public sectors (digital government, e-education, and Universal Service Fund), the private sectors (e-agriculture and e-commerce), and cybersecurity. Global trends and best practices are also referenced for Pakistan to identify gaps and potentials for future development.

Chapter 5 focus on digital innovation policy and talent development. A digital policy framework is proposed with the Digital Pakistan Vision as the pivot. The framework is intended to identify the ICT regulation priorities and steer the multi-stakeholder digital efforts. Several future investment priorities are proposed. This chapter also maps out the digital ecosystem and landscape in Pakistan. Digital adoption and utilization is one of the biggest challenges faced by Pakistan’s digital transformation, this chapter proposes that digital utilization could be promoted from three aspects, including government leadership, ecosystem, and digital awareness and skills. Human resource and entrepreneurship are the foundation of all digital efforts, therefore, recommendations for digital skills and entrepreneurial culture development are proposed in this chapter.

Chapter 6 provides recommendations for national ICT development, including practical recommendations to promote the development of the aspects discussed in Chapter 4.

This whitepaper is written by China Academy of ICT (CAICT), an independent research institution, based on data obtained from the Government of Pakistan, third-party database,
and public information sources, etc. The analysis and recommendations made in this whitepaper represent CAICT’s views by extensively drawing on international ICT development trends and best practices. They are intended to provide reference for ICT development and digital transformation in Pakistan, and should not be considered to represent the actual strategy, policy or plan of the Government of Pakistan.
2. Pakistan’s Digital Journey

2.1 Overall Socio-Economic Development

2.1.1 Pakistan Vision 2025

Pakistan is embarked upon a sustainable and inclusive growth and all the economic indicators and recent developments signify the strength and reliability of overall economic performance of the government in reinvigorating the economy, spurring growth, maintaining price stability, providing jobs to the youth and rebuilding key infrastructure of the country. The Government of Pakistan (GoP) is committed to correcting fundamentals of the economy through effective policy making and targeted reforms with an aim to achieve sustainable and inclusive growth trajectory. Facing formidable social, economic, security and governance challenges, the GoP has proposed Pakistan Vision 2025 with future development priorities, in order to address the challenges and achieve the integrated goals of high levels of human development, rapid rates of sustainable and inclusive economic growth, adherence to the rule of law, and steady progress towards democratic and transparent governance, achievement of water, food, and energy security, strong incentives for the private sector, sustained investment in knowledge resources, and optimal reliance on regional connectivity as an engine of growth.

Figure 2-1 “5+7” Framework for Pakistan’s growth and development

(Source: Pakistan Vision 2025)
**Human and Social Capital:** Human and social capital development is the very first since it is a prerequisite for all other development. Strengthen human and social capital to allow the population to optimally contribute to and effectively benefit from economic growth.

**Sustained, Indigenous and Inclusive Growth:** Offer opportunities for achieving better living standards to all Pakistanis irrespective of faith, creed, ethnicity, political affiliation or region i.e. inclusive growth.

**Governance:** Build a responsive, inclusive, transparent, and accountable system of governance.

**Energy, Water & Food Security:** Ensure sufficient, reliable, clean, and cost-effective availability of energy, water, and food for now and the future.

**Entrepreneurship:** Be a highly attractive destination for the private sector where private investment and entrepreneurship plays a lead role in the country’s development.

**Knowledge Economy:** Fundamentally improve competitiveness across the industrial/manufacturing, services, and agricultural sectors, thereby improving national competitiveness in this new era of globalization.

**Connectivity:** Establish an efficient and integrated transportation system that will facilitate the development of a competitive economy.

Pakistan Vision 2025 seeks to lay the foundation of a knowledge-based economy by promoting efficient, sustainable, and effective information and communications technology (ICT) initiatives. The country values its great advantage in a large young population and highlights the importance of innovation and entrepreneurship, computer literacy, and ICT infrastructure. Besides, Pakistan Vision 2025 also emphasizes the role of e-education, e-commerce, e-health, and digital government in improving governance and Public Sector development and shows the country’s ambition in developing smart cities.

### 2.1.2 Measuring Pakistan’s overall socio-economic development

**Prosperity Index**

The Prosperity Index (PI) by Legatum quantifies prosperity in 167 countries across the globe. The PI consists of 12 pillars of prosperity, which are grouped into three aspects of Inclusive Societies, Open Economies, and Empowered People.

Pakistan is positioned at 138th in the overall rankings in 2021, up by 13 places from its 2011 position. In terms of the PI score, Pakistan recorded 44.1 in 2021, with a steady, yet slow, improvement since 2016, below the global and Asia-Pacific averages, which shows that a prosperity gap remains. However, the country’s development has seen a steady progress over the last decade and are gaining momentum in recent year. Between 2016-2021, Pakistan has been advancing its prosperity at a slightly faster pace than the global and regional averages.
In terms of the breakdown performance, Pakistan ranked 111th in Enterprise Conditions, its best rank in the 12 pillars, yet 29 places down from where it was in 2011. Its lowest rank was in the 167th place in terms of the Natural Environment. Its rank moved up most in Safety and Security (up by 15) and down most in Enterprise Conditions (down by 29).

Over the past decade, Pakistan’s performance in most pillars saw improvement, which is represented by score changes. However, there are also several pillars in which Pakistan has fared a little worse, including Enterprise Conditions, Economic Quality and Natural Environment, etc.
Global Competitiveness Index

Covering 141 economies, the Global Competitiveness Index (GCI) measures national competitiveness—defined as the set of institutions, policies and factors that determine the level of productivity. The GCI framework is organized into 12 main drivers of productivity, or “pillars”, of 4 categories.

Pakistan scores 51.4 and ranks 110th in the overall ranking among 141 economies in 2019. In terms of pillar rankings, Pakistan performs most strongly in Market Size (29th), Business Dynamism (52nd) and Innovation Capability (79th). In contrast, it lags in ICT Adoption (131st) and Product Market (126th). This means the potential of Pakistan’s large market and high business dynamism is yet to be fully tapped in many ways. It is urgent for Pakistan to increase its ICT adoption, so as to leverage ICTs to enable economic growth and competitiveness. It is also urgent for the country to enhance its product market, by improving domestic market competition and trade openness.
2.2 Digital Economy Development

2.2.1 Digital Pakistan Vision

The government in Pakistan has recognized ICT as a key driver to encourage research and innovation, enhance economic competitiveness, and promote social inclusion. Digital economy is underscored in the Government’s policies.

In May 2018, Pakistan introduced the “Digital Pakistan Policy”. The primary aim of this policy was to bolster the IT industry by building a digital ecosystem. Taking a step forward, Government of Pakistan had taken the initiative of “Digital Pakistan Vision” in December 2019 with an aim of enhancing connectivity, improving digital infrastructure, increasing investment in digital skills, promoting innovation, and technological entrepreneurship. In 2020, MoIT&T proposed to add another “building block” to the Digital Pakistan Vision, i.e. software development & application.
### 2.2.2 Measuring Pakistan's digital economy development

According to UN's definition for digital economy\(^1\), different technologies and economic aspects of the digital economy can be broken down into three broad components:

- Core aspects of the digital economy, which comprise fundamental innovations (semiconductors, processors), core technologies (computers, telecommunication devices) and enabling infrastructures (Internet and telecoms networks).
- Digital and information technology (IT) sectors, which produce key products or services that rely on core digital technologies, including digital platforms, mobile applications, and payment services.
- A wider set of digitalizing sectors, which includes those where digital products and services are being increasingly used (e.g., for e-commerce). Even if change is incremental, many sectors of the economy are being digitalized in this way. Examples include finance, media, tourism, and transportation.

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\(^1\) DIGITAL ECONOMY REPORT 2019 by UNCTAD

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Based on the available data, Pakistan’s digital economy is measured in the two folds of ICT Core Industry and Digital and IT Sectors. In 2019, the contribution of the ICT Core Industry to the overall GDP is 1.2%. The contribution of the IT & Telecom sector to Pakistan’s GDP is 2.7%.

(Source: UNCTAD)
2.3 ICT Development

2.3.1 Overview of Pakistan’s ICT development

Ever since the liberalization of the telecom sector in 2003, ICTs have been playing a pivotal role in creating opportunities for economic and social growth. The GoP is striving hard to make the best ICT infrastructure available for enhanced productivity and growth of various Internet-based services that can fuel expansion of businesses. Pakistan’s telecom and ICT networks have grown at a faster pace in the last few years owing to supportive regulatory environment, huge FDI inflows, and effective competition among foreign telecom players.

According to Pakistan Telecommunication Authority (PTA), in FY 2021, Telecom and ICT services have a nationwide spread, covering over 89% of the population. Teledensity has touched 87%, of which cellular mobile penetration comprises over 86%. Telecom revenues touched the highest ever figure of PKR 644 billion in FY 2021, compared to PKR 592 billion in the previous year. The sector also attracted US$ 202 million in the shape of Foreign Direct Investment (FDI) and contributed PKR 226 billion to the national exchequer.

With the continuously improving ICT infrastructure and innovative ecosystem, the country has laid the groundwork for a Digital Pakistan.

2.3.2 The impact of COVID-19

The COVID-19 outbreak has had an adverse impact on national and global economies and social lives of people worldwide. It has also demonstrated the critical importance of telecom and ICT in the continuation of businesses, governments, and education in the wake of historic lockdowns and movement restrictions.

Amid the COVID-19, the GoP has introduced Smart Lockdown to balance the imperative to contain the spread of the pandemic with the need to keep the economy functional. It has also taken several initiatives to facilitate sectors, such as agriculture and construction, to accelerate economic recovery. Despite COVID-19, Pakistan has registered an upward trend in foreign remittances and FDI which is a clear reflection of confidence in Pakistan’s economy.

The immediate impact of the COVID-19 pandemic on Pakistan’s telecom sector is visible in the growth trends of vital telecom indicators. However, the sector braved the adversity—rather converted it into an opportunity. Digitization of the economy was already underway when the pandemic struck Pakistan by end-March 2020. The telecom sector met with a huge demand from corporate set-ups and individuals alike to meet the social, educational, health-related, and economic requirements across the country. To tackle and reduce the

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impact of the pandemic, the GoP and telecom operators took various regulatory initiatives across Pakistan. For instance, during March-June 2020, a total of 1,843 million messages were sent to mobile users and more than 1 million cautionary messages were sent to travelers and persons suspected of contracting the virus. In the lockdown stage, mobile data traffic in Pakistan increased by approximately 22%, while the industry managed to ensure the network resilience and provide uninterrupted telecom services. Mobile operators also extended relief to consumers through incentives and reduced price offers for telecom and broadband services. The prices of some bundles were reduced by as low as 82-90% while many services that were previously charged were extended to customers free of cost.

The ITU and governments segmented the pandemic into three phases namely, emergency, recovery, and the new-normal. As the world transitions to the new-normal wherein living paradigms and growth patterns are fast morphing via connectivity and digital economy, the GoP feels increasingly responsible to further unleash the potential of the telecom sector through continuous endeavors to achieve betterment in the regulatory frameworks for advanced technologies, facilitate existing players and new investors, promote ease of doing business, and create new linkages of the telecom industry with the rest of the economy to enhance the dividends of digitalization.

2.3.2 Measuring Pakistan’s ICT development

Global Connectivity Index
The Global Connectivity Index (GCI) released by Huawei encompass 40 indicators that can be analyzed both vertically (Supply, Demand, Experience and Potential) and horizontally (Broadband, Cloud, IoT and AI). It provides a gauge of the entire chain of ICT development and digital transformation.

In 2020, Pakistan ranked 75th out of 79 countries in GCI, and witnessed a year of progress in terms of enabling technologies and the pillars of Demand, Experience and Potential. However, the gap grew on supply-side particularly in ICT Investment.
Network Readiness Index

The Network Readiness Index (NRI) released by the Portulans Institute is grounded in four fundamental dimensions of Technology, People, Governance, and Impact, each comprised of three sub-pillars. The NRI covers issues ranging from future technologies such as AI and IoT to the role of the digital economy in reaching the Sustainable Development Goals (SDGs).

Pakistan ranks 97th out of the 130 economies included in the NRI 2021 a good 14 place improvement since the 2020 position of 111th. Its main strength relating to Technology pillar driven by Future Technology sub-pillar raking 43rd globally, followed by Impact pillar with the latter mostly driven the Economy sub-pillar where Pakistan ranked 50th globally.
Pakistan’s score and rank, by pillar/sub-pillar

<table>
<thead>
<tr>
<th>Pillar/sub-pillar</th>
<th>Rank</th>
<th>Score</th>
<th>Pillar/sub-pillar</th>
<th>Rank</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology pillar</strong></td>
<td></td>
<td></td>
<td><strong>Governance pillar</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access</td>
<td>83</td>
<td>55.65</td>
<td>Trust</td>
<td>103</td>
<td>27.78</td>
</tr>
<tr>
<td>Content</td>
<td>88</td>
<td>29.16</td>
<td>Regulation</td>
<td>108</td>
<td>49.14</td>
</tr>
<tr>
<td>Future technologies</td>
<td>43</td>
<td>40.77</td>
<td>Inclusion</td>
<td>117</td>
<td>36.06</td>
</tr>
<tr>
<td><strong>People pillar</strong></td>
<td></td>
<td></td>
<td><strong>Impact Pillar</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individuals</td>
<td>122</td>
<td>32.37</td>
<td>Economy</td>
<td>50</td>
<td>43.16</td>
</tr>
<tr>
<td>Businesses</td>
<td>69</td>
<td>38.15</td>
<td>Quality of Life</td>
<td>102</td>
<td>50.94</td>
</tr>
<tr>
<td>Governments</td>
<td>94</td>
<td>32.04</td>
<td>SDG Contribution</td>
<td>104</td>
<td>47.79</td>
</tr>
</tbody>
</table>

(Source: Portulans Institute)

**E-Government Development Index**

The United Nations E-Government Development Index (EGDI) assesses e-government development at the national level. It is a composite index based on the weighted average of three normalized indices of Telecommunications Infrastructure Index (TII), Human Capital Index (HCI) and Online Service Index (OSI).

In the 2020 UN E-Government Survey Report³, Pakistan ranked 153rd out of 193 countries and was among the “middle EGDI” group. China, Malaysia, Saudi Arabia, Thailand, and Turkey joined the “very high EGDI” group for the first time in 2020, with ranking of 45th, 47th, 53rd, 57th respectively. Philippines ranked 77th, among the “high EGDI” group.

According to the UN survey, Pakistan is among the least connected countries in the world. Both fixed broadband penetration rate and number of active Internet users are comparatively low. However, Pakistan is listed as “high” in the sub-index of Online Service Index. Considering its low level of infrastructure development, the impressive advancements in online services provision is particularly worthy of note.

The measurement results show that Pakistan is currently at a starter stage in terms of ICT development. However, the GoP is determined to enhance the country’s overall ICT level and head towards a vibrant digital economy.

2.4 Future Outlook

2.4.1 Advanced ICTs as new momentum

ICT infrastructure and services are the foundation for countries to develop digital economy and to increase their overall economic well-being and competitiveness. They are means to deliver quality goods and services in the areas of health care, education, finance, commerce, governance, and agriculture, among others. They can help reduce poverty and hunger, boost health, create new jobs, mitigate climate change, improve energy efficiency, and make cities and communities sustainable.

5G and F5G complement each other and create synergy to become the foundation of a fully connected, intelligent world. Wireless and fixed networks are the foundation of the connectivity industry. They have different use cases, but are well coordinated and inseparable. Currently, wireless networks are entering the 5G era. Built on globally unified standards, 5G is going beyond individuals and homes to revolutionize industries, enabling them to develop and prosper. So far, countries around the world have explored over 300
5G 2B use cases across more than 20 industries, including media, education, healthcare, connected vehicles, intelligent manufacturing, and smart mining.

Fixed network industry is moving towards the era of the 5th generation of fixed network (F5G). Fiber networks have many advantages, such as limitless bandwidth, long-distance transmission, and anti-electromagnetic interference. They also save energy and are eco-friendly. F5G, which features ultra-high bandwidth, full-fiber connection, and ultimate experience, will both enhance user experience in traditional home access scenarios and drive the digital transformation of various sectors such as enterprise, transportation, security, and campuses.

**Figure 2-11 Comparison between 5G and fiber optic**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>5G</th>
<th>Fiber optic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>It uses radio waves for sending and receiving data</td>
<td>It uses light to transmit data through fiber optic cables</td>
</tr>
<tr>
<td>Speed</td>
<td>Peak download speed: 20 Gbps</td>
<td>Up to 1000Gbps in theory</td>
</tr>
<tr>
<td></td>
<td>Peak upload speed: 10 Gbps</td>
<td>Up to 100Gbps in practice</td>
</tr>
<tr>
<td>Reach</td>
<td>Up to few hundred meters</td>
<td>Up to 70km without losing signal over fiber</td>
</tr>
<tr>
<td>Last mile deployment</td>
<td>Easier and less costly</td>
<td>More difficult and costly</td>
</tr>
<tr>
<td>Installation cost</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td>Operation cost</td>
<td>Up to 5 times higher than that of fiber</td>
<td>Lower</td>
</tr>
</tbody>
</table>

From the above comparison between 5G and fiber optic, the question of 5G replacing fiber does not arise. Both 5G and fiber optic technologies co-exist to realize wide and high-quality connectivity. 5G provides wireless connectivity to mobile users, indoors or outdoors. At the same time, fiber optic carries huge bandwidth data of the 5G cellular system in the backhaul connections among multiple cell tower sites or from one region to another. Hence, both 5G and fiber optic technologies are dependent on each other and co-exist to provide connectivity and services the digital world needs. By fully harnessing F5G networks’ ultra-high bandwidth and 5G networks’ mobility as part of deep fixed-mobile hybrid synergy, combined with the mass connectivity of both, 2H/2B/2C all-scenario smart life will become possible.

For Pakistan, fixed/optical and 5G network should be planned and rolled out in parallel. As 5G networks require high speed backhauling, Pakistan should adopt the all-optical network strategy in parallel with its planning for 5G.

With the fast growth of Internet regarding the number of connected devices and bandwidth, IPv6 (Internet Protocol version 6) is the only sustainable way for the future Internet to connect different networks together: the 5G, optical and cooper access network on one side, and the cloud, applications, etc. on the other side. The old version of IP, IPv4, is
already exhausted. The number of IPv4 addresses per 1 thousand population is only 27 for Pakistan – far away from connecting every person, not to mention the development IoT for connecting everything.

IPv6 provides not only a large number of address space, but also extensibility and security. With IPv6 Enhanced innovations such as segment routing, network slicing, etc., IPv6 could bring a high-quality, more stable and future-proof network backbone for the 5G and cloud era.

Therefore, IPv6 deployment should play a key role in the national Internet development strategy. Lots of countries, like the USA, China, France, Germany, India, Vietnam, have released industry policies to promote the IPv6 deployment.

**Figure 2-12 IP is in the center of 5G and cloud era for connecting everything**

(Source : ETSI IPE Gap Analysis)

With the maturity of four enabling technologies—IoT, cloud computing, big data analytics and AI—modern ICTs’ potential will be further realized to accelerate economic and social progress. According to Huawei’s study⁴, modern ICTs will lead to a digital economy valued at USD 23 trillion in 2025. It is predicted that there will be 100 billion connections by 2025, helping to drive digital transformation in domains including public utilities, transportation, manufacturing, healthcare, agriculture, and finance. By that time, 85% of enterprise applications will be on the cloud, 86% of global companies will adopt AI, and data utilization rates will skyrocket to 80%. This means 180 billion TB of data will be generated every year, which in turn will act as a constant source of innovative intelligence and value creation.

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⁴ Huawei. GIV 2025: Blueprint of an Intelligent World
2.4.2 Priority Areas for Pakistan’s Digital Development

With the COVID-19 further highlighting the importance of a robust digital economy, Pakistan needs to enhance its dedication to developing the digital economy. This whitepaper identifies several priority areas for Pakistan’s digital development, based on the key sectors of Pakistan Vision 2025 and their feasibility to realize digital transformation in the coming years, with a special view to promote sustainable development after the COVID-19.

Based on the pillars and missions outlined in Pakistan Vision 2025, the sectors involved to underpin those pillars are identified.

Figure 2-14 Key sectors that support Pakistan Vision 2025
Looking into the future, 9 sectors are deemed to be the priority areas for digital transformation in Pakistan, including the IT & Telecom sector, education, health, smart city, digital government, finance, manufacturing, agriculture, and energy.

Figure 2-15 Priority sectors for digitalization in Pakistan and the benefits

The following figure demonstrates the relevance of different digital technologies and themes to Pakistan. The ones towards the darker side are more relevant to Pakistan from the temporal perspective. For example, some of the digital technologies are already used widely, e.g., 3G/4G, or on a small scale, e.g., sensor technology. Some of the technologies, e.g., NB-IoT, are already in the process of being planned by governments and business. Some cutting-edge technologies, which are still in evolution, will be considered for large-scale application in Pakistan when the technology is mature and the business model is determined.
Figure 2-16 Key digital technologies and themes for Pakistan
3. National Transformation Framework

3.1 Digital Transformation Framework

The Digital Pakistan is based on a four-level framework of digital transformation. It integrates the various applications, services, resources and physical infrastructure. As seen in the figure below, an integrated ICT framework will enable all participants to move in the same direction, avoid duplication and wastage in infrastructure planning and ensure collaboration, coordination and solid integration among all stakeholders in order to embrace the digital economy.

Figure 3-1 Pakistan’s digital transformation framework

- **Smart devices layer**: A better connected country has the potential to be a smarter nation and it is at the smart devices layer that many of the key connections take place. This layer is intertwined with the Internet of Things (IoT).
- **Connectivity layer**: The connectivity layer represents various networks provided by telecommunication operators, as well as other networks provided by city stakeholders or enterprise private communication networks. This layer is responsible for carrying all the data produced by the sensors as well the communications between each of the elements of the ICT infrastructure such as – the data centers, platforms, end user devices and applications. In addition, it has Fixed and Wireless components, each delivering parts of the data which underlies Digital Pakistan.
- **Digital platform layer**: The digital platform includes computing and storage
infrastructure based on the data center and edge data center. The layer, integrates cloud computing, edge computing and intelligent computing, to provide high-efficiency computing power. New technologies, such as AI and block-chain, are evolving to form infrastructure in the form of platforms.

- **Application layer**: Leverage the capacity of ICTs to enable the 8 focus sectors (public/private).

### 3.2 Development Goals

Pakistan’s national digital transformation aim at long-term, sustainable development, which is in consonance with the Digital Pakistan Vision. By 2025, Pakistan’s digital ecosystem will see significant improvement and stronger competitiveness. The role of digital economy in driving GDP growth and contributing to the achievement of SDGs will be enhanced significantly.

**Figure 3-2 Goals of digital transformation**

By 2025,

- **Digital transformation of public sectors**: Government agencies are connected in their operations. Government operations are integrated and run as a single entity to provide services to all citizens. Inter-agency data are integrated on government data platform, sharing digital resources with maximum efficiency.

- **Digital transformation of private sectors**: Digital technologies are deeply integrated into the private sectors, accelerating the development of real economy, e.g. agriculture, manufacture, energy, finance. The application of advanced ICTs, e.g. AI, block-chain, cloud computing, in production is deepening, which further increase the digitalization and intelligence of private sectors.

- **ICT infrastructure**: The capability of ICT infrastructure in promoting digital
transformation is significantly enhanced. The population coverage of mobile broadband reaches 95%, in which the population coverage of 5G reaches 4%. The population coverage of FTTH reaches 20%. Fixed broadband subscribers in urban and rural can access broadband services at a speed no less than 50Mbps and 30Mbps respectively. Public services (schools, hospitals, etc.), government can access broadband services at a speed no less than 100Mbps. The IPv6 adoption rate reaches 40% in both fixed and mobile networks. Major ISPs must be ready for providing IPv6 services.

Facilitators of digital transformation: The policy framework of the digital transformation is more comprehensive. Cybersecurity legislation is improved. The number of talents grow significantly to support every aspect of digital transformation. The capacity of scientific innovation has been greatly enhanced.

As the integration of digital technologies deepen in Pakistan, the scale of digital economy will expand sharply in the next five years. The contribution of the digital economy to GDP will continue to grow. From 2019 to 2025, the contribution of ICT core industry to GDP will increase from 1.2% to 8.15%. The contribution of digital & IT sectors to GDP will increase from 2.7% to 13%.

Figure 3-3 Goals for digital economy’s contribution to GDP

Digital transformation will contribute to the implementation of all the 17 SDGs, extending social and economic progress to all the people in Pakistan.
### Table 3-1 Goals for promoting SDG implementation

<table>
<thead>
<tr>
<th>SDGs</th>
<th>Goals of leveraging ICT to promote SDG</th>
<th>SDGs</th>
<th>Goals of leveraging ICT to promote SDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Leverage ICT to improve productivity among millions of people so they have better means of income and livelihood. Promote work and financial inclusion by providing services such as mobile banking and micro-crediting.</td>
<td>2</td>
<td>Leverage ICT-enabled solutions to make agricultural practices more data-driven and efficient, help farmers increase crop yields and reduce use of energy.</td>
</tr>
<tr>
<td>3</td>
<td>Deploy widespread e-health applications. Improve direct patient interaction, health informatics and telemedicine through better connectivity.</td>
<td>4</td>
<td>Equip millions of young people with job-ready digital skills.</td>
</tr>
<tr>
<td>5</td>
<td>Improve women’s access to ICT, build relevant digital and other skills, and promote female leadership in digital transformation.</td>
<td>6</td>
<td>Leverage ICT to facilitate smart water and sanitation management.</td>
</tr>
<tr>
<td>7</td>
<td>Develop greener ICTs, and use green energy-saving equipment to reduce energy consumption and carbon emissions.</td>
<td>8</td>
<td>Stimulate ICT-centric innovative entrepreneurship and vibrant micro, small and medium enterprises</td>
</tr>
<tr>
<td>9</td>
<td>Accelerate digital transformation with better infrastructure, investment, innovation, and inclusivity.</td>
<td>10</td>
<td>Reduce digital divide and inequality within and between communities and populations by enabling access to ICTs and knowledge for all.</td>
</tr>
<tr>
<td>11</td>
<td>Leverage ICT-enabled solutions to realize more effective and holistic city management and facilitate the transition to smart sustainable cities.</td>
<td>12</td>
<td>Leverage ICT innovations and applications to improve the use of the natural environment and resources, and promote sustainable lifestyles.</td>
</tr>
<tr>
<td>13</td>
<td>Leverage ICT to optimize value chains and reduce resource usage, waste, and emission, and facilitate all sectors to better respond to climate change.</td>
<td>14</td>
<td>Leverage ICT to conduct marine monitoring, plan mitigation and adaptation strategies, and achieve marine conservation and sustainability.</td>
</tr>
<tr>
<td>15</td>
<td>Leverage ICT to conduct land monitoring, plan mitigation and adaptation strategies, and achieve land conservation and sustainability.</td>
<td>16</td>
<td>Leverage ICT-enabled solutions to promote digital governance, increase transparency, empowers citizens, and improve public services.</td>
</tr>
<tr>
<td>17</td>
<td>Enhance public-private partnerships to provide better ICT infrastructure and digital services for all. Foster international cooperation to promote technology transfer and capacity building.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. ICT Development - Current Status

4.1 IT & Telecom Sector

4.1.1 Mobile Broadband

Currently, mobile connectivity has become an essential part of the social and economic life. Mobile continues to be the primary way in which many users access the internet in low- and middle-income countries (LMICs). According to the ITU, in 2019, mobile accounted for 87% of broadband connections in developing countries. Mobile devices and networks are increasingly driving economic growth, connecting people and businesses, and delivering public and private e-services in health, education, and finance, etc. The mobile ecosystem in Pakistan plays an increasingly important role in economic growth, through its direct contribution to GDP and through driving productivity and efficiency gains across different sectors of the economy.

**Figure 4-1 Mobile broadband framework**

4.1.1.1 Mobile services development

Currently, 4G serves as the foundation of mobile broadband in most countries around the world, and its penetration rate is still growing. At the same time, the world is witnessing a transition from 4G to 5G.

**4G dominates in connection and is catching up with 3G coverage.** According to the latest research of GSMA\(^5\), in 2019, 4G for the first time accounted for more than 50% of mobile connections globally. 82% of the population in LMICs were covered by 4G, compared to 90% for 3G. It has taken LMICs around seven years to reach more than 80% coverage for 4G, compared to 10 years for 3G.

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\(^5\) GSMA. The State of mobile internet connectivity 2020
5G enters the phase of scale deployment. According to CAICT, as of 2020, 92 countries/regions have released 5G development strategy/plan, conducted 5G spectrum auction, or decided 5G spectrum auction/allocation timetable. 135 operators in 52 countries/regions have launched commercial 5G services. In the coming years, there will be more widespread deployment and adoption of the technology around the world, including in LMICs.

4G/5G FWA has become one of the top choices of household broadband services. 4G/5G fixed wireless access (FWA) enables reliable and affordable broadband connections to the Internet, meaning that it can play a big role in providing broadband for all. To date, 406 4G and 40 5G FWA networks have been deployed, and more than half of mobile carriers have launched FWA services around the globe. The number of 4G/5G FWA subscribers has exceeded 100 million worldwide. FWA has also become a new option for national broadband. More than 30 countries have incorporated FWA into their national broadband plan. A number of support measures have been introduced to promote broadband, such as proactive spectrum allocation, policy subsidies, and flexible infrastructure openness.
Mobile broadband in Pakistan keep growing, yet still has plenty room for growth. Mobile subscription and penetration are increasing at a steady pace in Pakistan. As of June 2021, total mobile users and mobile broadband (MBB) users have reached 184 million and 103 million, respectively. Mobile penetration and MBB penetration have reached 84% and 51%, respectively. The proportion of MBB subscribers in the total mobile subscribers keep increasing over the past years.

**Figure 4-4 Total mobile and MBB penetration rates**

![Chart showing the total mobile and MBB penetration rates from 2017 to 2022.](source)

MBB network coverage is relatively insufficient, while MBB penetration is significantly low. As per PTA, at the end of 2021, 4G network coverage in Pakistan is

(Source: PTA)
71%, while the number is above 94% for most benchmark countries. Moreover, the gap in MBB penetration is alarmingly large. Pakistan has a total MBB penetration of above 46% (including 3G penetration of 10% and 4G penetration of 36%), while the number for other benchmark countries (excluding Philippines) is above 74%. The sharp contrast shows a usage gap, i.e., although a large proportion of the population is covered by MBB in Pakistan, less than half of them use MBB services. Access to connectivity, affordable devices, and content barriers are among the factors behind this usage gap.
Pakistan is trailing in 4G and 5G development. The GSMA had projected that more than 50% of users will have a 4G connection in Pakistan by 2022, these projections are accurate, however remain three years later than the trajectory of global average. Compared with world average, the percentage of 4G connection in Pakistan is significantly smaller than the rest of the region, but is expected to grow at a faster pace and continue to grow beyond 2023. 5G is projected to pick up from 2023, but continue to account for a very small proportion of connections in the following years.
Fixed wireless broadband services are yet to be fully developed in Pakistan. In Pakistan, digital services function primarily through mobile, with fixed broadband penetration relatively low. 4G FWA can provide a reliable, affordable, and high-quality solution to enhance household broadband connections to the Internet. However, few 4G FWA service has been developed in Pakistan. To further promote the penetration of household broadband, the country should start develop FWA on 4G.
4.1.1.2 Spectrum

Spectrum allocation

Mobile operators need timely and affordable access to a sufficient amount of spectrum in order to support high speed, mobile broadband services with good coverage. When operators are spectrum-constrained, they are likely to have to invest more on densifying their network in urban areas than they would otherwise. This in turn can constrain their ability to invest in the rest of the network and, especially, improve coverage.

The GSMA Mobile Connectivity Index shows that countries that have allocated more spectrum for mobile are more likely to have higher levels of mobile broadband coverage. A recent research\(^6\) has shown that 4G mobile coverage increases by 11-16 percentage points, and 3G coverage increases by 20 percentage points, when operators are assigned spectrum 2 years earlier. The same study showed an additional 20 MHz of spectrum per operator increases 4G coverage by 2-4 percentage points. Besides, to get ready for 5G launch, a significant amount of new harmonized mobile spectrum is needed.

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\(^6\) GSMA. The impact of spectrum pricing on consumers

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Pakistan. Currently, cellular mobile telephony frequency spectrum in 900 MHz, 1800 MHz, and 2100 MHz were made available in Pakistan. Pakistan has released 274 MHz mobile spectrum in total, which is significantly insufficient. Besides, the spectrum allocated to mobile operators is relatively fragmented.

Table 4-1 Current mobile spectrum allocation in Pakistan

(Source: Pakistan Frequency Allocation Board)

Pakistan is expected to see exponential growth of data traffic over the next five years to reach close to 1Gb/month/user, reaching similar levels seen in countries like Saudi Arabia, Malaysia, and Thailand. Moreover, with greater availability of content, applications and devices now compared to few years ago, Pakistan has grown at a rate of 1.75Gb/month/user. Pakistan should have a goal to have 840 MHz of IMT spectrum allocated in low and mid-bands by end of 2024/2022/early 2023. Should Pakistan aspire to be the early adopter of 5G, more spectrum will be required. Prevailing spectrum allocations and license fees in Pakistan risk the nation falling further behind peers in digital transformation of its economy. It is urgent for Pakistan to release more spectrum for mobile broadband services.

Countries around the globe have been dedicated to promoting 4G and 5G development with reasonable spectrum allocation. LTE is designed to work across a number of frequency bands ranging from 450 MHz up to 3.8GHz. The available bandwidths
are also flexible starting with 1.4 MHz up to 20 MHz with Carrier Aggregation allowing use of wider multiples. Availability of specific bands varies per country and operator. 5G services require MNOs to have access to large and contiguous spectrum to support wider coverage, faster speed, and lower latency. 5G supports all bands, from sub-1 GHz to mmWave (above 24GHz). Regulators around the world are objectively focused on identifying, clearing, and allocating new spectrum for 5G. By November 2020, 71 countries/regions have definite 5G auction/allocation plans, including 39 countries/regions that have completed or partly completed 5G auction/allocation.

**Figure 4-7 Global 4G LTE spectrum landscape, 2020**

(Source: Qualcomm)

**Figure 4-8 Snapshot of allocated/targeted 5G spectrum in major countries, 2020**

(Source: Qualcomm)

**Pakistan has made spectrum rolling plan to meet the demand for future mobile**
services, but timeline is uncertain for the allocation of some key bands. The Rolling Spectrum Strategy 2020-23 published by the Ministry of IT & Telecommunication after approval of the Federal Government provides a future roadmap for spectrum allocation.

Table 4-2 Selected spectrum outlook

<table>
<thead>
<tr>
<th>Work Item</th>
<th>Plan</th>
<th>Demand</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>700 MHz Band (703 – 803MHz)</td>
<td>To refarm this band and allocating the band for mobile services</td>
<td>Medium</td>
<td>2020 – 2022</td>
</tr>
<tr>
<td>2100 MHz Band (1950 – 1980 MHz / 2140 – 2170 MHz)</td>
<td>PTA/FAB is refarming the band and will make the spectrum available for mobile services.</td>
<td>High</td>
<td>2020 – 2021</td>
</tr>
<tr>
<td>2300 MHz Band (2300 – 2400 MHz)</td>
<td>PTA/FAB intend to make this band available in the future when there is adequate demand.</td>
<td>Medium</td>
<td>2020 – 2022</td>
</tr>
<tr>
<td>2500 MHz Band (2500 – 2690 MHz)</td>
<td>MoIT&amp;T/PTA/FAB is working to refarm the band with the intention of allocating it for IMT services. Further GoP Policy has identified this band for trials of 5G networks; the same is under consideration for auction for IMT.</td>
<td>High</td>
<td>Depending on the judiciary process</td>
</tr>
<tr>
<td>3.5 GHz Band (3300 MHz to 3400 MHz)</td>
<td>3300-3400 MHz is identified for the implementation of IMT.</td>
<td>Low</td>
<td>2021-2022</td>
</tr>
<tr>
<td>3.5 GHz Band (3400MHz to 3600MHz)</td>
<td>PTA/FAB is considering expanding the usage of the band to include mobile when the licenses expire. Further GoP Policy has identified this band for trials of 5G networks; the same is under consideration for auction for IMT.</td>
<td>High</td>
<td>Beyond 2024</td>
</tr>
</tbody>
</table>

(Source: Rolling Spectrum Strategy 2020-23)

It can be seen from the above table that there is high demand for 1.8 GHz, 2.1GHz, 2.5GHz, and 3.5GHz for mobile. Federal Government plans to release or auction spectrum. PTA shall follow the decision of the Federal Govt accordingly. Looking into future, a long term spectrum strategy should be defined to support the sustainable development for mobile broadband. Among all frequency bands, mid-band should be considered as the first priority as it can provide a good balance between capacity and coverage. The device availability and affordability in mid-band will be more favorable by developing countries such as Pakistan. A GSMA study identified that total mid-band spectrum needs estimated to be 2000 MHz in average to meet the IMT-2020 user experienced data rates of 100 Mbit/s (downlink) and 50 Mbit/s (uplink), for citywide high capacity coverage in the 2025-2030 timeframe.

WRC-23 AI 1.2 is to study more mid-band for IMT identification, 6 GHz (6425-7125 MHz) is one of the candidate bands. 6 GHz is allocated to Mobile Service on a primary basis globally, and can provide large continuous blocks. Monument of 6GHz IMT is growing. 3GPP started work on 6 GHz NR specifications and is planned to be finalized in 2022. Regions and countries are formed their view to support 6 GHz IMT identification. Field tests showed that 6 GHz can provide similar coverage as 3.5 GHz.

Another possible option in 6 GHz is Wi-Fi. When compared to the limited user connectivity of Wi-Fi (which requires an existing broadband connection), the prospect of providing high capacity IMT services to large numbers of users is a more compelling proposition in a
country such as Pakistan with very limited fixed access. Furthermore, there are alternative bands to accommodate potential increases in traffic in local area networks such as the 60 GHz band where WiGig is available.

It must be noted that broadband connectivity in Pakistan is often provided through a Mobile hotspot. This means that the data traffic will be backhauled over the Mobile network’s spectrum. Therefore, it is more efficient to use a band such as 6 GHz for mobile or Fixed Wireless Access rather than using it for Wi-Fi. According to the latest analysis by GSMA-Intelligence, an IMT exclusive or a balanced allocation between IMT and Wi-Fi in 6 GHz will bring the greatest contribution to economy, which will greatly empower the future economy growth of Pakistan. Pakistan should reserve at least 6425-7125 MHz for future mobile broadband/IMT use in its long term spectrum strategy.

■ Spectrum price

The GoP is considering new spectrum pricing framework.

The aim of spectrum pricing is to ensure that radio frequencies are used efficiently – both technically and economically. The setting of spectrum fees by the regulator is usually influenced by the revenue goals and requirements of government. According to ITU guidelines on spectrum pricing\(^7\), these revenue targets should align with the objectives of (i) optimal spectrum efficiency, (ii) achieving economic and social development goals, (iii) spectrum users paying for spectrum resource usage, and (iv) recovering spectrum management costs.

Spectrum prices are established using either an administrative method, a market-based method, or by using a combination of both.

- Administrative mechanisms include administrative incentive pricing (AIP) and spectrum fee formulas that recover regulator costs of spectrum management.
- Market-based mechanisms for setting spectrum prices typically involve a market exchange such as spectrum auctions and (in the secondary market) spectrum trading.

Currently, PTA/FAB is in the process of developing recommendations for Spectrum Sharing and Trading Frameworks in consultation with the Ministry of IT & Telecommunication in addition to an AIP-base spectrum pricing framework to replace the current Annual Spectrum Administrative Fee (ASAF)\(^8\).

Costs of spectrum are high for operators in Pakistan.

Countries with low spectrum auction prices and long spectrum license lengths tend to have better network coverage, a wider choice of services, better take-up, and healthier competition. An econometric study by the GSMA\(^9\) found that high spectrum costs lead to negative consumer outcomes by restricting the financial ability for network investment. The

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\(^7\) ITU. Guidelines for the review of spectrum pricing methodologies and the preparation of spectrum fee schedules

\(^8\) ASAF: In Pakistan, spectrum fees are imposed to cover FAB’s annual budget. Mobile operators pay the ASAF to cover 75% of FAB’s annual budget based upon the portion of auctioned access spectrum they hold. Other licensed and private spectrum users cover the remaining 25% of FAB budget on administrative charging basis.

\(^9\) GSMA. The impact of spectrum pricing on consumers (2019)
study also noted that in developing countries, high spectrum costs slowed the rollout of 3G and 4G networks and drove long-term reductions in overall network quality.

Globally, the spectrum costs are declining. A Coleago Consulting study\(^{10}\) computed the Spectrum Price Index (SPI), i.e., total spectrum cost divided by monthly mobile revenue. The SPI is 6 for 3G, 4 for 4G, and 2 for 5G. This equals an annualized spectrum cost at 3% of revenue for 3G, 2% for 4G, and 1% for 5G. In countries such as China, the UAE, Saudi Arabia, and Kuwait, the number is below 1%.

The Coleago study also calculated the impact of annualized cost of spectrum on MBB investment and drew the following findings:

- A cost of spectrum of up to 5% is unlikely to slow down investment in mobile broadband and 5G. There is also evidence that lower percentage is likely to deliver better outcomes for 5G deployment.
- In many well developed 4G markets the annualized cost of spectrum is 5-9% of mobile revenue. This indicates that below 10% the annualized may not have material negative impact on network deployment.
- When the cost of spectrum amounts to 10% of mobile revenue, operators may hit budget constraints, i.e. investment in mobile broadband and 5G is likely to be slower than it otherwise would be. A cost of spectrum above 10% of revenue presents a threat to the development of 5G.

**Figure 4-9 Operators’ costs on spectrum are high in Pakistan**

(Source: market insight)

In Pakistan, three out of four MNOs’ expenses on spectrum are above 10% of their revenues. The high spectrum cost may jeopardize operators’ ability to invest and to support affordable services, resulting in slower deployment of MBB networks and more expensive, lower-quality MBB services. In the long term, it will hinder social and economic digital

\(^{10}\) Coleago Consulting. Sustainable spectrum pricing
development. Therefore, the GoP is recommended to take measures to increase the affordability of spectrum for the operators. There are many countries around the world that use measures like annual payment and deferred payment, etc., to reduce the cost burden of operators, particularly in the first years of network roll-out.

**Thailand: affordable spectrum price**

1. **Reasonable spectrum reserved price**
   2.6GHz per carrier reserve price is 37% of 4G L1800 in terms on price per MHz.

![Graph showing spectrum prices](image)

2. **Three-year grace period for deferred payment terms**
   Grace period for deferred payment term was given for 2.6GHz. With 3 years of grace period from 2021-2023, MNO has more cash flow to rollout in first 4 years.

![Table showing deferred payment terms](image)

3. **Deferred payment bond with rollout obligation**
   i. To get 2.6GHz grace period payment term need to complete the rollout obligation
   ii. Eastern Economic Corridor GEO coverage 50% in 1 year
   iii. Other Top 6 Provinces/Smart City 90% GEO coverage in 4 years

![Map showing deferred payment bond](image)
4.1.1.3 Infrastructure sharing

Infrastructure sharing can be a step to enable rationalization of legacy networks such as 2G or 3G networks. Considering the falling revenues of 2G/3G networks and higher spectral efficiencies of next-generation networks (4G and 5G), many mobile operators are already rationalizing these legacy networks. Co-construction and sharing has become a global trend: the number of mobile network infrastructure sharing increased with a y-o-y rate of nearly 25% between 2010 and 2015, and has continued to rise since then. Some regulators are encouraging infrastructure sharing of mobile operators because they believe that there are regulatory/social benefits that society can reap. Major social benefits come directly from the economic benefit, where mobile operators can direct saved cost to the customer in pricing. In addition, infrastructure sharing can help reduce energy consumption and radio emissions of networks.

A different perspective of business/ownership can classify infrastructure sharing agreements to four types.

• Unilateral service provisioning: only one company’s provide its sites to be shared, and ownership remains separate
• Mutual service provisioning: two or more companies provide their sites to be shared, and ownership remains separate
• Joint venture: companies enter into an agreement to form a joint venture (can operate as a tower company) to own and operate the networks but do not directly own the sites
• 3rd party service provider: an independent company (not necessarily affiliated with a mobile operator) owns and leases sites to mobile operators to use. The municipalities or the government can become the 3rd party provider of infrastructure under a public-private partnership.

Figure 4-10 Business/ownership classification of site sharing

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### Table 4-3 Comparison of infrastructure sharing forms (business/ownership)

<table>
<thead>
<tr>
<th>Sharing form</th>
<th>Pros</th>
<th>Cons</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Service provisioning</strong></td>
<td>1. Reduction in OPEX: removal of depreciation costs; 2. Simpler to implement; 3. Ownership still with operator</td>
<td>1. Coordination of operation and network deployment plans 2. Challenges of strategic control and flexibility 3. Difficult to exit 4. Regulatory risks 5. Transformational effort (e.g. setting up new organization)</td>
<td>UK</td>
</tr>
<tr>
<td><strong>Joint Venture</strong></td>
<td>1. Reduced risk: fixed CAPEX is transferred to variable OPEX 2. Reduction in OPEX: reduced O&amp;M costs 3. Cut down CAPEX cost for new deployment 4. Control over diverting cost savings to operators</td>
<td>1. Coordination of operation and network deployment plans 2. Challenges in differentiation 3. Regulatory risks</td>
<td>China</td>
</tr>
</tbody>
</table>

(Source: GSMA)

In Pakistan, the site sharing rate is 10%, while 18% of population are not connected to mobile broadband network, hampering their participation in society and contribution to economy. Infrastructure sharing will be a cost-effective way for Pakistan to adopt, which can lower the cost and time span of expanding network coverage in remote areas, and also support the expansion of LTE network in under-served areas in Pakistan. Wider coverage and higher speed would breed richer digital lifestyle and e-commerce, and benefit business, especially cross-border, to operate.

**4.1.1.4 Supporting facilities**

In the era of 4G and 5G, to cope with the rising demand for MBB services, operators are adopting the “network densification” strategy. With more cell sites built, it is necessary to first lay a sound foundation of backhaul and energy. Innovative backhaul and energy solutions and enabling policies can improve the cost of deploying and operating networks and thus promote MBB development.

- **Backhaul**

Globally, terrestrial wireless remains the most popular backhaul method. Terrestrial
wireless and fiber are the two main methods of backhaul. Despite fiber being the first choice for MNOs for 4G and 5G backhaul, most operators still rely heavily on microwave backhaul solutions in the 7GHz to 40GHz bands. There is also growing interest in using 59-64GHz (V-band) as well as 71-76GHz/81-86GHz (E-band) for short, high capacity backhaul links.

According to ABI Research, backhaul links (an aggregate of macrocells and small cells) deployed worldwide in the traditional 7GHz to 40GHz bands was 56% in 2017 and projected to decline to 38% by 2025. Microwave links in the 41 GHz to 100 GHz bands will double from 5% to 12% from 2017-2025.

**Figure 4-11 Comparison of backhaul options in 2017 and 2025, by technology**

(Source: ABI research, GSMA)

In the era of 5G, microwave backhaul will complement fiber backhaul solutions particularly in countries that do not have extensive fiber infrastructure. Compared with fiber, microwave backhaul is less expensive and easier to deploy. However, since microwave requires license, an appropriate licensing regime is needed to make wireless backhaul spectrum available in sufficient quantities at affordable price.

**Table 4-4 Comparison of trade-offs for 4G and 5G mobile backhaul, wireless vs. fiber**

<table>
<thead>
<tr>
<th>Segment</th>
<th>Microwaves (7–40 GHz)</th>
<th>V-Band (60 GHz)</th>
<th>E-Band (70/80 GHz)</th>
<th>Fiber-optic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Future-Proof Available Bandwidth</strong></td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Deployment Cost</strong></td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Suitability for Heterogeneous Networks</strong></td>
<td>Outdoor Cell Site/Access Network</td>
<td>Outdoor Cell Site/Access Network</td>
<td>Outdoor Cell Site/Access Network</td>
<td>Outdoor Cell Site/Access Network</td>
</tr>
<tr>
<td><strong>Support for Mesh/Ring Topology</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes, where available</td>
</tr>
<tr>
<td><strong>Interference Immunity</strong></td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>Very High</td>
</tr>
<tr>
<td><strong>Range (Km)</strong></td>
<td>5~30, ++</td>
<td>1~</td>
<td>~3</td>
<td>&lt;80</td>
</tr>
</tbody>
</table>
Ministry of Information Technology and Telecommunication

<table>
<thead>
<tr>
<th>Time to Deploy</th>
<th>Weeks</th>
<th>Days</th>
<th>Days</th>
<th>Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>License Required</td>
<td>Yes</td>
<td>Light License/Unlicensed</td>
<td>Licensed/Light License</td>
<td>No</td>
</tr>
</tbody>
</table>

*Note: blue shading indicates preferred choice*

(Source: ABI Research)

**Microwave remains the dominating backhaul method in Pakistan.** According to Omdia\(^1\), fiber-to-the-cell-site (FTTS) penetration (percentage of total mobile cell sites that are fiber connected) in Pakistan is only 5%. Currently, most of the backhaul networks in Pakistan comprise of point-to-point microwave radios. There are different microwave spectrum bands that are now being used for wireless backhaul in Pakistan. They are assigned by block to operators.

**Figure 4-12 Microwave spectrum assignment in Pakistan**

![Microwave spectrum assignment in Pakistan](image)

(Source: market insight)

**The GoP is considering new pricing scheme for microwave backhaul spectrum.** Under the current arrangement, the use of microwave links for Mobile operators is covered under the ASAF. There is no separate annual fees for microwave backhaul links. PTA/FAB is considering introducing a separate AIP-based regime for microwave backhaul spectrum, which will correlate with the number of microwave links MNOs have deployed. This will inevitably increase the spectrum costs of the operators compared with the status quo. Considering that the overall annualized spectrum costs are already above 10% of revenue for some operators, an extra expense on microwave backhaul spectrum is likely to cause concerns from the industry.

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\(^1\) Omdia. Global Fiber Development Index Analysis: 2020

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The transformation of mobile bearer network with fiber is just beginning. Compared with other media, fiber has the advantages of large capacity, low latency and high reliability. Mobile infrastructure relying on fiber can be upgraded to higher-speed 5G applications at a faster pace if fiber infrastructure is in place. As the world moves to 5G, optical connectivity to cell sites will be critical to meet all the promises of all 5G applications including high availability. Currently in Pakistan, fixed operator PTCL has the most fiber resources, while other mobile operators have less fiber resources and slow growth. Comparing to other countries, the operator with the same subscriber scale has more fiber resources and higher FTTs rate.

Table 4-5 Comparison between Pakistan and Philippines in 2020

<table>
<thead>
<tr>
<th>Territory (km²)</th>
<th>Population (Mln)</th>
<th>Per capital GDP (USD)</th>
<th>Largest Operator in the country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pakistan</td>
<td>880,000</td>
<td>1200</td>
<td>PTCL</td>
</tr>
<tr>
<td>Philippines</td>
<td>300,000</td>
<td>3300</td>
<td>Airtel</td>
</tr>
</tbody>
</table>

For current mobile network, and future 5G to grow and flourish, it is expected that the number of base stations will grow significantly, about 1.7 times of current numbers. The 5G cell site density and topology are shifting dramatically in favor of all-fiber connections. The implications are that higher-bandwidth signals travel best over fiber, and 5G is going to be flooding the airwaves with these signals in just a few years. Getting the wireless signals onto fiber as soon as possible is required in order to achieve the promised 5G performance.

### Energy

Reliable energy supply has a direct bearing on reliability and availability of ICT infrastructure and digital service delivery. The primary source of energy to power base station sites is the grid. Telecom operators use grid energy whenever possible since grid energy is cheap compared to other sources, and most of the time the grid has high availability and reliability. In case there is a grid failure, telecom operators must have backup power for continuous service and usually use batteries as backup. There are different battery technologies, and the type of battery may vary depending on the capacity need, number of discharges expected and cost. The most popular battery technologies among are VRLA and Lithium, while diesel gen-sets and hydrogen fuel cells are other (and additional) backup alternatives.

A growing number of operators have taken a leading role in sustainability, using renewables to meet or exceed the decarburization goals. The many solutions to enhance network energy efficiency fall into two major groups: increasing the use of alternative energy sources to reduce dependence on the primary power grid; network load optimization to reduce the energy consumption.

To promote ICT infrastructure development, energy is a crucial issue to consider. Today,
some of the considerations include:

- Energy increase in 5G: with network densification and increased traffic demand, energy consumption may increase.
- Energy impacts operators’ network construction incentive. RAN and base stations make up 20-40% of network operation costs of many operators. Difficulty in energy supply may discourage operators from network construction.
- Climate change: considering Paris Agreement’s objective of keeping the rise of global average temperatures to well below 2 degrees Celsius above pre-industrial levels, green energy should be a key consideration in ICT infrastructure construction.
- Cost of energy sources: on the one hand, cost of carbon-based energy is volatile and affected by geopolitical events. On the other hand, cost of renewables has been declining. Cost of renewables are now cheaper than the grid in many countries.

**Pakistan faces both challenge in power supply of the network and opportunity towards greener network operation.** Currently, quality and intermittency of power supply remain a challenge in Pakistan, particularly in smaller towns and rural areas. The average load shedding hours (power outage) is 8.7 hours per day. In certain tribal areas of the country, the outages can exceed 14 hours, making the operation problematic. Maintaining uninterrupted power supply of the network is still a demanding task. Although diesel-based energy generation is a reliable mechanism to provide continuous power supply in the absence of grid power, diesel remains harmful to the environment, and a costly solution due to increasing price and volatility.

However, the availability of alternative energy like solar is sufficient in Pakistan. Pakistan enjoys long sunny daylight hours for most of the year, making it a suitable for deployment of solar energy solutions. Utilizing the extremely remote locations of hilltops, deserts and border/security areas adds to the feasibility for solar solution deployment maximizing the high solar irradiation and low cost of land. The country has a great potential to harness renewable energy to support ICT infrastructure in the rural and remote areas. The USF has already been funding such projects conducted by the operator.
4.1.1.5 Terminal

2019 witnessed a decline of 2% in worldwide smart phone shipments. The global smartphone market declined by 7% YoY, shipping 328 million units in Q1 2022 caused by the ongoing component shortages, as well as COVID resurgence at the beginning of the quarter. In contrast to the sluggish global market, smart phone shipments in Pakistan grew by 9% in 2019. However, a large gap can be observed in terms of smart phone shipments share—Pakistan is 43%, only a half of the same figure in worldwide.
Many factors may result in such a gap: the imbalance between national income and pricing, the lack of demand stimulation in rural areas etc., while among them the under-developed local manufacturing capacity is a stronger one, which leads to an import-dependent market and unaffordability incurred by high tariffs and VAT on imported mobile phones. It is therefore urgent to promote local manufacturing in support of a healthy development of smart phone market in Pakistan.

The GoP is fully aware of the importance to spur local manufacturing. Ministry of IT & Telecom presented the recommendations for Smartphone Manufacturing in Pakistan in the ECC twice in 2020 and expedited the publication of the Mobile Device Manufacturing Policy. Ministry of Industries and Production of Pakistan initiated Mobile Device Manufacturing Policy, which identifies objectives of technology acquisition and localization of mobile devices through local investment, Joint Ventures, Foreign Direct Investment etc, creation of 200,000 direct and indirect jobs, price reduction for consumers, increase in digitization through supporting 4G/5G technologies, development of efficient manufacturing ecosystem, exports of competitively manufactured handsets and achievement of security objectives.

In 2020, PTA has prepared a draft of regulations to be enforced under the first-ever Mobile Device Manufacturing Policy in the country aimed at promoting local manufacturing of smart phones. The drafts would help the government curb the smuggling of mobile phones in the country and would promote local manufacturing of devices.

Apart from the effort to build a conducive policy environment, PTA is facilitating local assembling in setting up plants for assembly of mobile handsets in Pakistan which has gained payback: local assembled handsets have been increasing at an annual pace above 100% in the years since 2016 and has reached 24.7 million, 71% of total shipments in 2021. This initiative has also created approximately 10,000 jobs in the market and

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12 As reported by **Pakistan Observer** September 14, 2021

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enabled young professionals to gain skills in this highly specialized field.

### Figure 4-14 Commercial imports & local assembled mobile devices share (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Commercial Imports</th>
<th>Local Assembly + Local Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>21.36</td>
<td>0.29</td>
</tr>
<tr>
<td>2017</td>
<td>18.11</td>
<td>0.17</td>
</tr>
<tr>
<td>2018</td>
<td>12.07</td>
<td>5.2</td>
</tr>
<tr>
<td>2019</td>
<td>16.28</td>
<td>11.74</td>
</tr>
<tr>
<td>2020</td>
<td>24.51</td>
<td>13.05</td>
</tr>
<tr>
<td>2021</td>
<td>24.66</td>
<td>10.26</td>
</tr>
<tr>
<td>2022 (Jan–Apr)</td>
<td>9.72</td>
<td>0.86</td>
</tr>
</tbody>
</table>

**Total Mobile Devices on Pakistan Network**

<table>
<thead>
<tr>
<th>Year</th>
<th>Smart Phones</th>
<th>2G</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>41.0%</td>
<td>59.0%</td>
</tr>
<tr>
<td>2019</td>
<td>44.0%</td>
<td>56.0%</td>
</tr>
<tr>
<td>2020</td>
<td>48.0%</td>
<td>52.0%</td>
</tr>
<tr>
<td>2021</td>
<td>52.0%</td>
<td>48.0%</td>
</tr>
<tr>
<td>2022 (Apr)</td>
<td>53.0%</td>
<td>47.0%</td>
</tr>
</tbody>
</table>

(Source: PTA)

### 4.1.2 Fixed Broadband

Broadband infrastructure is now a vital infrastructure, as essential as water and electricity networks. ITU's analysis of more than 200 studies on broadband impact notes that a 10% increase in broadband penetration yields an increase in GDP ranging between 0.25% and 1.5%. OECD estimates that a 10% increase in broadband penetration can raise labor productivity by 1.5%. An EIB study asserts that a doubling of broadband speeds can result in 0.3% GDP growth. Fiber optic has become a mainstream FBB technology globally, and most governments around the world have issued policies to accelerate the
construction of fiber optic network. According to the forecast of Point Topic, by the end of 2025, 59% of the global broadband users will be served by FTTx.

**Figure 4-15 Fixed broadband framework**

![Fixed broadband framework](image)

4.1.2.1 Fixed services development

FBB subscription has been growing in a stable way. FTTH proportion in Pakistan is low. While FTTH subscription has been growing faster than that of DSL since 2016, DSL still dominates the market in Pakistan at nearly 90%.

After an initial acceleration in 2017, FBB subscribers have continued to grow in a stable way. It is estimated that as of 2024, Pakistan will have 2.32 million FBB subscribers (including consumers and enterprises) with a household penetration of about 7%. DSL is the dominant FBB technology in Pakistan, accounting for nearly 90%. FTTH proportion in Pakistan is low. In 2021, China took the lead with FTTH accounting for almost 90 percent of all FBB subscriptions. The other 5 benchmark countries ranged from 10% to 75%, while Pakistan was only 0.3%.

Mobile infrastructure relying on fiber can be upgraded to higher-speed 5G applications at a faster pace if fiber infrastructure is in place. According to Omdia data, apart from the FTTH penetration, Pakistan’s FTTS penetration is also low at 0.3%, while the bestperforming Cluster 1 countries have reached more than 90%.
Figure 4-16 FBB subscriptions by technology in Pakistan, 2016-2024

(Source: PTA - Actual)

(Source: Ovum - Forecast)
Demand for greater video quality will push the need for greater speed. However, the existing bandwidth cannot meet the users’ needs of high-bandwidth and high-quality broadband services. Broadband has become an essential service for the modern home, powering everything including home entertainment, commerce, and especially in recent times, home education. Video services, in particular, have been a big driver for both the broadband service and the bandwidth that is required. According to Omdia data, globally, IPTV services accounted for 24% of all pay-TV services by the end of 2019, and 31% of homes have at least one OTT video subscription. In recent years, the OTT TV has experienced rapid development in Pakistan.
With the rapid increase in 4K TVs and other 4K-enabled devices in the home, demand for multiple high quality video streams has grown and is by far the biggest driver of data traffic. 4K TV service, even at the lowest level, requires access bandwidth of more than 12Mbps.

Table 4-6 Bandwidth, delay for 4K TV services

<table>
<thead>
<tr>
<th></th>
<th>Basic</th>
<th>Real 4K</th>
<th>Ultra-4K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>3840 x 2160</td>
<td>3840 x 2160</td>
<td>3840 x 2160</td>
</tr>
<tr>
<td>Frame rate</td>
<td>30P</td>
<td>50/60P</td>
<td>100/120P</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>20-30Mbps</td>
<td>30-50Mbps</td>
<td>50-100Mbps</td>
</tr>
<tr>
<td>Delay</td>
<td>6-11ms</td>
<td>6-11ms</td>
<td>6-11ms</td>
</tr>
</tbody>
</table>

Driven by large-bandwidth applications such as video streaming and on-line game, internet traffic has been booming. Especially during the COVID-19 pandemic, internet traffic has seen a significant upsurge and the critical role of broadband network in supporting social and economic functioning has become more prominent. Data traffic in Pakistan showed a significant growth from 2015 to 2020 and is projected to continue growing at fast pace. The low bandwidth has become a major bottleneck.
In terms of FBB speed, the vast majority of FBB subscriptions are below 10Mbps. However, the proportion of subscriptions above 10 Mbps, especially that of 10-30Mbps, keeps growing at a fast pace. According to the latest statistics in 2020, there is little FBB subscriptions with speed above 100Mbps in Pakistan, while the number is above 25% in countries such as China and Malaysia. Currently, 84% of FBB subscriptions in Pakistan have a speed below 10Mbps. However, it can be seen from the development trend that the proportion of subscriptions above 10 Mbps keeps growing.
In the past five years, new fiber-optic cable has been built in Pakistan at a pace slower than other benchmark countries. With the rapid development of the fiber-optic access technology, the construction of fiber-optic network has been accelerated globally. From 2016 to 2020, Pakistan has newly built 44,000 km of fiber-optic cable, and the total length of fiber-optic cable has exceeded 127,000 km in 2020. Currently, FTTH in Pakistan mainly covers densely populated areas such as Karachi and Lahore, etc. Its construction pace is significantly slower than other benchmark countries. For example, China has been vigorously promoting the transformation to “all fiber-optic network” since 2013. In 2019, China built 4.34 million km of new fiber-optic cable, bringing the total length to 47.5 million km. In Philippines, PLDT is still expanding its fiber infrastructure during the COVID
pandemic, with 61,000 km fiber-optic network built in the first 10 months of 2020.13

**Figure 4-24 Fiber-optic cable length and growth rate in Pakistan**

![Graph showing fiber-optic cable length and growth rate in Pakistan]

(Source: market insight)

4.1.2.2 Right of Way

FTTH, as the long-proven ICT transmission medium for high data rates, has the characteristics of large bandwidth, low delay, high reliability and long life cycle, etc., and has been valued by many countries. More than 100 countries have introduced a broadband strategy/plan, as well as industrial policies regarding the right of way (RoW), cable deployment solutions, opening of public facilities, infrastructure sharing, pre-deployment of optical fiber, etc. to accelerate the construction of optical fiber cables. A lot of good practices have emerged.

The GoP has approved a new RoW policy. In order to boost the digitization process in Pakistan, the federal government has approved the Right of Way Policy for the telecom sector in 2021. The new policy is a milestone towards creating “Digital Pakistan” and will remove massive hurdles faced by telecom firms and internet service providers in the installation and maintenance of their equipment and expansion of systems across the country. Federal Minister for IT, Syed Amin-ul-Haq said, “A one-window operation would facilitate the telecom sector regarding infrastructure development. The policy will play a pivotal role in fulfilling the vision of Digital Pakistan”. The key features of Right of Way Policy are: fee determination, dispute resolution, national security, safety and protection from health hazards, telecom as critical infrastructure, sharing of RoW, security of telecom infrastructure and common services corridor.

In order that the Pakistani telecom sector effectively benefits from the RoW Policy, the

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13 https://www.pna.gov.ph/articles/1119302

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policy needs to be further clarified to clear the implementation hurdles. Some of the aspects that can be improved are as follows:

Table 4-7 Improvements, clarity & gaps removal for the RoW Policy

<table>
<thead>
<tr>
<th>No.</th>
<th>Analysis Summary for Improvements, Clarity &amp; Gaps Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>One Window operation</strong></td>
</tr>
<tr>
<td></td>
<td>a. Online one-window operation with RoW (private + public)</td>
</tr>
<tr>
<td></td>
<td>b. Clarity of application documentation &amp; mechanism</td>
</tr>
<tr>
<td></td>
<td>c. National DB for RoW &amp; RoW sharing</td>
</tr>
<tr>
<td>2</td>
<td><strong>Fee Charges</strong></td>
</tr>
<tr>
<td></td>
<td>a. Standard RoW tenure for single application should be specified</td>
</tr>
<tr>
<td></td>
<td>b. Upper cap to be set w.r.t. Scope of Work (SoW) models</td>
</tr>
<tr>
<td>3</td>
<td><strong>Dispute Resolution</strong></td>
</tr>
<tr>
<td></td>
<td>a. Clear Escalation plan to be shared for dispute &amp; complain from district level to cabinet secretary</td>
</tr>
<tr>
<td></td>
<td>b. Online system should be part One Window</td>
</tr>
<tr>
<td>4</td>
<td><strong>Relocation, Removal or Alteration of ROW</strong></td>
</tr>
<tr>
<td></td>
<td>a. Should be processed through one window for update and change</td>
</tr>
<tr>
<td>5</td>
<td><strong>Sharing of RoW</strong></td>
</tr>
<tr>
<td></td>
<td>a. Max. fee of 50% of NOC for sharing fee should be limited for 2 applicants</td>
</tr>
<tr>
<td></td>
<td>b. One window support for RoW sharing with payment data</td>
</tr>
<tr>
<td>6</td>
<td><strong>Establishment of Common service Corridors</strong></td>
</tr>
<tr>
<td></td>
<td>a. Deployment standards &amp; SOPs for low cost, easy &amp; safe deployments to be specified</td>
</tr>
<tr>
<td></td>
<td>b. Charging mechanism needs to be designed for public sector as per deployment scenario</td>
</tr>
<tr>
<td>7</td>
<td><strong>Miscellaneous - Charges &amp; structural readiness by DISCOs &amp; Development Public Authorities</strong></td>
</tr>
<tr>
<td></td>
<td>a. WAPDA notification 1507-34 GMCSrrariff-62/voc-lV validity on ex-WAPDA DISCOs should be reviewed &amp; provided as annexure to policy</td>
</tr>
<tr>
<td></td>
<td>b. Non-BTS site charges should also be capped similar to BTS site</td>
</tr>
</tbody>
</table>
Turkey: RoW process for co-deployment of telecom and highway infrastructures

- In Turkey, the Regulation on the Transition of all kinds of Cables and Similar Material Used in the Fixed and Mobile Communication Infrastructure or the Networks provides the policy framework for RoW. Take the co-deployment of telecom and highway infrastructures as an example, the RoW process clearly stipulates the responsible departments for RoW processing, the timescale, and RoW pricing.

1. Clearly-defined processes, including the portal and timescale of approval
   - Applications made to the Ministry of Transport and Infrastructure shall be assessed within 30 days.
   - Operators are directed to right of way providers.
   - Right of way providers has to assess the right of way request within 60 days.
   - Agreement on crossing right: Within the scope of the Regulation, the operator and the crossing right provider may freely negotiate the right of passage.
   - Crossing right submission on highways, if possible, is subject to a mutually signed protocol at present.

2. Definite charges
   - The operator has to pay utilization permit fee to General Directorate of Highways described by the regulation.
   - Price = K*Current value*Area.
     K=Type of organization: Public (0.5), State economic enterprise (0.5), Private (1)
     Area (m²)

3. Utilization and protection standards
   - For the request of right of ways on highways network General Directorate of Highways takes into consideration of highway conditions such as traffic safety and road works before providing crossing right for the operator.

India: RoW rules to promote deployment of fiber and tower

- In India, the RoW rules are considered as a key enabler for expediting the deployment of underground (optical fiber) and over ground (mobile towers) infrastructure. The rules aim to rationalize administrative expenses across the country to a maximum of Rs 1000 per km for fiber, and a maximum of Rs 10 000 per application for overhead towers.
- The rules mandate development of an electronic application process within one year of the roll-out of ROW rules, single clearance window for application, designation of nodal officers for appropriate authorities, and fast-tracking decision on RoW permits to within 60 days after application are expected to facilitate a transparent, economical, and rapid rollout of fiber backhaul in the country.

For setting up tower
- Firms should give details of land required with necessary approvals from central government

Granting permit
- Authorities can't take more than 60 days from date of application to grant permit

Administrative expenses
- Rs 10000 per application for tower companies
- Rs 1000 per kilometer for companies laying fiber

For removing/altering tower or underground fiber
- Companies can submit plan within 30 days
- Minimum 90 days will be granted

To resolve disputes
- Central government to designate officers with jurisdiction within 60 days
4.1.2.3 Cable deployment solutions
In terms of FBB construction model, direct burial is still the main way. However, the cost of time and money of directly buried cable is much higher than that of the aerial cable. In order to realize the rapid rollout of broadband in Pakistan, it is suggested that aerial cable be widely adopted in FBB construction. Besides, since aerial cable face more challenges in security than buried cables, relevant laws and regulations should be established to protect aerial cables.

Comparison between aerial and buried cable deployment solutions in Country X

- In Country X, by adopting the aerial cable solution, Operator A realized fast deployment, with 400,000 lines deployed in 15 months. By contrast, it took Operator B 80 months to deploy 350,000 lines with the digging solution.

Operator A from Region A:
- “Aerial cable + micro channel” to realize fast deployment with cost controlled
  - Deploy OSP through “aerial cable + micro channel” to improve speed and reduce cost;
  - Aerial ADSS fiber cables were deployed on power holes with space between 20-40m;
  - Micro channels were 8-10cm wide and 30cm deep with duct buried inside;
  - Deployment speed of micro channels:
    - 500m/day (machine), 150m/day (manual);
  - Team consisted of: 8 labors + 1 supervisor;
  - The deployment of 400,000 lines HP took 15 months.

Operator B from Region B:
- Traditional deployment through digging with high cost and great difficulty
  - Deploy OSP through “dig and backfill”, and pipe jacking on road bridge;
  - Excavation required 40cm wide and 100cm deep all the way along road;
  - Deployment speed of excavation: 300m/day (machine), 100m/day (manual);
  - Team consisted of: 8 labors + 1 supervisor;
  - The deployment of 350,000 lines HP took 80 months.

4.1.2.4 Infrastructure sharing
FBB construction requires huge investment, which discourages large-scale construction. A power network can provide a more universal network or be better suited to FTTH rollout in certain locations based on space availability and infrastructure robustness. This could be attractive to incumbent telcos that want to provide a more universal service. For alternative telcos, deploying FTTH based on power networks may provide access to better products and more attractive pricing. It can also stimulate competition in a way that benefits policy makers.

Currently, there is not a successful case or business model for inter-sectoral infrastructure sharing in the deployment for fiber-optic cable in Pakistan. As a result, each telco builds its own network and bears all the costs of getting approvals and construction, thus lowering the efficiency and increasing the costs of fiber-optic cable construction. High costs and complex approval procedures have affected telcos’ will to roll out fiber-optic cable, and therefore hinder the FBB development in Pakistan in the long run.

The GoP is seeking to promote infrastructure sharing. As per Telecom Policy 2015, PTA is to develop the necessary regulatory instrument to encourage, facilitate and
standardize infrastructure sharing in consultation with MoIT and stakeholders. To this effect, infrastructure sharing guidelines are being developed by PTA based on the principles of neutrality, non-discrimination and equal access. The guidelines will provide a mechanism for licensees and other stakeholders to share their telecom and other infrastructure facilities that would include space, electrical power, air conditioning, security, cable ducts, space on antenna and towers, etc. In October 2020, PTA opened a public consultation on the “Telecom infrastructure sharing guidelines”.

European Commission (EC) targets for gigabit connection speeds plus consumer demand for fast connections are spurring an interest in widespread FTTH rollout. But, the high costs of FTTH means that savings must be made to ensure scheme viability. An electric power infrastructure allows FTTH to be deployed more cost effectively than a new build, with overhead poles better for rollout than underground ducts, particularly in rural and suburban areas. The EC’s Cost Reduction Directive encourages different infrastructure providers to share their infrastructure. However, to enter the FTTH market, power companies must be sure they won’t compromise the availability of power services or safety.

Four possible business models can facilitate FTTH deployment by a power company on its own or in partnership with one or more telcos.

![Diagram of four possible business models for FTTH deployment by a power company.](image-url)
4.1.2.5 Fiber pre-deployment

There are at least 20 countries who already issued a guideline for the Fiber pre-deployment in new buildings, such as China, Singapore, South Korea, Switzerland, UAE, etc. And a recent case is from UK, who released a guideline for a gigabit ready new development buildings. From these cases, we can see there are lots of benefits:

- Total cost of Fiber deployment is minimized. Developers can share the construction teams;
- Rollout time is saved significantly, because permission is not mandatory when the homes are not handed over to users;
- Users will enjoy the less lead time for a service provisioning, because Fiber is already there in their home; And it is easier for users to choose service provides, by which the market competition is encouraged;
- Economic benefits will also be significant, because operators spend less time for Fiber rollout and service commissioning, and possibly, a higher take up rate as well.

Currently, there is not a guideline for the fiber pre-deployment in new buildings in Pakistan, while many countries who already issued a guideline for the Fiber pre-deployment in new buildings, such as China, Singapore, France, etc.
Saudi Arabia: Rules for ICT infrastructure provision and deployment in new developments

Communications and Information Technology Commission (CITC) of Saudi Arabia released the *Rules for ICT Infrastructure Provision and Deployment in New Developments* to regulate the provision and deployment of ICT network infrastructure in New Developments. The purpose of the *Rules* is to make high-speed ready infrastructure for broadband services, prevent from multiple digging and reduce the cost of ICT infrastructure rollout. Fiber pre-deployment in Saudi Arabia has the following features:

**Strong government leadership:** CITC governs the rights and obligations of property developers and facility-based service providers for the provision and construction of Outside Plant and In-building Physical Infrastructure (IPI) in New Developments.

**Wide scope of implementation:** New Developments include the real estates to be developed by land and building developers, including land planning and preparation, and building construction for residential, commercial, industrial, governmental or any other purpose, and vary greatly in their size and character. They may include any of the followings:
- Preparation and completely new constructions (Greenfield).
- Major renovations of existing buildings (Brownfield).
- Construction in existing developed areas.

**Practical technical standards:** CITC has also issued many practical standards such as the *Technical Standards for In-building Physical Infrastructure (IPI) for Multi Dwelling Units*. Those standards are enabling all building developers and licensed facilities-based service providers to design and deploy telecommunications network infrastructure in new public and private buildings. Though the definition of “high-speed ready” is minimum speed of 100Mbps, Fiber Optic Cable (FOC) shall preferably be used for internal cabling. There are some highlights as below:
- Each Unit shall have at least 4 connections to the Building Distribution Frame (BDF). For business customers a higher number of connections may be designed if demand is expected. BDF means a distribution element between the Outside Plant and the In-building Physical Infrastructure.
- Each residential room (except the wet rooms such as: bathrooms and laundry rooms) or office room shall be equipped with at least one Network Termination (NT). An electrical power source shall be available nearby an Optical NT.
- In-building Physical Infrastructure shall have capacity to provide at least four fiber connections per Unit from the Access Point to the Telecommunications room. From the Telecommunications Room there are at least four connections (fibers, coaxial, or twisted pair Ethernet) to the Unit Distributor (UD). From UD there is one connection to each NT.

China: National Mandatory Standards for FTTH in Residential Buildings

In 2013, China has issued the "<Code for design of communication engineering for fiber to the home in residential districts and residential buildings>" and "<Code for construction and acceptance of fiber to the home in residential districts and residential buildings>", which requires that since April 1st, 2013, the communication facilities of new residential buildings, in urban areas at and above the county level, should adopt FTTH mode.

The two national standards have set out the FTTH design and construction specifications in new residential buildings. The residential developers must simultaneously construct communications facilities, such as pipeline, in-building optical fiber, equipment room, within residential areas and open to operators in an equal manner. Since then, the local housing and urban-rural authority and communication authority have organized inspections on the FTTH construction to ensure the implementation of the standards.
4.1.2.6 IPv6 Development

IPv6 is the only way to sustainable Internet, not only because of its vast address space, but also the extensibility and security features. Developed countries, such as the USA, France, Japan, Germany, etc., as well as emerging countries like China, India, etc., all released industry policies to accelerate the deployment of IPv6.

The migration to IPv6 could bring benefits from different aspects:

- **Massive connectivity**: the shortage of IPv4 addresses raises lots of problems when the number of users grows. The operators could only buy addresses from the grey market or use shared IPv4 addresses. The first option becomes significantly more expensive as the price of each IPv4 address is doubled in 2021 and is now above $50. The second option adds complexities to the network and brings legal issues because it is hard to trace the source.

- **Higher Performance**: IPv6 could bring more efficient and higher performance packet processing, simplified network structure and more robust quality of service.

- **Improved Security**: by eliminating technologies like NAT, it is easier to provide native IPSec support. The simplification of network will also reduce attack vectors to the network.

- **Wider Application Support**: by providing end-to-end connectivity, IPv6 can enable new services like smart homes, IoT, etc.

By April 2022, the IPv6 adoption rate in Pakistan is 4.67% (according to Google IPv6 statistics), which is still far away from the world average (around 40%) and the leading countries like India (64.1%) and the USA (45.67%). A national-level IPv6 strategy is needed to guarantee the sustainable development of the Internet.
## IPv6 Development Industry Policies

### USA: Federal government set roadmap to migrate to IPv6-only

For more than 15 years, the US federal government has been aiming to transition agencies from the older generation of IPv4 onto IPv6. In November 2020, the Office of Management and Budget (OMB) memorandum, M-21-07, "Completing the Transition to Internet Protocol Version 6 (IPv6)" was released. This policy is to ensure and enforce the implementation of the Federal Energy Regulatory Commission (FERC) processes in place to assist with the Federal government’s strategic commitment to the transition to IPv6 and keep pace with industry trends. The following milestones were set for operating in IPv6-only environments:

- At least 20% of IP-enabled assets on Federal networks by the end of FY 2023;
- At least 50% of IP-enabled assets on Federal networks by the end of FY 2024; and
- At least 80% of IP-enabled assets on Federal networks by the end of FY 2025.

### China: Set up the National IPv6 Promotion and Deployment Commission to release policies, and formulate a development strategy

In July 2021, the Chinese government issued the "Special Action Plan of IPv6 Traffic Promotion (2021-2023)". The goals are, by the year 2023:

- IPv6 Traffic ratio in mobile networks is over 50%, the traffic volume of wireline networks is more than 3 times compared to Dec. 2020.
- IPv6 concentration in TOP 100 commercial websites is over 70%
- The ratio of Fixed terminal which obtains IPv6 address is over 80%.

### Vietnam: National Digital Transformation Program to 2025, with a vision to 2030

Approved by the Prime Minister in June 2020, identified digital infrastructure development as an important task which would lay the foundation for national digital transformation. Vietnam has already significant achievement in IPv6 deployment:

- IPv6 services in 11 million FTTH subscribers
- More than 40 million IPv6 mobile subscribers
- 17,790 ".vn" websites IPv6 ready
- 100% major ISPs ready to provide IPv6 services.

**IPv6 for Gov Program in 2021-2025**

- Phase 1 (2021-2022): 50% of Ministries, branches, provinces/cities issue and deploy IPv6, have IPv6 enabled portals and public service portals of government agencies.
- Phase 2 (2022-2025): 100% of Ministries, branches, provinces/cities issue and deploy IPv6, have IPv6 enabled portals and public service portals of government agencies.
4.1.3 Challenges Faced by Telecom Sector of Pakistan

Telecom industry is key for digitalization in Pakistan. Due to recent economic and monetary changes Telecom industry is facing major challenges for its sustainability. Some of the challenges mentioned below require deliberations among multiple industry stakeholders. Resolution of these challenges will facilitate telecom sector growth in Pakistan.

4.1.3.1 Revision of tenor and fix exchange rate of license payments

Challenges to Overcome:

a) Staggering of License Installments over 10 annual installments rather than 5 without interest
b) Exchange rate has a lot of fluctuation and a PKR value needs to be set

Justification:

a) License cost is the biggest cost for CMO’s spreading it over 10 years instead of 5 will provide significant fiscal space to the operators. Further investments into networks will become possible. Successful precedent exists in Pakistan where moratorium of 5 years on payments and staggering of remaining over 10 remaining years was provided by ECC in 2005
b) Interest rate and FX rate to be fixed at the date of license agreement to mitigate against currency risk and remove uncertainty from future business plans

Impact if Challenges are addressed:

- Improve cashflow for the CMOs. No loss to the GoP only the tenor will be extended. Provide predictability to the CMOs

4.1.3.2 Low ARPU Impacting Commercial Viability

Challenges to Overcome:

a) Inflation just like other sectors has impacted telecom sector adversely. Allowance of Inflationary adjustment on Mobile Recharge by CMOs, Consultation needs to be initiated by regulator for inflationary adjustment
b) Baseline prices need to be adjusted for data to match the price of production

Justification:

a) Telecom Sector is badly hit by the currency devaluation, interest rates hike, inflation and CAPEX/OPEX increase
b) Allow the sector to apply deduction of inflation charge on Mobile recharge and bills to mitigate fluid inflationary situation
c) Price floors and ceilings should be provided within legal provisions
Impact if Challenges are addressed:
- Improve the revenue for the industry which will help the industry grow and create indirect benefits for GoP

4.1.3.3 Reduction in Telecom Taxation

Challenges to Overcome:
- Telecom sector in Pakistan is one of the highly taxed sectors. WHT currently increased to 15% which was planned to be 8% as provided in the Finance Bill 2021
- Regulatory Duty is 20% on optical fiber cable

Justification:
- WHT is paid even by those who cannot get it adjusted. Increase in taxes inversely impacts the digitalization and network growth
- Fiberization of towers in Pakistan is ~ 10%, too low as compared to other countries in the region

Impact if Challenges are addressed:
- Improve the revenue for the industry which will help the industry grow and create indirect benefits for GoP. Fiberization will improve Fiber to the site ratio and help in expansion and evolution of existing networks

4.1.3.4 Industry Benefits for Telecom Sector

Challenges to Overcome:
- Telecom sector has already been declared an “Industry” in Finance Bill 2021. Still the industry has to purchase electricity at a higher commercial rate and no other distinct benefits are provide to Telecom Industry which is backbone of digitalization in Pakistan

Justification:
- Both fixed line operators and CMO’s are being charged as per commercial power tariff and no compensation is provided which generates high OPEX for operators
- National Electric Power Regulatory Authority (NEPRA) needs to work with operators to approve special tariff for telecom industry

Impact if Challenges are addressed:
- Reduction in OPEX for operators will help improve business environment for CMO’s and fixed line operators
4.1.3.5 Telecom Sector Equipment Import Challenges

Challenges to Overcome:
   a) SBP requires prior approval before opening LCs to Import Telecom Equipment and 100% Upfront Payment is required for these LCs

Justification:
   a) Telecom service is not a luxury; it is required even during war times. Telecom equipment is not manufactured locally and it is critical for provisioning of essential voice and broadband services in Pakistan
   b) All network development and maintenance work is impacted with this prior approval of LCs
   c) Ban on import of essential telecom equipment, not otherwise locally available, is impacting CMO’s network expansion and O&M activities

Impact if Challenges are addressed:
   • Revision on these should be taken immediately for the survival of telecom industry

4.1.3.6 Reinstatement of inter-bank fund transfer (IBTF) fees to support viable DFS business. Relevant Ministry / Regulator SBP.

Challenges to Overcome:
   a) IBTF Fees were suspended by SBP during the Covid Pandemic to encourage digital transactions.
   b) Although free transfers were useful to scale up adoption but ultimately result in unviability of the transaction product.
   c) As Covid situation has eased some level of fee is necessary for service viability.

Justification:
   a) The IBTF fees need to be reinstated appropriately by SBP to sustain fintech and Digital Financial Services industry.

Impact if Challenges are addressed:
   • Positive impact of PKR 15-20 Billion on Telecom Fintech players.
   • No loss to Government of Pakistan.

4.1.4 Data Center

Globally, the data center is toward large-scale and intensified development. The number of data centers has been declining since 2017, while that of super large data centers began to grow. According to Synergy Research Group, the world had about 728 hyper scale data centers in 2021 and the number is expected to increase to 1,200 by end of 2026. The power of single rack has increased rapidly, and the number of racks has
increased slightly. According to Gartner, the number of racks deployed globally in data center in 2019 was about 4.9 million, and grew to an excess of 5.01 million by 2022.

**Figure 4-25 Number of hyperscale data centers and racks worldwide 2015-2020**

(Source: Synergy, Statista, Gartner)

*European Data Strategy* reported that **the way we store and process data will change significantly in the next five years.** Currently, 80% of the data processing and analysis takes place in data centers and centralized computing facilities, and only 20% in intelligent connected devices and edge computing networks. But by 2025, the proportion is likely to reverse. Computing will be transferred to devices, edge computing will enter the stage of large-scale deployment, steady progressing to the integration of Cloud and Edge.

From 2010 to 2020, the data center industry in Pakistan experienced a spectacular decade. Data center has evolved from ICT equipment rooms to cloud data center. Rapid development of new technologies such as AI, cloud computing, big data, and 5G will bring a new golden era and market demand for data centers will increase dramatically. At the same time, data centers are facing several challenges.

**Figure 4-26 Pakistan data center industry challenges**

**Lower power density.** Currently, the average power capacity in a data center of Pakistan market is 4kW/rack, but the CPU and server capacity keep continuously increasing with the evolving of IT computing capacity. As the demand for AI applications increases, the
importance of AI computing power further rises. To balance efficiency and costs, data centers will develop with row based precision cooling system to support the high density trends. It is anticipated that power density of 15 to 20 kW/rack will predominant data centers by 2025.

**Lower efficiency.** Currently, lots of datacenter in Pakistan market take the traditional architecture to build a datacenter, tower UPS, non-containment and comfortable cooling system will bring low efficiency, so Energy saving and operating expense (OPEX) reduction are big challenges. Adopt the higher efficiency (up to 97%) modular ups and cold/hot aisle containment to reducing the power usage effectiveness (PUE) of data centers and building green data centers are inevitable.

**Modularization and scalable architecture.** More data centers will be constructed in full modular mode to address the problems of slow construction and high initial investment costs. Modular design will evolve from component modularization to architecture modularization and equipment room modularization, finally achieving full modularization of data center. The full modular design will enable fast deployment, flexible capacity expansion, simple O&M, and high energy efficiency. The typical TTM of a data center is 9 to 12 months, which is expected to be shortened to less than 6 months in the future by Modular pre-fabricated architecture.

Currently, mainstream data centers all adopt a modular architecture. Modular data centers have been rapidly applied in many sectors such as the Internet, telecommunications, finance, and government.

**Full digitalization and AI-enablement.** Data center facilities will inevitably evolve towards digital and intelligent. With the continuous improvement of IoT and AI technologies, data centers will gradually evolve from single-domain digitalization in terms of O&M, energy saving, and operation to full-lifecycle digitalization and automatic driving in terms of planning, construction, O&M, and optimization. AI will be widely applied.

**Simplified power supply architecture. Lithium battery replace lead-acid battery.** The power supply and distribution system of a traditional data center is complex and fragmented, occupies a large footprint, and is difficult to locate faults. A simplified power supply architecture will reduce power conversion times, shorten the power supply distance and footprint, and improve the space utilization rate and system energy efficiency. Compared with lead-acid batteries, lithium batteries have advantages in terms of footprint and service life. As the cost of lithium batteries decreases, lithium batteries will be widely used in data centers in the future.

4.1.4 IoT

4.1.4.1 IoT deployment

Globally, the number of deployed/launched networks has continued to grow. As of 2020, GSA has identified 128 operators in 62 countries that have deployed/launched at least one
of the NB-IoT or LTE-M technologies\textsuperscript{14}. **Pakistan has started to deploy its NB-IoT in recent years.** Telenor has launched its first NB-IoT site in November 2019. Zong 4G has completed successful trial of NB-IoT network in 2020. NB-IoT will pave the way for Pakistan’s digital ecosystem development by increasing performance and efficiency in the industrial and civil infrastructures. With its ability to support massive machine-type communication (mMTC) and enable high-penetration, low-power, low-cost and low-data-rate communication, NB-IoT is set to be a game changer for the local industries.

**Figure 4-27 Map of countries with deployed/launched NB-IoT and LTE-M networks**

![Map of countries with deployed/launched NB-IoT and LTE-M networks](source: GSA)

**There is still a big room for Pakistan to increase its IoT connections.** According to GSMA data, Pakistan has 1.05 million licensed cellular IoT connections by 2020. The percentage of IoT connections in total cellular connections is small, at 0.6%. In Turkey, the number is 8.6%, and in China, 49%.

\textsuperscript{14} GSA. NB-IoT & LTE-M: Global Ecosystem and Market Status December 2020
The GoP is enhancing its policy support for IoT development. PTA/FAB has assigned 920 MHz to 925 MHz band to IoT. Besides, PTA is all set to create a regulatory framework for IoT to address the relevant regulatory requirements such as licensing, numbering and addressing, spectrum management, network standards, data protection, privacy and security, etc.

4.1.4.2 IoT application
GSMA forecast that in 2025 IoT connections will total at 24 billion. Consumer IoT, smart buildings, and smart utilities rank the top 3 in terms of IoT connections. Consumer IoT, including smart vehicles, wearables, consumer electronics, and smart home, accounts for 57% of all IoT connections in 2020. Industrial IoT will take over consumer IoT and account for over 54% of all IoT connections in 2025.
Currently, IoT is applied in Pakistan to a very limited scope both in consumer IoT and industrial IoT. Ignite – Pakistan’s national technology fund supported by the MoIT&T-funded some IoT based projects which aim to solve some of the country’s needs in industries such as IT, Energy, and Healthcare, which offers a glimpse of IoT application in Pakistan.

(Source: GSMA)
This whitepaper analyzes Pakistan’s potential of IoT application in each subcategory of IoT scenarios, taking into consideration the following factors: 1) Benefits/impact on promoting the sectoral development; 2) Existing status of IoT application in the subcategory; 3) Feasibility. Subcategories with two or more factors rated as “high” are considered to have the potential of scale application in Pakistan in the near future.

Table 4-8 Potential of IoT application in Pakistan, by scenarios

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory</th>
<th>Impact</th>
<th>Current status</th>
<th>Feasibility</th>
<th>Potential</th>
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<tbody>
<tr>
<td>Consumer IoT</td>
<td>Consumer electronics</td>
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<td>Smart home</td>
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<td>Wearables</td>
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<td>Smart vehicles</td>
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<td>Smart city</td>
<td>Public transport</td>
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<td>Surveillance</td>
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<td>Electric vehicle charging</td>
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<td>Street lighting</td>
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<td>Parking</td>
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<td>Waste management</td>
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<td>Smart health</td>
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<td>Remote monitoring of medical devices</td>
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<td>Emergency vehicle infrastructure</td>
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<td>Fleet management</td>
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<td>Construction</td>
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Note: H=high, M=medium, L=low
4.1.5 IT Exports

GoP attaches special attention on knowledge economy as outlined in Pakistan's vision 2025. By transforming itself to digital economy, GoP plans to best utilize its youth bulge to overcome its economic recession. To align with Pakistan's vision 2025, MoITT has adopted a multipronged strategy, and IT/ITes Development and Export is one of its 8 key pillars of this strategy.
According to the SBP data, IT exports for the period July-May FY2022 have surged to US $2.381 billion at a growth rate of 25.45 percent in comparison to US $1.9 billion in the same period last year. These include telecommunication, computer and information services. Compared to the rest of the Services Sector, Pakistan’s IT Industry is the largest net services exporter with exports to 169 countries (see Figure 4-33).

(Source: State Bank of Pakistan)
4.2 Public Sectors

The central and provincial governments in Pakistan has initiated many projects to provide digital services in various public and private sectors.

4.2.1 Digital government

In 2018, MoIT&T launched Digital Pakistan Policy, outlining digital transformation initiatives including the objective to boost digital government.

4.2.1.1 Digital government services

Digital governance is the application of ICTs for delivering government services, exchange of information, communication transactions, integration of various stand-alone systems and services between government-to-citizen (G2C), government-to-business (G2B), and government-to-government (G2G).

Globally, Governments have continued to increase the provision of digital government services in both 2C and 2B sectors. According to the UN survey, more than 84% of
countries now offer at least one online transactional service, and the global average is 14. The most commonly offered services include registering a new business, applying for a business license, applying for a birth certificate, and paying for public utilities.

**Smart Dubai Initiative**

- Dubai has launched Smart Dubai Initiative since 2014, which is transforming city-wide experiences to inspire new realities, with an aim of achieving a happier life for all. The Initiative consists of a portfolio of digital government services covering 2B and 2C sectors enabled by cutting-edge technologies and a holistic and mature ecosystem.

**Smart governance & planning**
- Transformation in both 2C and 2B sectors

**ECOSYSTEM**

**START-UP SUPPORT**
- GLOBAL BLOCKCHAIN CHALLENGE:
  - 200+ application received
  - Finalist teams from 17 cities
  - $45,000 awarded in phases

**SMART DUBAI ACCELERATOR:**
- 100+ applications received
- $5 million setup investment from 6 strategic partners

**DUBAI FUTURE ACCELERATORS:**
- 120+ start-ups participated
- 94 MoUs signed
- 4 cohorts completed

**INTERNATIONAL PARTICIPATIONS & GLOBAL BODIES BENEFITS**
- Reinforce Smart Dubai's position as a thought leader
- Standardization - ITU SG30
- Knowledge creation - ITU FG DPM & U4SGC
Bring citizens into the center of services will change the entire service delivery concept from that of traditional service delivery. With more and more services and departments incorporated in digital government platforms, Governments are under pressure to re-engineer the process for establishing a single point of access to complete services of different departments and at different levels. Business process re-engineering is the core of improving the work efficiency. Only on the basis of business integration and data sharing can business process re-engineering be realized, and therefore the re-engineering is a long-term process. This will not only achieve cost savings and efficiency gains, but provide citizens and businesses with better access to digital government services.

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**Turkey: high level of online services provision**

- Turkey established a Digital Transformation Office under the Presidency in 2018 to coordinate the digital transformation of public institutions. The office puts together 100-day action plans which aim to transpose all G2C, G2G, G2B e-Services to the e-Government portal.
- Turkey was ranked as very high in terms of government online service provision level by the UN in its E-Government Survey, 2020. Through its e-Government portal, businesses can access to 7 groups of G2B services which includes 21 kinds of services and involves 15 different responsible departments.

### Digital Government Services for Businesses

<table>
<thead>
<tr>
<th>Running a business</th>
<th>Product requirements</th>
<th>Selling in the EU</th>
<th>Finance and funding</th>
<th>Dealing with customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Intellectual property&lt;br&gt; - Turkish Patent Institute&lt;br&gt; - Start-ups Developing a business&lt;br&gt; - Registration of a new company&lt;br&gt; - Owner/Partner/Authorised&lt;br&gt; - commercial Business or Companies&lt;br&gt; - Commercial Business and Company&lt;br&gt; - Interrogation&lt;br&gt; - Foreign trade permissions and notifications</td>
<td>• CE marking, Standards in Europe&lt;br&gt; - Product certification&lt;br&gt; - Energy labels, Eco-design requirements, EU Ecotable&lt;br&gt; - Environment-related permits</td>
<td>• Public contracts&lt;br&gt; - Public procurement/procurement&lt;br&gt; - Competition between business&lt;br&gt; - Protection of the competition</td>
<td>• Accounting&lt;br&gt; - Submission of data to statistical offices</td>
<td>• Consumer contracts and guarantees&lt;br&gt; - Consumer protection&lt;br&gt; - Solving disputes with customers&lt;br&gt; - Complaints gateway&lt;br&gt; • Data protection&lt;br&gt; - Personal Data Protection</td>
</tr>
<tr>
<td><strong>Taxation</strong></td>
<td><strong>Human Resources</strong></td>
<td><strong>Central Government</strong></td>
<td><strong>The Police Department</strong></td>
<td><strong>National Council on Occupational Safety and Health</strong></td>
</tr>
<tr>
<td>• Excise duties, VAT &amp; Business Tax&lt;br&gt; - VAT: declaration, notification&lt;br&gt; - Electronic Payments&lt;br&gt; - Corporate tax: declaration, notification&lt;br&gt; - Customs declarations (e-Customs)&lt;br&gt; - Internet Tax Office Application</td>
<td>• Employment contracts&lt;br&gt; - Social contributions for employees&lt;br&gt; - Working hours, holiday and leave&lt;br&gt; - Social security and health&lt;br&gt; - National Council on Occupational Safety and Health Web Portal</td>
<td>• Turkish Patent Institute&lt;br&gt; • Ministry of Trade&lt;br&gt; • Revenue Administration&lt;br&gt; • Ministry of Customs and Trade&lt;br&gt; • Turkish Standardization Institute</td>
<td>• Public Procurement Authority&lt;br&gt; • Competition Authority&lt;br&gt; • Social Insurance Institution&lt;br&gt; • Ministry of Family, Labour and Social Services Security</td>
<td>• Ministry of Environment and Urbanization&lt;br&gt; • Turkish Statistical Institute&lt;br&gt; • The Data Protection Authority</td>
</tr>
</tbody>
</table>
4.2.1.2 Towards data-centric digital government

With the emerging trends in government data and the mounting risks and challenges, a paradigm shift is occurring that compels Governments to leverage data governance frameworks and data-centric digital government strategies to generate public value in innovative ways. According to 2020 UN E-Government Survey, the number of countries that have set up open government data (OGD) portals has increased markedly rising from 46 in 2014 (24%) to 153 in 2020 (80%).

With the growing technological capacities to process ever-larger and more complex data sets that can provide policymakers with better insight and foresight and make e-services more efficient, accountable and inclusive, the potential and opportunities surrounding data abound, especially in the context of delivering on complex sustainable development targets. Shifting from “gut instinct” to data-centric policymaking is now a viable alternative and is rapidly moving towards becoming a strategic imperative.

The 2030 Agenda for Sustainable Development recognizes the value of data, acknowledging that data is key to effective decision-making and that quality, accessible, timely and reliable disaggregated data is needed to facilitate the measurement of progress towards sustainable development and to ensure that no one is left behind. Data governance also directly contributes to the implementation of SDG16 “promote peaceful and inclusive societies for sustainable development, provide access to justice for all and
build effective, accountable and inclusive institutions at all levels’.

For many countries, the collection and use of timely, high-quality data remain a challenge. Lack of cohesion in the way data are shared and managed represents another concern. Siloed planning and decision-making result in fragmentation and duplication of efforts, preventing governments from realizing the full benefits of data. Governments have approached interoperability of data systems in various ways. Some have enforced specific technical requirements and standards, some have adopted policies and laws on interoperability, and others have taken concrete steps to implement relevant institutional reforms or formalize new arrangements. The UN\(^{15}\) summarizes some common approaches to publishing, sharing, linking and exchanging data across government agencies (both horizontally and vertically) and strengthening the interoperability of government data systems.

\(^{15}\) UN E-Government Survey 2020
## Figure 4-35 Different approaches to sharing, linking and exchanging data and strengthening interoperability

<table>
<thead>
<tr>
<th>Approaches</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Open government data</strong></td>
<td>Publishing open government data that are accessible internally within the Government and externally to the general public.</td>
<td>Since 2014, the UN E-government Survey has documented development trends relating to open government data (OGD). The number of countries with OGD portals jumped from 46 in 2014 (24%) to 153 in 2020 (80%). Among the Member States surveyed, 59% have an OGD policy, 62% have metadata or a data dictionary, 57% accept public requests for new data sets, 52% offer guidance on using OGD, and 49% engage in promotional efforts (such as data hackathons).</td>
</tr>
<tr>
<td><strong>Linked data</strong></td>
<td>Linked data is a technical standard for structuring complex information and relating and linking independent sets of data from different sources; used for launching linked open government data portals to connect isolated data repositories (data silos).</td>
<td>The Administrative Data Research Network in the UK has created a number of “safe havens” where administrative data can be anonymized and linked, with strict controls over who has access to the data and for how long.</td>
</tr>
<tr>
<td><strong>Data sharing</strong></td>
<td>Sharing government data in accordance with guidelines, policies or other instruments that govern data formats and dictate data management, retention, security and privacy rules.</td>
<td>Ireland passed the Data Sharing and Governance Act 2019. The Act paves the way for more efficient and cost effective service delivery by public bodies by providing a clear legal basis for the sharing of personal data in certain circumstances.</td>
</tr>
<tr>
<td><strong>Interoperability</strong></td>
<td>Enabling systems and devices to exchange machine-readable data from multiple sources in a standardized and contextualized way and to interpret shared data. Standards are essential for data interoperability, as they allow different system components to be integrated seamlessly without any loss of meaning or integrity.</td>
<td>Argentina has an interoperability framework; Mexico, Uruguay, Brazil, Peru, and Argentina have interoperability acts/decrees; the National Digital Interoperability Regulation in Portugal covers the adoption of open standards in State computer systems; and the three-part Philippine eGovernment Interoperability Framework (PeGIF) addresses the technical aspects and standards of interoperability, information interoperability, and exchange and business process interoperability.</td>
</tr>
<tr>
<td>Data exchange</td>
<td>Often a combination of two or more of the elements listed above; platforms that provide two-way data exchange through application programming interfaces (APIs), data exchange portals or centralized data services.</td>
<td></td>
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<tr>
<td>---------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
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</tbody>
</table>

The data exchange platform in **Estonia** (X-Road) is administrated centrally to interconnect government information systems and databases and allow government authorities and citizens to securely send and receive information over the Internet within the limits of their authority. In **the US**, the National Information Exchange Model has been used for integrated applications such as the Disaster Assistance Improvement Program, which provides “a single access point for more than 40 federally funded forms of assistance”.

(Source: adapted from *UN E-government Survey 2020*)
Currently, with the exponential growth of data, Governments are increasingly transitioning from traditional relational database server to cloud server. G-Cloud is designed to meet the needs of data sharing among national, provincial, and local governments.

**Malaysia – MyGDI Data Services Application**

**Introduce:** MyGDI Data Services Application is a web based application which is developed for geospatial data sharing between government agencies. It is an initiative of MaCGDI under the MyGDI program to provide a platform for data sharing between Government to Government (G2G).

Data sharing in this application involves 12 categories of Geospatial Data Centre (GDC) basic data that is Aeronautical, Built Environment, Demarcation, Geology, Hydrography, Hypsography, Soil, Transportation, Utility, Vegetation, Special and General Use through internal secured map services which is secure (government cloud).

**Objective:**
I. Provide a geospatial data sharing platform between government agencies (G2G) in a secure environment.
II. Facilitate access to geospatial data by government agency users.
III. Encourage geospatial information sharing by data provider agencies.
IV. Avoid duplication of effort in collecting, processing and preparing geospatial information between related agencies.

**Architecture**

![Architecture Diagram](image-url)

[Diagram showing the architecture of the MyGDI Data Services Application]
Although governments around the world have been dedicated to improving their data governance, yet they are still faced with many challenges. The most common challenges include the lack of data leadership, data infrastructure, resources and expertise, and security issues, etc. To take advantage of the emerging trends in government data and address the mounting risks and challenges, the UN proposed a data governance framework for digital government.
4.2.1.3 Government organization collaboration

To move the digital government transformation process forward, there is a need for organizational structures that can operationalize the new rules and contribute to the development of new, critical mindsets. Capacities are needed to promote coordination at the organizational level to enable different government ministries and agencies to effectively communicate and exchange information. Increasing the capacity of government agencies to communicate effectively within and outside of government is essential for enhanced collaboration for policy coherence and service delivery in diverse areas such as health, education, disaster risk reduction, and national security. Effective coordination, communication and collaboration can be leveraged to achieve government interoperability.

Promote coordination at the organizational level

- The National Information Resources Service in the Republic of Korea was established to integrate the information of central government institutions. The Service is responsible for the operation and management of 1,230 digital government services linked to 45 central government institutions and controls about 45,000 government information resources.

- Establish the Big Data Administration: Out of 30 provinces in China, 20 provinces have set up an independent Big Data Administration. The Big Data Administration is mainly responsible for the unified construction, management, and efficient operation of e-government.
The challenge is not only to introduce digital technologies into administrations; it is also to integrate their use into public sector digitalization efforts. Public sector capacities, workflows, business processes, operations and frameworks need to be adapted to the rapidly evolving dynamics and relations between the stakeholders. Secure leadership and political commitment to the strategy is very important. It is urgent to establish effective organizational and governance frameworks to co-ordinate the implementation of the digital strategy within and across levels of government. For instance, in Turkey, a Digital Transformation Office of the Presidency was established in 2018 to coordinate the digital transformation of public institutions. Based on the current enterprises and talent capabilities, it is necessary to cultivate and support the home-grown digital enterprises to carry out the digital government projects for the sake of long-term development and security.

Figure 4-37 Implementation framework of digital government
### Figure 4-38 Cases and experiences of digital government services

<table>
<thead>
<tr>
<th>Case</th>
<th>Experience</th>
</tr>
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</table>
| **G2C** | Smart Dubai Initiative  
_Dubai eGovernment Department offers many direct public services and other core services to government entities through its corporate website. It is also tasked with fully managing and supervising the official portal of Dubai Government, www.dubai.ae, which has become a virtual government park featuring over 2,000 government services provided by Dubai departments and is constantly updated._  
I. Single portal, www.dubai.ae, for all digital government services.  
II. Establishing Dubai eGovernment as a Department under the Law, and merging the eServices and Government Information Resource Planning teams into one department. |
| **G2B** | Digital Government Services  
_Turkey Digital Government Services for Businesses is designed to help things avoiding unnecessary inconvenience and red tape in regard to doing business. The group of services for businesses are: running a business, taxation, human resources, product requirements, financing and funding, dealing with customers._  
I. The Digital Transformation Office established under the Presidency coordinated the digital transformation of public services process through regular meetings.  
II. With the Single Window Port Application Service, agencies and public institutions can use the same database |
| **G2G** | MyGDI Data Services Application  
_MyGDI Data Services Application is a web based application which is developed for geospatial data sharing between government agencies. It is an initiative of MaCGDI under the MyGDI program to provide a platform for data sharing between Government to Government (G2G)._  
I. Provide a geospatial data sharing platform between government agencies in a secure environment.  
II. Avoid duplication of effort in collecting, processing and preparing geospatial information between related agencies. |

### 4.2.2 E-education

#### 4.2.2.1 Current status

E-education in Pakistan is mainly in higher education sector. The tertiary education sector in Pakistan—that is, education beyond 12 years—consists of two main subsectors: universities and affiliated colleges (ACs), both comprising public and private institutions. Each of the subsectors is governed by different regulations and faces different challenges, especially around governance and quality assurance. As of 2020, there are 134 public and 83 private sector universities across the country with a total enrollment of approximately 2 million students.

The Higher Education Commission (HEC) is the regulatory body for both public and private universities and degree-awarding institutes. It has three core functions: regulation, capacity building, and funding.

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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Students ('000)</td>
<td>948</td>
<td>1039</td>
<td>1139</td>
<td>1237</td>
<td>1296</td>
<td>1393</td>
<td>1491</td>
<td>1581</td>
<td>1859</td>
<td>1929</td>
</tr>
<tr>
<td>Public HEI</td>
<td>73</td>
<td>82</td>
<td>95</td>
<td>101</td>
<td>103</td>
<td>110</td>
<td>116</td>
<td>126</td>
<td>130</td>
<td>134</td>
</tr>
<tr>
<td>Private HEI</td>
<td>60</td>
<td>66</td>
<td>71</td>
<td>72</td>
<td>73</td>
<td>75</td>
<td>76</td>
<td>82</td>
<td>83</td>
<td>83</td>
</tr>
<tr>
<td>Total HEI</td>
<td>133</td>
<td>148</td>
<td>166</td>
<td>173</td>
<td>176</td>
<td>185</td>
<td>192</td>
<td>208</td>
<td>213</td>
<td>217</td>
</tr>
</tbody>
</table>

(Source: HEC records)

Pakistan’s higher education sector has been a leader in adopting new technologies in
higher education, following an innovative Information and Communication Technologies (ICT) Strategy pioneered by HEC. Most notably, HEC has partnered with telecom operators to build a PERN9 digital architecture (I, II, and III) that provides high-speed broadband to the vast majority of HEIs in the country. While most universities and their sub campuses have access to PERN, at present only 52 ACs (out of a total of 3,033) benefit from PERN. Once connected, institutions can use a variety of digital services such as a digital library, eduroam (which includes campus wide WiFi services), a Safe Campus initiative, a content management system, and a limited suite of software packages (including anti-plagiarism software).

While HEC has led the way with its ICT infrastructure, there are several reasons why universities do not fully utilize the technology that is available to them. First, HEC still regulates online education as a cheap way to reach the masses, while imposing many regulations that effectively disincentivize regular universities from offering blended learning programs. Second, PERN is understaffed and is governed centrally, so that its technical staff are overburdened and have little participation from the universities in either the governance or the administration of their networks. Third, only a few universities (and no colleges) have rolled out a campus network using eduroam, offering free Wi-Fi, there are virtually no cloud services or computing clusters available to do research, and there are no incentives to adopt learning management systems or online courses such as Massive Open Online Courses.

4.2.2. HEDP Project

The Higher Education Development in Pakistan (HEDP) is aligned with the World Bank Group, Pakistan Country Partnership Strategy. The Project is also aligned with HEC’s Vision 2025. Pakistan at 100, a new flagship study by the World Bank, also highlights the imperative to invest in human capital, particularly higher education and skills. The proposed Higher Education Development Project (HEDP) supports the implementation of a subset of activities from the Higher Education Commission’s Vision 2025, within the broader development framework for Pakistan as envisaged in the Government’s Vision 2025. The project will be implemented over a five-year period of 2019/20 – 2023/24. The project has five components.
Higher Education Development Project (HEDP)

- **Component 1: Nurturing Academic Excellence in Strategic Sectors**
  This component will provide competitive research, innovation, and commercialization grants to researchers and potential entrepreneurs from among faculty members, current students, or fresh graduates of the HEIs.

- **Component 2: Supporting Decentralized Higher Education Institutes for Improved Teaching and Learning**
  - **Subcomponent 2.4: Connecting Affiliated Colleges to Pakistan Education and Research Network (PERN)**
    The Project will support the expansion of Pakistan Education and Research Network (PERN) to selected ACs to provide them access to a campus network and/or offers free WiFi to staff and students, and/or smart classroom facilities. A total of 300 colleges selected for 4 year bachelor’s program under component 2 will be added to the existing PERN network.

- **Component 3: Equipping Students and Higher Education Institutions with Modern Technology**
  - **Subcomponent 3.1: Improving the policy environment for ICT use**
  - **Subcomponent 3.2: Enhancing PERN Activities**
  - **Subcomponent 3.3: Expanding PERN Vertically**

- **Component 4: Higher Education Management Information System and Data Driven Services**
  - **Subcomponent 4.1: HEC’s Data Repository**
  - **Subcomponent 4.2: Digitization of University Administration**

- **Component 5: Capacity Building through Partnerships, Project Management, Monitoring and Evaluation**
  This component will support HEC in strengthening its core functions of regulation, capacity building, and fund of Pakistan’s higher education sector through strategic and targeted TA.

- **Subcomponent 2.4: Connecting Affiliated Colleges to Pakistan Education and Research Network (PERN)**
  The Project will support the expansion of Pakistan Education and Research Network (PERN) to selected ACs to provide them access to a campus network and/or offers free WiFi to staff and students, and/or smart classroom facilities. A total of 300 colleges selected for 4 year bachelor’s program under component 2 will be added to the existing PERN network. These connections will be created using a last mile connection to the existing PERN infrastructure, that has already connected several ACs in Khyber Pakhtunkhwa and Punjab.

- **Subcomponent 3.1: Improving the policy environment for ICT use**
  This subcomponent will (i) prepare a new ICT strategy for the higher education sector, laying down the overall vision on the use of technology, possible strategies to leverage PERN to develop blended education content, potential technology needs and the pedagogical and didactical model underlying blended learning; (ii) review quality assurance and accreditation standards and guidelines to facilitate innovation in the higher education sector.

- **Subcomponent 3.2: Enhancing PERN Activities**
  PERN is a leased fiber-optic network that connects all universities in Pakistan, providing both an internet connection and online services to facilitate teaching, learning and research. Recently, PERN has launched its new phase, PERN III which will upgrade the last mile of the major universities to 10Gbps and upgrade the backbone to 40Gbps. Under, PERN-III,
the PERN services will also be extended to smaller cities in remote areas to facilitate tertiary education at all levels across the country.

- **Subcomponent 3.3: Expanding PERN Vertically**
  This subcomponent will expand cloud services under PERN, including expansion of data centers to create storage to enable other cloud services that can be offered through PERN, procurement of high-performance computing cluster for research purposes, and development of a platform for blended learning in universities. PERN will use a platform-approach for cloud services, in line with international standards for National Education Research Networks. PERN will also procure a high-performance computing cluster that can be used for research purposes (i.e. big data analytics). A third service is the development of blended learning in universities, through the development of a platform from which universities can establish a learning management system.

- **Subcomponent 4.1: HEC’s Data Repository**
  The subcomponent will support design and implementation of a web-based data system holding information on key variables on students, enrolments, staff, financials and facilities in universities. To create the data repository, the HEC will design a data system that maps out which kinds of indicators and variables are needed for its planning purposes. These data are already collected as part of HEC’s regulatory work (primarily by Statistics and Finance Units) and are currently available in Excel format. Business intelligence tool(s) will be used to slice and dice the data in the portal for purposes of data-driven decision making and predictive analytics.

- **Subcomponent 4.2: Digitization of University Administration**
  This subcomponent will (i) implement a cloud-based enterprise resource planning system to manage universities’ human resources, finances and procurement tasks; and (ii) develop and implement a digital student administration package that manages the student lifecycle, including the admissions, registrar function, alumni relations and student scholarship/aid functions. This digitization of the administration of universities will make university administration more transparent.

Direct beneficiaries of the project include all tertiary education students, recent graduates, academic staff, and administrators, in selected AUs and approximately 500 ACs who will benefit from improved conditions of the teaching, learning and research environment and strengthened governance in both public and private institutions across the country. It is expected that approximately 1.2 million students and academic staff in selected AUs and ACs will benefit from interventions under the Project. Indirect beneficiaries include the ACs under all universities that gain enhanced autonomy and society in general and employers in particular who will benefit from improved teaching and learning and research.

**Besides official e-education initiatives, online learning is booming in Pakistan.** The top 5 online learning applications is DigiSkills LMS, Coursera, Khan Academy, PhotoMath and Youtube.
4.2.2.3 E-education during COVID-19

According to the data released by UNESCO, the COVID-19 outbreak has resulted in the suspension of 1.58 billion students in 191 countries, accounting for 91.3% of the total students worldwide. In response to the epidemic, many countries have introduced measures to promote education from offline to online. At present, some countries are making steady progress in “back-to-school” plans. As the pandemic continues to spread, relevant countries continue to promote and develop distance education. During the COVID-19 prevention and control, many countries have started the online learning.

**Online Learning during COVID-19**

- **Improving e-learning platforms**
  - In KSA, the national education portal “Ain” has become the main channel of education for more than 6 million users. This digital education platform has provided 30,000 devices for students in need, in addition to providing more than 100,000 interactive digital learning hours for undergraduate students.

- **Providing free Internet services**
  - The Egyptian and Saudi governments have provided free Internet services to university professors and free SIM cards for students to access learning platforms through their devices. In Tunisia, Morocco and Bahrain, operators have provided free access to online education platforms.

- **Building new platforms**
  - In Jordan, new platforms have been developed in the wake of the pandemic to host teaching materials such as Darsak, Idrak, Jo Academy and Abwab.
  - In countries where network conditions were not able to handle the surge of e-learning applications, governments have used Television to broadcast lessons to students to ensure that the kids’ education is not impacted.
In Pakistan, HEC issued guidelines encouraging universities to move on to online education while taking into account their respective capacities and available infrastructure. The six pre-requisites for launching online classes by any university were: availability of the Learning Management System (LMS), trained faculty for online teaching, course readiness concerning the online mode of learning, availability of course material on the web, technology readiness i.e. the platform through which the classes can be arranged and last but not the least, students’ readiness to learn online. To resolve the technical issues in far-flung areas of the country, options like arranging unified online teaching platform for universities, negotiating taleem bundles, development of lectures in blended modes and establishing student facilitation committees, were considered. Necessary steps are also being taken by the HEC to address the quality-related concerns during the online classes. Recently, a tele-education channel was launched by Prime Minister of Pakistan to keep the students associated with their education through dedicated lectures for class I to XII.

4.2.3 Universal Service Fund

USF is endeavoring to provide, among other programs and services, support for the deployment of voice and data services to remote areas of Pakistan, characterized by mountainous terrains and sparsely populated communities. It has already successfully run a portfolio of projects including Broadband for Sustainable Development Programme, Optic Fiber Programme, ICT for Girls Programme.

**Figure 4-41 USF programs and the impact created**

<table>
<thead>
<tr>
<th>USF Programmes</th>
<th>Targets</th>
<th>Impact Created</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. NG-BSD (Next Generation Broadband for Sustainable Development Program)</td>
<td>High speed broadband for application coverage to population and commuters.</td>
<td>1,250 FTTH connected, 7,771 Covered McNab</td>
</tr>
<tr>
<td>b. Broadband</td>
<td>Fixed broadband, primarily through DSL, EVDQ &amp; WIMAX</td>
<td>552 No. of cities &amp; towns, 470,520 Broadband connections</td>
</tr>
<tr>
<td>c. Optic Fiber</td>
<td>Extension of Optic fiber connectivity to the unserved Tehsil HCos in Pakistan, for meeting the growing requirements of Voice, Data and Video.</td>
<td>79 &amp; 27 No. of connections wired &amp; wireless, 7,231 Length of optic fiber laid</td>
</tr>
</tbody>
</table>

(Source: Pakistan Universal Service Fund Limited)

The requirement of universal services continue to evolve together with the ongoing improvement of technologies, so does the definition of what constitutes a basic level of broadband speed. In the past, universal services mainly provide the basic voice services in rural and remote areas. With the increase of telephone penetration, universal service has been gradually extended to the Internet, broadband and other fields, e.g. e-health, e-education. Especially in developed countries, the level of telecom universal service has
reached a new level, while the minimum access rate has risen accordingly.

Currently in Pakistan, the Broadband Internet Access Services may be provided by any network technology which can provide a minimum data transfer rate of 512 Kbps for downlink and 128 Kbps for uplink. ITU defines the minimum access rate as 10 Mbps or above (download) and anticipated that by 2023, 40% of countries would have more than half of broadband subscriptions more than 10 Mbps. Considering the basic telecom demand in rural areas, e.g. voice, website visit, SD video, it is difficult for the minimum data transfer rate to meet the basic demand of users, and the minimum data transfer rate should subject to annual review and adjustment in consultation with the stakeholders.

**Figure 4-42 Bandwidth requirements for different applications**

(Source: Netflix, Cisco)

The USF policy articulation must be bolstered by the development of defined and measurable objectives. Without clearly defined objectives, it is extremely difficult, if not unachievable, to ascertain the extent to which the Fund has been effective in carrying out the overall policy and vision as regards the funding of universal service requirements. This instils greater confidence in the stakeholders and encourages overall support of the program. However, many USFs do not have a clear articulation of either. In Pakistan, the lack of a clear strategy has resulted in inability to adequately set targets and level of levies for subsequent years’ funds.
4.3 Private Sectors

4.3.1 E-agriculture

4.3.1.1 Fact sheet
Agriculture is still the largest sector of the economy of Pakistan in terms of labour participation (40% of the labor force) and as such livelihood of the majority of the population directly or indirectly depends on it. During the last few decades, its contribution to GDP has gradually decreased to 19.3 percent however there is a lot of potential in the sector to increase its share in GDP through increased productivity utilization of latest agricultural technologies.

Figure 4-43 Fact sheet of agriculture sector

(Source: Pakistan Economic Survey 2019-2020)

4.3.1.2 Selected initiatives
The Connected Agriculture Platform Program (CAPP), a first of its kind program in the Asia-Pacific region, is all about digitizing the small/landless farmer community to make them well connected, well aware, and in control of their farming workflow. During initial stage 110,000 smart phones was distributed among registered farmers of Kissan Package and during next stage all registered farmers got this smart phone equipped with special apps that helped farmers to interact with agriculture experts for taking advice regarding improvement in crops, know the weather condition in real time and see videos about latest

Comparison

Columbia:
The Fund produces a four year plan with targets, detailed project descriptions and the projected associated cost of the projects.

Malaysia:
The Fund produces an overall plan, listing targets and budgeted amounts for achieving each target.

Peru:
FITEL produces an annual report on fund performance with respect to project allocation and project performance versus target; this report also lists the projects and related targets to be addressed in the subsequent fiscal year.

Comparison

Population Size
5th most populous country in the world, with 57% rural population

Agriculture Contribution
19% agriculture contribution to GDP
40% of working labor force in the agriculture sector

(Source: Pakistan Economic Survey 2019-2020)
production technology of crops, know about crop calendar etc. The Department of Agriculture, Government of Punjab, in collaboration with Telenor and PITB (Punjab Information Technology Board) developed the carefully crafted mobile apps services.

Pakistan is on the journey of digitalizing different aspects of sectoral value chains for delivering better services to the farmers and improving livelihoods. **Digitalization of the agriculture value chain is in its initial stages.** The following initiatives provide a glimpse into the enterprising nature of various actors in the current landscape and the vast scale of opportunities that exist in digitalizing the agriculture sector.

**Figure 4-44 Top 5 digital agricultural apps in Pakistan**

- **Bakhabar Kissan** is a dedicated app that helps farmers to increase their crop yield with updated information and technology. The information provided by this app covers everything from soil preparation to post-harvest, along with livestock and weather updates with audio, video and pictorial presentations.

- **Ricult** helps farmers implement best practices and get better access to credit and crop buyers, helps banks in giving out loans faster, and helps food processing mills in optimizing their supply chains and promoting sustainability.

- **Kisan Zar Zameen** is a health analysis app that provides multiple services to farmers which includes the use of multi-spectral imagery from satellites. Soil condition, crop health analysis, and weather updates all are provided through this app making it a one-stop digital solution for farmers. By using this app the user can detect crop stress at an early stage, benchmark crop performance, and monitor crop growth.

- **Kissan Bazaar** is an online market place where a farmer can buy and sell agriculture items. The app includes separate sections for fruit, vegetable, poultry, and livestock. It provides an e-commerce facility to the farmer making it easy for the rural farmer to get access to the market directly through his smartphone.

- The Punjab Public Management Reform Program (PPMRP) launched an ‘Agri Smart’ app for extension workers with a wide range of services including farmer training sessions, pest warnings, monitoring agricultural inputs, soil sampling and receiving complaints. This app will digitalize the work of extension workers which means more easily, accessible and fast service for the farmers in Punjab.
### Turkey: 2020, the year of digital agriculture

- Historically, the agricultural sector has been Turkey’s largest employer and a major contributor to the country’s GDP, exports and rural development. Its share has been declining in proportion to the industrial and service sectors, but it continues to play a fundamental role, accounting for 6.4 per cent of GDP in 2019.
- In the last 10 years Turkey took place many digitization moves (see chart below). The Ministry of Agriculture and Forestry in Turkey has started developing a national e-agriculture strategy with the technical assistance of FAO (Food and Agriculture Organization). The strategy continues to be developed in 2020 and is still in draft by now.

#### Figure 4-45 Fact sheet of e-agriculture

- **Public Side**
  - 27 E-services (farmer registration system, agricultural parcels information service, the livestock identification service, land consolidation service etc.)
  - Farm Accountancy Data Network
  - Integrated Administration and Control System: enhance the administration and control of the agricultural support payments
  - Meteorological Observation System

- **Private Side**
  - Vodafone: Vodafone Farmers' Club: offer special tariffs & agricultural information  
    - Smart Villages Project: agricultural ICTs
    - Digital Agriculture Project: remote monitoring system
  - Tarfcom: offer price comparison of farm inputs
  - Doktar: provide agronomic advice, operational optimization techniques and market insight
  - Filt: increase farm productivity and savings in irrigation
  - Teros: facilitate fertilization

- **Public & Private & Academic**
  - Intelligent Precision Agricultural Platform: e-agriculture news and events updates and other knowledge sharing functions

### 4.3.2 E-commerce

#### 4.3.2.1 Fact sheet

Pakistan’s e-commerce is emerging rapidly and has the potential to strengthen the country’s economy by creating more job opportunities, linking remote areas to the mainstream, development of small and medium enterprises and finally enhancing exports through online platforms.

#### Figure 4-45 Fact sheet of e-commerce

- **E-commerce**
  - E-merchant: **4445** (Mar 2022)
  - Volume: **21.9 mn** (FY-2021)
  - Value: **60.6 bn** PKR (FY-2021)

(Source: State Bank of Pakistan)

According to State Bank of Pakistan, the number of e-commerce merchants has reached 4,445 by March 2022. In FY 2021, the number of e-commerce transactions reached 21.9 million, while the value reached 60.6 billion PKR. Despite the economic downturn during the COVID-19 pandemic, it is quite promising that e-commerce transactions during recent
years have seen continuously rapid growth.

**Figure 4-46 Pakistan’s e-commerce transactions**

![Graph showing e-commerce transactions](image)

(Source: State Bank of Pakistan)

Currently, Pakistan is still a cash-intensive economy, but it keeps improving the digital payment system to support the transformation towards a digital economy. State Bank of Pakistan is operating two payment systems: Pakistan Real-time Interbank Settlement Mechanism (PRISM) commonly known as RTGS, and Raast (Micropayment gateway). Pakistan has established an international e-payment gateway, which will improve consumer confidence in E-Commerce through global connectivity, pave the way for financial inclusion and payment digitization.

### 4.3.2.2 Selected initiatives

The federal government has finalized e-commerce policy framework to create an enabling environment for holistic growth of e-commerce across all sectors of the country, with a special focus on development and promotion of SMEs to transform Pakistan into a significant player in the regional and global digital economy.

**Figure 4-47 E-commerce Policy Framework**

![Diagram showing e-commerce policy framework](image)

**Regulatory Framework**: At present, there is no mechanism/registry for e-commerce businesses. This policy framework proposes registration of e-commerce businesses with
the Securities & Exchange Commission of Pakistan (SECP) and making it mandatory for them to maintain a physical address in Pakistan. In addition, for enhancing consumers' trust, measures or protection against counterfeit goods and a code of conduct are proposed under this Policy Framework.

**Payment Infrastructure:** It is essential to enable Card-Not-Present (CNP) transactions and explore the possibility of co-badging with international card payment schemes. Moreover, it is proposed that banking services should be improved for promoting the use of local online merchant accounts by online businesses and exploring the possibility of establishing an international payment gateway in Pakistan.

**Consumer Protection:** It should be mandatory for all online businesses to provide for an efficient customer support and dispute resolution mechanisms and federal and provincial governments should make arrangements for establishing independent alternate dispute resolution centers for expeditious settlement of disputes.

**Taxation Structure:** This policy framework proposes that for the purposes of provincial sales tax, online businesses should be treated at par with other businesses and parallel to that, provincial sales tax regimes should be harmonized to address the concerns of online marketplaces.

**Logistics and e-Commerce:** In Pakistan, business-to-consumer (B2C) e-commerce model has grown significantly in the last few years and this trend is likely to continue. Logistics play a pivotal role in the B2C model. The main area of concern to be addressed is system automation of B2C players and third-party-logistics (3PL) businesses.

**Data Ownership and Localization:** At present, the Ministry of Information Technology and Telecommunication (MoITT) has formulated Pakistan First Cloud Policy. on top of this e-commerce policy from commerce division will help the growing e-commerce industry of Pakistan

E-Tijarat, Pakistan’s first e-commerce online portal, was launched in February 2022. The e-Tijarat Portal is a one window information and facilitation platform that provides all e-Commerce related Government regulations, procedures, trends and updates in one place. It helps the country’s businesses grow while also assisting the government in bringing transparency to the information technology sector. Aside from that, Prime Minister Nawaz Sharif addressed the E-Commerce Pakistan Convention, where he announced the country’s first zero-tax programme for registered freelancers.
China: harnessing e-commerce to create jobs and promote inclusive growth

China has one of the largest and fastest-growing e-commerce markets in the world, accounting for more than 40 percent of the total value of e-commerce transactions worldwide. More than 5 percent of total employment in China is in e-commerce. It also plays a key role in promoting inclusive growth.

1. Job creation through e-commerce
According to Alibaba’s survey, e-commerce contributes to job creation through three channels:
- fostering entrepreneurship, such as self-employed e-shop owners;
- creating jobs directly related to e-commerce, such as e-shop workers as well as jobs that directly serve e-shops (website designers, e-shop models, and e-shop photographers);
- creating jobs indirectly related to e-commerce with linkages upstream or downstream, such as logistics services, materials, and intermediate input providers to e-shops.
About half of the entrepreneurs on Alibaba platforms are women, compared to only one quarter among all entrepreneurs in China; three-quarters of rural e-tailers are 20-29 years old.

2. Initiatives to support e-commerce development in less-developed areas
The Chinese government and private sector companies have implemented several initiatives to support e-commerce development in less-developed areas. For example, The government’s Rural E-Commerce Demonstration Program seeks to promote e-commerce in rural areas by establishing and improving rural e-commerce public service, fostering rural e-commerce supply chains, promoting connectivity between agriculture and commerce, and enhancing e-commerce training. The Program annually selects a limited number of new counties, many of which are poverty-stricken counties, to demonstrate the role of e-commerce for poverty alleviation in rural areas. The provinces determine which counties will be included in the program based on the criteria of logistics, Internet availability, and characteristic industries. By 2018, the program had supported 1,016 demonstration counties, including 737 poverty-stricken counties, among them 137 counties with extreme poverty. Online stores registered in rural areas grew from 8.17 million in 2016 to 9.86 million in 2017 and created 28 million jobs. With the assistance of the program, e-commerce companies have accelerated their penetration into rural areas and at least 15 e-commerce companies have joined the government’s effort to reduce poverty in rural areas.

Alibaba’s Rural Taobao Program seeks to establish an e-commerce service system in 100,000 administrative villages in 1,000 counties across China to bring consumer goods to rural areas and agricultural products to urban areas. The Program engages in multiple activities that help promote the development of e-commerce in rural areas. It promotes entrepreneurship among rural returnees and creates new sources of rural employment by establishing “incubators” at the village level. By 2018, it had established more than tens of thousands village-level service stations in 29 provinces, autonomous regions, and municipalities, and recruited more than 30,000 rural full-time shop assistants and nearly 30,000 part-time aides. It improves logistical connections with underserved villages to ensure timelier pickup and delivery by expanding existing private logistical systems from county centers to villages. The Program agent not only helps villagers navigate the platforms to support online transactions, but also expands the availability of customer services, such as charging stations, Internet access, online booking travel. It provides training in e-commerce through 11 training centers throughout the country and a series of online e-commerce training courses for self-learning by entrepreneurs. It also supports rural financial services, such as online payment, small collateral-free loans, and insurance.

3. Three pillars that support e-commerce development in China

4.4 Cybersecurity

4.4.1 Current status

The Global Cybersecurity Index (GCI) is formulated around the data provided by the ITU membership, focusing on five pillars: legal, technical, organizational, capacity building and cooperation. In 2018, Pakistan ranks the 94th out of 175 countries, lagging behind in the benchmarking. Malaysia, ranking the 8th, had the best performance among the benchmark countries. By 2020, Pakistan had advanced 15 places to rank 79th, Saudi Arabia ranked 2nd globally, having overtaken Malaysia that itself improved from 8th to 5th place.

Figure 4-48 Benchmarking of Global Cybersecurity Index (ITU), 2020 from 201

Pakistan is enhancing its legislation system for cybersecurity. In 2002, Pakistan formulated Electronic Transaction Ordinance (ETO) 2002 to regulate the electronic transactions and to recognize all means of electronic data and electronic signatures in term of their validity or invalidity. In 2016, Pakistan passed a cybercrime law called the Prevention of Electronic Crimes Act, 2016. In 2020, PTA developed the Critical Telecom Data and Infrastructure Security Regulations (CTDISR) which will pave the way to improve the security of Pakistan’s telecom sector. PERSONAL DATA PROTECTION BILL 2022 will further strengthen the cybersecurity of Pakistan. Multiple consultations with different local and international stakeholders have been carried out and bill is under review and finalization stage by MoITT.
### Table 4-10 Benchmarking of cybersecurity legislation

<table>
<thead>
<tr>
<th>Country Name</th>
<th>Regulatory Category</th>
<th>National Strategy</th>
<th>Military</th>
<th>Content</th>
<th>Privacy</th>
<th>Critical Infrastructure</th>
<th>Commerce</th>
<th>Crime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philippines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2000</td>
<td>2012</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td></td>
<td>2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2007</td>
<td>2007</td>
</tr>
</tbody>
</table>

(Source: Compiled by CAICT based on publicly available information)

In recent years, the surge in internet traffic has led to a drastic increase in cybercrimes in Pakistan. They vary from phishing attacks to harassment and digital identity theft and cover a myriad of other criminal activities carried out over the internet through computers or cellphones.
4.4.2 Key factors impacting Pakistan’s cyber security

Implementation of NATIONAL CYBER SECURITY POLICY 2021 to counter identity theft, financial data theft, and surveillance of critical infrastructure. Besides, with Pakistan being one of the top targets of foreign espionage, there are increased calls within the country to devote more resources for securing computer systems, investing in the security of the country’s digital infrastructure, and strengthening cybersecurity research and development. The factors impacting Pakistan’s cybersecurity include organization, legislation, and innovation.

Table 4-11 Key factors to enhance cyber security for Pakistan

<table>
<thead>
<tr>
<th>Organization</th>
<th>Legislation</th>
<th>Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No authority fully committed to cybersecurity</td>
<td>Lack of sufficient legislation</td>
<td>Labs limited in formative stage</td>
</tr>
<tr>
<td>Lack of capacity to protect critical infrastructure</td>
<td>Critical aspects of cybersecurity not fully covered</td>
<td>Lack of advanced tools and research technologies</td>
</tr>
<tr>
<td>Deficient in resources, manpower and facilities</td>
<td>No mandate on organizations to protect computer systems and information</td>
<td>Shortage of indigenously trained cybersecurity professionals within the public sectors</td>
</tr>
</tbody>
</table>

The government needs to invest in modernizing its agencies to enable them to deal with cyber threats. In Pakistan, the national cybersecurity threats/issues are being managed by different regulators in their own domains and there is a strong need of a centralized organization/body. The National Response Center for Cyber Crime (NR3C), a unit of Federal Investigation Agency (FIA), deals with cybercrimes, however, the capacity enhancement with regards to resources (manpower and infrastructure etc.) may be required to cope up with the increased scope under consideration.
In 2016, Pakistan passed a cybercrime law called the Prevention of Electronic Crimes Act (PECA), 2016. In 2021, National CyberSecurity Policy (NCSP) was approved by the Government which addresses overall national cybersecurity.

4.4.3 Cross-border data flow

In the era of digital economy, data has become a factor of production, an important strategic asset of a country, and the key to build a country's core competitiveness. Currently, due to various factors such as geopolitics, industry competition, and legislation, countries across the world have embarked on holistic regulation or even restriction of cross-border data flow. Legislation on data protection and localization is becoming a global trend. According to the Information Technology and Innovation Foundation of the USA (ITIF), except African countries, most countries have implemented data localization policies to various extents. Data localization is reflected in different legal compliance requirements, including the prohibition of data departure, local retention of data copies, the implementation of security assessment before data cross-border, and the requirement that data centers be located within the country, etc.
The differences between data localization and cross-border data flows legislation are mainly reflected in “the types of data to be regulated” and “the mechanism for regulating cross-border data flows”. The PERSONAL DATA PROTECTION BILL 2021 covers these important issues of cross-border transfer of personal data and data localization, which is in accordance the global trend of data localization legislation.

(Source: ITIF)
Table 4-12 Cross-border transfer of personal data

<table>
<thead>
<tr>
<th>Type</th>
<th>Definition</th>
<th>Whether the data can be transferred cross-border</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical personal data</td>
<td>“critical personal data” means and includes data relating to public service providers, unregulated e-commerce transactions and any data related to international obligations</td>
<td>Only be processed in a server or data center located in Pakistan.</td>
</tr>
<tr>
<td>Sensitive personal data</td>
<td>“Sensitive personal data” means and includes data relating to access control (username and/or password), financial information such as bank account, credit card, debit card, or other payment instruments, and, passports, biometric data, and physical, psychological, and mental health conditions, medical records, and any detail pertaining to an individual’s ethnicity, religious beliefs, or any other information for the purposes of this Act and rules made thereunder.</td>
<td>Personal data other than those categorized as critical personal data may be transferred outside the territory of Pakistan under a framework (on conditions) to be devised by the Authority.</td>
</tr>
</tbody>
</table>

According to the Bill, data may be transferred to a country that offers at least the same amount of protection of personal data, and critical personal data may only be processed in servers and data centers located in Pakistan. “Critical Personal Data” - to be classified by the Authority with the approval of the Federal Government. Personal data is widely distributed in on-site systems and the cloud. The definition of personal data is critical, which helps government and companies identify whether they are data handlers or data controller, and what data they have in their hands.

The policies for the cross-border data flows began in the area of personal data protection, in which the most typical case is European Union. As the complexity of cross-border data flows increases, many countries are attaching importance to other kinds of data besides personal data.
Another important issue is “the mechanism for regulating cross-border data flows”. According to the Bill, cross border transfer of personal data shall be ensured that the country where the data is being transferred offers personal data protection at least equivalent to the protection provided under this Act.

Different countries have set different localization and cross-border flow rules, but no country has restricted all types of cross-border data transfers. Instead, it takes sensitivity threshold and other factors into consideration to distinguish and control according to different types of data. Important and sensitive data are generally prohibited and examined by classification.

- According to data types and risk levels, countries all over the world generally impose transfer restrictions on data from critical infrastructure and important industries/fields such as government, banking, finance, credit investigation, health and taxation, including complete exit ban, selective exit ban, and conditional exit.
- Case by case review: before leaving the country for certain types of important data,
the data sender shall submit the declaration materials to the relevant authorities, and the authorities shall carry out the examination for the exiting activities, and the exit shall be allowed only after passing the examination.

**4.4.4 Mobile network security**

In the era of mobile digital economy, safeguarding network security is a common goal of the industry, users, regulators and other stakeholders, and building trust is one the greatest challenges for network security. Mobile network security should be verifiable based on common standards. Governments should be responsible for Formulation of regulations and laws, involving cross-discussion with all public and private partners, to guarantee a consistent security framework. Governments should take a key role to define the requirements of security and encourage the development of new technologies with risk control mechanisms to address both the economic objectives and security needs. This can be achieved through collaboration with all stakeholders, based on a common goal to define world standards. Governments play a major role in providing incentives to deliver a positive economic output for their respective countries, in terms of both leveraging innovations (for example 5G) and guaranteeing that regulations are available for defining key aspects such as the security agenda, security assurance mechanism, certification program, and policies. The Network Equipment Security Assurance Scheme/Security Assurance Specifications (NESAS/SCAS), jointly defined by GSMA and 3GPP, established a framework to facilitate improvements in security levels across the mobile industry, and been adopted by many Carriers, Vendors, Evaluation laboratories and Regulator worldwide.
5. Digital Innovation Policy & Talent Development

5.1 Digital Innovation Policy Framework

As mentioned in Chapter 2, the Digital Pakistan Vision is built upon six blocks. A policy framework is proposed with the Vision as the pivot. The framework is intended to identify the ICT regulation priorities and steer the multi-stakeholder digital efforts:

Figure 5-1 Digital policy framework

The GoP has been dedicated to establishing and improving a policy system to support ICT development and digital transformation in Pakistan. Currently, the GoP has the top-level plans of the Digital Pakistan Policy and Telecom Policy 2015 to guide the overall digital innovation in Pakistan. It has also released a number of polices ranging from Broadband policy to IT policy to boost the development of ICT infrastructure. Besides, in recent years, it has made efforts to develop policies such as

- National Cyber Security Policy 2021
- PAKISTAN CLOUD FIRST POLICY
- Public & Private Right of Way Policy
- PERSONAL DATA PROTECTION BILL 2021

However, the GoP still needs to continue its great work on digital policy framework to create an enabling environment for Digital Pakistan development. In particular, the policy framework should:

- Keep up with the global ICT development trends, and leverage the advanced global experience in ICT policy and regulation.
- Enhance MoIT&T’s leadership in setting direction and priorities, coordinating inter-
sectoral cooperation in ICT development, managing scarce resources, regulating appropriately, and supporting the provision of services in underserved and unserved areas.

Promote the robust growth of the ICT industry and facilitate more efficient infrastructure provision and service delivery.

Figure 5-2 What can be done to build Digital Pakistan from policy perspective

<table>
<thead>
<tr>
<th>Access &amp; Connectivity</th>
<th>Digital Infrastructure</th>
<th>eGovernment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion:</td>
<td>Foundational:</td>
<td>High-efficiency:</td>
</tr>
<tr>
<td>Ensuring everyone can reap the benefit of digital technology</td>
<td>Develop countrywide high-efficiency digital infrastructure</td>
<td>Transform the public sector into a digital government</td>
</tr>
<tr>
<td>• Promoting local manufacturing to increase smartphone adoption</td>
<td>• Using USF to improve network coverage in rural and remote area</td>
<td>• Promoting disclosure, collection, exchange and integration of data in public sectors, in accordance with Open Data standards</td>
</tr>
<tr>
<td>• Subsidizing last mile costs of fixed broadband connections to lower cost and encourage uptake</td>
<td>• Favorable fiscal &amp; tax policies for operators to invest in ICT infrastructure</td>
<td>• Developing government service platforms that support the delivery of basic public services, via new applications or new forms of services.</td>
</tr>
<tr>
<td>• Supporting the basic demands from educational institutions, hospitals and communities</td>
<td>• Mapping policies and plans to manage for infrastructure, spectrum reform and release, and future technological convergence.</td>
<td>• Strengthening the security of e-service provision by the public sector.</td>
</tr>
<tr>
<td>• Promoting int’l cooperation with global partners</td>
<td>• Promoting int’l cooperation with global partners</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Digital Skilling &amp; Training</th>
<th>Innovation &amp; Entrepreneurship</th>
<th>Software development &amp; Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive:</td>
<td>Innovative:</td>
<td>Attractive:</td>
</tr>
<tr>
<td>Develop workforce for the age of digital economy and society</td>
<td>Drive the economy with digital technology</td>
<td>Develop common and practical platforms with technology integration</td>
</tr>
<tr>
<td>• The teaching/learning of digital technology at all educational levels will be streamlined in order to focus on both practical skills and theoretical knowledge</td>
<td>• Raising awareness and understanding of innovation business models in public and private sectors, and to amend relevant laws and regulations.</td>
<td>• Promoting autonomous software application, smart factory, smart agriculture, and big data analytic, that will increase production efficiency and reduce production cost.</td>
</tr>
<tr>
<td>• Mapping a digital workforce development plan to support Pakistan’s digital workforce development, at all levels, in the educational, public, and business sectors.</td>
<td>• Enhancing business competitiveness in order to create economic value added by using digital technology to reform business practices throughout the value chain.</td>
<td>• Promoting the development of commercial and public service platforms, promote business applications, and enhance digital appeal and penetration across the country.</td>
</tr>
</tbody>
</table>

5.2 Future Investment Priorities

Based on the analysis of Chapter 4, future investment priorities are identified. It is recommended that the GoP prioritize investments in the sectors of IT & Telecom, e-education, and digital government.

Digital infrastructure, that is accessible to and usable by all people, will play a foundational role in leveraging the country’s economy and society with digital technology toward becoming Digital Pakistan. The key initiatives in the IT & Telecom sector, focusing on the digital infrastructure, include fixed broadband (FTTx), mobile broadband, national data center, and rural connectivity, etc.

Digital government will meet the demands of people and businesses with respect to convenience, speed and accuracy, and will be able to access public sector information conveniently and sufficiently to ensure transparency and civic participation. The key initiatives in the digital government sector include government data center, G-Cloud, G2G, G2B, and G2C services, etc.
E-education will bring the subversive change of educational form and learning, promote education equity and improve education quality. The key initiatives in the e-education sector include enhancing PERN activities, HEC’s data repository and ICT talent development, etc.

These initiatives are not only comparatively low-hanging fruits for Pakistan, but also the key cornerstones for the Digital Pakistan efforts.

**Figure 5-3 Key digital themes and technologies in Pakistan**

The MoIT&T is playing an important role in planning these initiatives. The close cooperation among MoIT&T, ICT companies, and relevant government departments is critical.
### Figure 5-4 Recommended future investment priorities for Digital Pakistan

<table>
<thead>
<tr>
<th>Key Sector</th>
<th>Key Initiatives</th>
<th>MOIT&amp;T’s Role</th>
<th>Key Stakeholders</th>
<th>Fund Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT &amp; Telecom Sector</td>
<td>Fiber optic connectivity</td>
<td>Create favorable policy environment and regulate</td>
<td>Fixed line operators</td>
<td>Private-sector fund</td>
</tr>
<tr>
<td></td>
<td>Wireless broadband (4G/5G)</td>
<td>Create favorable policy environment and regulate</td>
<td>Mobile cellular operators</td>
<td>Private-sector fund</td>
</tr>
<tr>
<td></td>
<td>Cloud Computing and Big Data: Promote the cloud infrastructure and associated delivery models (PaaS, SaaS, and IaaS)</td>
<td>Create favorable policy environment and regulate</td>
<td>Internet Service Providers (ISPs)</td>
<td>Private-sector fund</td>
</tr>
<tr>
<td></td>
<td>Fiber optic connectivity in rural areas</td>
<td>Steer and guide</td>
<td>Fixed line operators &amp; USF Company</td>
<td>USF</td>
</tr>
<tr>
<td></td>
<td>Wireless broadband in rural areas</td>
<td>Steer and guide</td>
<td>Mobile cellular operators &amp; USF Company</td>
<td>USF</td>
</tr>
<tr>
<td></td>
<td>National Data Center: Build a national data center that benefit public and private sectors with data calculation and storage services</td>
<td>Lead and coordinate</td>
<td>NADRA, FBR, AGPR, etc. ISPs</td>
<td>Fiscal fund</td>
</tr>
<tr>
<td>E-Government</td>
<td>Establish holistic enterprise architecture through the creation of data center clusters at essential sites.</td>
<td>Lead and coordinate</td>
<td>NADRA, FBR, AGPR, etc. ISPs</td>
<td>Fiscal fund</td>
</tr>
<tr>
<td></td>
<td>Establish G-Cloud to integrate different databases and to provide a resilient and secure ICT environment.</td>
<td>Lead and coordinate</td>
<td>ISPs, Relevant government agencies</td>
<td>Fiscal fund</td>
</tr>
<tr>
<td>E-Education</td>
<td>Initiate projects to provide network accessibility at educational institutes across Pakistan (PERN, HEC program to be expanded to schools).</td>
<td>Support</td>
<td>MoFE&amp;PT, HEC</td>
<td>Fiscal fund</td>
</tr>
<tr>
<td></td>
<td>Promote integration of computing courses particularly coding, cloud computing etc. into the curriculum</td>
<td>Support</td>
<td>MoFE&amp;PT, HEC</td>
<td>Fiscal fund</td>
</tr>
</tbody>
</table>
5.3 Digital Ecosystem and Landscape

The digital ecosystem encompasses the policies, strategies, processes, infrastructure, technologies, applications, and stakeholders that together make up an ecosystem for a government, a sector or an enterprise. The manner in which this system is constructed and operates is an aspect of emerging paradigms that consider the interplay between ICT multi-level usage by various players within systems of governance, citizenship, communication, knowledge, and innovation. MoIT&T plays a key role in this ecosystem.

Figure 5-5 Digital Pakistan ecosystem

Pakistan has by and large established a fully-fledged digital landscape, bringing together public and private players, both domestic and global, in sectors of smart devices, telecom, digital platform.
5.4 Digital Adoption and Utilization

A crucial element for the success of digital transformation is the adoption and utilization of digital services. Incentives from both government and industries are vital to boosting utilization. The digital adoption and utilization should be promoted from three aspects: government leadership, ecosystem, and digital awareness and skills.
5.4.1 Government leadership

**Policy & Laws:** All ministries synergize their digital policy efforts

Pakistan’s digital transformation is intended to benefit all social and economic sectors and thus need the engagement of all ministries. Under the guidance of the Digital Pakistan Policy, all ministries should enact relevant laws or issue policies to promote the application and adoption of ICT technologies in their own sectors.
Pilot Project / Zone: set examples for digital transformation

Digital technologies allow for rapid, lower-cost change. A concept that might have taken months and cost millions to build five years ago could be deliverable now in days and at small cost, using cloud technologies, deployed onto smartphones or a web browser and with a proven user interface. The consequences of this cannot be understated, as the dynamics of transformation business cases have changed in a profound way. It is now possible to explore ideas in practice that were previously uneconomic to move forward with.

While digitalization provides access to a broad range of customers, the most effective approach is to start with a well-defined pilot project that addresses the specific needs of a small homogeneous target audience. This increases the success of customer adoption and minimizes the challenge of managing wider-range customer expectations and priorities.

- Policies can be tested more before they are implemented.
- New designs can be tried and improved before they are baked into a target operating model and rolled out at scale with appropriate workforce plans.

In the pilot zone/project, favorable policies or incentives could be used to promote the digital adoption and utilization. The successful experience or lessons learnt from the pilots can provide invaluable reference for future expansion of the digital efforts.
5.4.2 Ecosystem

APP development: provide abundant applications on the market

The Application is the bridge linking end-user and infrastructure. There are many examples around the globe that the introduction of some excellent APPs brought about digital transformation of long-lasting significance. For instance, the various and targeted e-commerce APPs in China not only created an enormous e-commerce market, but also changed the shopping habits of the customers and business models of enterprises, and created millions of new jobs.

A sufficient number of APPs are required on the market to meet the diversified needs of end-users.

- Public services are driven by citizen’s needs. The functions of all public agencies will be converged and delivered through a single portal.
- Each vertical sector has its own unique needs, e.g. telemedicine apps require timely and accurate diagnosis, and agriculture apps require professional agricultural knowledge.
To develop more APPs that unleash the vast potential of digitalization, a complete APP development cycle needs to be built to foster long-term sustainable innovation.

- Pakistan digital ecosystem already has many active mobile APP developers.
- The government should further encourage digital APP R&D and innovation through policy and tax incentives.

### Top 5 Digital Medicine APPs in Pakistan

<table>
<thead>
<tr>
<th>APP Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Find my Doctor</strong></td>
<td>The first healthcare app of Pakistan which provides you with convenience of finding the nearest doctor to cover all your medical needs. Find my doctor connects doctors and patients together for mutual benefit. The app provides you with information such as, the doctor’s qualification, specialization, experience, availability (timing) and fee.</td>
</tr>
<tr>
<td><strong>TeleDoc doctors</strong></td>
<td>Developed by Medicount Pvt Ltd. It’s a ‘Find a Doctor’ app that helps you find available doctors within your range and also helps you book an appointment. It is a simple and clean application that allows you to pay from your phone as well.</td>
</tr>
<tr>
<td><strong>Dawaai</strong></td>
<td>One-stop-shop for medicines. All the information about medicines, ordering medicines online, delivery, possible side effects and where to order medicines and when to refill them is available at Dawaai. It gives you reminders and news about upcoming ones. ‘Denture at Home’ is one of the features that was introduced in Pakistan by Dawaai and it also offers Lab tests at home.</td>
</tr>
<tr>
<td><strong>Pharmapedia Pakistan</strong></td>
<td>Is an encyclopedia of pharmacy. It contains all the information on available medicines in Pakistan, their dosages, their side effects and many more.</td>
</tr>
<tr>
<td><strong>Medical Guide App Pakistan</strong></td>
<td>Contains all the information that you would need about hospitals, drugs, and ambulances. It also runs offline so that you can learn about the specific drugs and medications offline, ad-free.</td>
</tr>
</tbody>
</table>

### 5.4.3 Digital awareness and skills

**Digital Skills: cultivate professional digital talent**

Digital talent is another major challenge for digital utilization in Pakistan as well as around the global. Expertise in app development, software development, digital manufacturing and other related services is required for markets to keep up with the pace of global transformation. This expertise is especially crucial for inhouse initiatives. Entities need skilled employees to manage, maintain and troubleshoot these digital applications regularly. For more recommendations on talent development, see the following section of this whitepaper.

**Enhanced Awareness: get citizens/users on board**

More promotional efforts are needed to enhance citizens/users’ awareness that online services are more efficient, safe, up-to-date, and reliable. The following case of e-commerce in Pakistan in 2020 illustrates that it has huge potential of digital transactions, while the customer retention is not high after the lockdown measures were lifted. The industry should continue to expand the customer base by cultivating their digital awareness.
5.5 Talent Development

Building a digital infrastructure necessarily entails building competencies. This requires a strong education and training ecosystem to be put in place. In the traditional talent cultivation model, higher education prioritizes theories and concepts but neglects practices and capabilities.

The ITU classified the digital skills into three levels of basic, intermediate, and advanced, and predicted that there would be tens of millions of jobs requiring advanced digital skills globally in the coming years. However, as analyzed in Chapter 2 with international benchmarking, Pakistan is still at a starter stage of ICT development, with relatively low level of ICT skills of the population. Pakistan needs to train or re-skill its citizens and workforce.

**Figure 5-8 ITU Digital Skills Level**

<table>
<thead>
<tr>
<th>Basic Skills</th>
<th>Intermediate Skills</th>
<th>Advanced Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware:</td>
<td>Job ready skills:</td>
<td>Needed by specialists in ICT</td>
</tr>
<tr>
<td>- Using keyboards and touch</td>
<td>- Desktop publishing</td>
<td>professions:</td>
</tr>
<tr>
<td>screens</td>
<td>- Digital graphic design</td>
<td>- Artificial intelligence (AI)</td>
</tr>
<tr>
<td>Software:</td>
<td>- Digital marketing</td>
<td>- Big data</td>
</tr>
<tr>
<td>- Word processing</td>
<td></td>
<td>- Coding</td>
</tr>
<tr>
<td>- Managing privacy settings</td>
<td></td>
<td>- Cybersecurity</td>
</tr>
<tr>
<td>Basic online operations:</td>
<td></td>
<td>- Virtual reality</td>
</tr>
<tr>
<td>- Email</td>
<td></td>
<td>- Internet of Things (IoT)</td>
</tr>
<tr>
<td>- Search</td>
<td></td>
<td>- Mobile app development</td>
</tr>
<tr>
<td>- Completing an online form</td>
<td></td>
<td>- Digital entrepreneurship</td>
</tr>
</tbody>
</table>

(Source: ITU)
Over the last few years, the GoP has demonstrated its commitment to complete Pakistan’s transition to a digital economy through enhancing talent and entrepreneurship development. National incubation centers initiative is another significant step to contribute to digital economy through innovation and entrepreneurship, which has incubated 209 startups, raised 1.23+ billion PKR investment and generated 1.42+ billion PKR revenue. The Digital Pakistan Policy has 12 policy goals with the overall vision “to become a strategic enabler for an accelerated digitization ecosystem to expand the knowledge based economy and spur socioeconomic growth” which includes the strategy to develop human resource, entrepreneurship, research and innovation and freelancing in IT. Human and social capital is one of the seven pillars to support Pakistan Vision 2025, which will allow the population to optimally contribute to and effectively benefit from economic growth. For Pakistan, a skilled and innovative workforce will lay a key foundation for its economic and social progress.

**Figure 5-9 Facts about National Incubation Center in 2022**

<table>
<thead>
<tr>
<th>Incubated Startups</th>
<th>Graduated Startups</th>
<th>Total Founders</th>
<th>Women Entrepreneurs</th>
<th>Hours of Curriculum</th>
<th>Hours of Mentoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>295</td>
<td>173</td>
<td>707</td>
<td>136</td>
<td>2,015</td>
<td>3,060</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Jobs Created</th>
<th>Direct Jobs Created</th>
<th>Indirect Jobs Created</th>
<th>Investment Committed (PKR)</th>
<th>Revenue Earned (PKR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16,444</td>
<td>2,216</td>
<td>14,028</td>
<td>4.32+</td>
<td>2.77+</td>
</tr>
</tbody>
</table>

(Source: National Incubation Center)

According to *Global Talent Competitiveness Index 2020* released by the INSEAD, Pakistan ranks 106 out of 132 countries, lagging behind peer countries. While in contrast to the comprehensive index score, the scores of sub-indexes concerning skills (Vocational & Technical Skills and Global Knowledge Skills) are above the peer, especially in terms of employability of skilled workforce which ranks 48th. But the GTCI Report still deems that the supply of workforce and education of both mid-level and high-level skills could be further enhanced.
### Figure 5-10 WEF Digital Skills

<table>
<thead>
<tr>
<th>Education &amp; Skills</th>
<th>Digital skills among active population</th>
<th>Technology Adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Talent supply and demand are somewhat disconnected, and the model struggles to support the industry’s development.</td>
<td>⚫ 50.7%</td>
<td>⚫ 47%</td>
</tr>
<tr>
<td>According to WEF statistic, the current education &amp; skills in Pakistan is shown on the right.</td>
<td>⚫ 36.4%</td>
<td>⚫ 55%</td>
</tr>
</tbody>
</table>

**Notes:**

1. Role identified as being in high demand or increasingly redundant with their organization, ordered by frequency
2. "Technology adoption" in the chart represents the share of survey respondents from companies operating in Pakistan who indicated that, by 2025, their company was “likely” or “very likely” (on a 5-point scale) to have adopted the stated technology as part of its growth strategy.

(Source: WEF)

Top universities in Pakistan have already realized the importance of emerging digital technologies as identified by the WEF above and integrated them into their academic programs to different extent. For instance, the National University of Sciences and Technology has incorporated e-commerce, artificial intelligence, big data science, network security, etc. into its curriculum of bachelor’s in Software Engineering and Computer Science; the University of Management and Technology has established independent bachelor degree for AI, IoT and Data Science.
However, educational capacity in ICT is still inadequate in Pakistan. Despite a rather limited number of universities which list these advanced curricula only as electives, most higher education institutes fail to start the design of such curriculum, leading to the gap between IT graduate skills and IT industry needs. What’s more, it is also necessary to update the academic degree system according to the technology trends.

To meet the requirements of digital economy, many countries have reformed their curriculum at all levels of educational institutions to cultivate talent with different digital skills. Take China as an example, some universities have set up new first-level academic disciplines relating to ICT, such as cybersecurity. Some universities have added new curriculum, such as e-commerce, into their existing disciplines. Vocational schools and colleges provide curriculum such as software development, cloud computing, and IoT, etc. Elementary and secondary schools have computer and coding courses.

Entrepreneurship in Pakistan is also already on the rise. Since 2010, nearly 800 startups have been established (60+% still active) with 100+ successfully raising funding, indicating the vast opportunity for local startups and increased investors’ interest of Pakistan. Correspondingly, a startup ecosystem is slowly maturing.

**Figure 5-11 Startup ecosystem in Pakistan**

<table>
<thead>
<tr>
<th>Government:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Government, at both the provincial and federal level, is carrying out initiatives to promote startup culture.</td>
<td></td>
</tr>
<tr>
<td>• License for Pakistan's first PE &amp; VC funds approved in 2017 by SECP</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Talent:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Universities and academia promote entrepreneurship, particularly by providing space for students to test and incubate potential businesses and learn entrepreneurial skills.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Funding:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Corporations, foundations and government provide funding for early stage startups to accelerate their growth.</td>
<td></td>
</tr>
<tr>
<td>• Planet N has invested in 14 startups across e-commerce, fintech, edu-tech and renewable sectors.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incubators:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Incubators provide management services and secondary support services to help new startups setup on ground.</td>
<td></td>
</tr>
<tr>
<td>• Government has funded incubation centers in all 4 provinces.</td>
<td></td>
</tr>
</tbody>
</table>

To improve digital skills and entrepreneurial culture in Pakistan, the following approaches and suggestions are made.
## Figure 5-12 Recommendations for digital skills and entrepreneurial culture development

<table>
<thead>
<tr>
<th>Digital Skills Development</th>
<th>Entrepreneurial Culture Development</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Government side:</strong></td>
<td><strong>Government side:</strong></td>
</tr>
<tr>
<td><strong>Approaches:</strong></td>
<td><strong>Approaches:</strong></td>
</tr>
<tr>
<td>• Leverage formal and non-formal education channels</td>
<td>• Facilitate the funding</td>
</tr>
<tr>
<td>• Form cross-sector partnerships</td>
<td>• Shorten the time to start business</td>
</tr>
<tr>
<td>• Upgrade existing infrastructure when necessary</td>
<td>• Encourage provincial competition</td>
</tr>
<tr>
<td><strong>Suggestions:</strong></td>
<td><strong>Suggestions:</strong></td>
</tr>
<tr>
<td>• Partner with technology companies to develop ICT curriculum or establish academy</td>
<td>• Establish seed funding initiatives and IT incubators</td>
</tr>
<tr>
<td>• Provide ICT curriculum for all levels of education and improve its weight in academic program.</td>
<td>• Enhance e-governance to facilitate the approval process, establish public-private partnership to provide more opportunities for technology companies</td>
</tr>
<tr>
<td>• Establish vocational ICT qualifications and digital literacy centers nationwide</td>
<td>• Establish provincial special economic zone for ICT</td>
</tr>
<tr>
<td>• Upgrade ICT infrastructure in all universities to implement internet-facilitated learning</td>
<td>• Attract investors for innovative companies</td>
</tr>
<tr>
<td><strong>Enterprise side:</strong></td>
<td><strong>Enterprise side:</strong></td>
</tr>
<tr>
<td><strong>Approaches:</strong></td>
<td><strong>Approaches:</strong></td>
</tr>
<tr>
<td>• Leverage technology capacity of base company</td>
<td>• Embrace disruptive ideas</td>
</tr>
<tr>
<td>• Enhance international cooperation</td>
<td>• Delegate authority</td>
</tr>
<tr>
<td><strong>Suggestions:</strong></td>
<td><strong>Suggestions:</strong></td>
</tr>
<tr>
<td>• Establish ICT Academy</td>
<td>• Value experimentation</td>
</tr>
<tr>
<td>• Hold ICT competition to expand influence</td>
<td>• Develop a formal document of entrepreneurial culture initiatives</td>
</tr>
<tr>
<td>• Launch exchange program</td>
<td></td>
</tr>
</tbody>
</table>
**Recommendations**

**IT & Telecom Sectors**

1. **Promote the expansion of broadband connection through 4G FWA**
   - The GoP should include 4G/5G FWA into national broadband plan and leverage FWA in providing broadband access to rural, remote, or geographically challenged areas where FTTH technologies are not feasible.

2. **Boost the usage of mobile broadband services.**
   - The GoP take the lead to promote the use of the Internet through enabling of government services via electronic means, i.e., Digital government.
   - The GoP create an enabling policy environment to encourage and support innovation and development of e-applications in various sectors.

3. **Assign sufficient amounts of mobile spectrum to operators in a timely manner**
   - **Phase 1:** Auction of 1800, 2300 and 2100 MHz unused spectrum in 2021.
     - The GoP should auction 1800, 2300 and 2100 MHz unused spectrum soon in 2021. The bands should be used to deploy 4G with technology neutrality for future 5G use.
   - **Phase 2:** Auction of key bands of 2600 and 3500 MHz for 5G in 2022.

4. **Enhance spectrum availability for MNOs with reasonable price and obligation**
   - **Do not inflate spectrum prices**
     - When awarding and renewing spectrum licenses, the GoP should prioritize improved mobile broadband services with excellent coverage and set reasonable prices to help operators develop MBB networks and services quickly. Considering global experience, spectrum costs should be below 5% of the mobile operator’s revenue to avoid jeopardizing MBB deployment progress and below 5% if the country wants to promote 5G rollout.
   - **Allow operators to pay spectrum fee annually**
     - MNOs be allowed to pay annual spectrum fee according to their status of obligation achievement. Specific incentives include: less initial payment; longer license duration for installment; and reduced annual payment if operator achieve the network obligation.

*Note: They are just recommendations made by CAICT and do not represent the actual spectrum plans of the Government of Pakistan.*
5. Create an enabling policy environment for microwave backhaul development
   - **Assign the remaining microwave spectrum by block**
     To keep up with the increased demand on microwave backhaul in the 4G and 5G era, the GoP assign the remaining frequency by block to operators.
   - **Avoid inflating microwave spectrum costs**
     Since the high spectrum costs already risk slowing down operators’ deployment progress, the pricing regime of microwave backhaul spectrum should be designed in a manner that avoids extra cost burden on the operators and encourages them to deploy backhaul.

6. Improve energy supply
   - Telecom operators should be encouraged to increase the use of alternative energy sources to reduce dependence on the primary power grid. The USF could be used to support more projects that expand solar energy utilization.
   - Telecom operators should be encouraged to use innovative technological solutions to ensure fuel-efficient and reliable sources of power for the network.
   - MoIT&T should enhance cooperation with the Water and Power Development Authority (WAPDA) to strengthen energy network construction and provide stable power supply to cell stations, especially in the rural area and tribal areas.

7. Establish an infrastructure sharing regime on the principles of neutrality, non-discrimination, and equal access
   - Under the infrastructure sharing regime, all licensees may share infrastructure on mutually agreed commercial terms and licensees with significant market power in a relevant market are obliged to share infrastructure on fair and non-discriminatory terms where practical. Infrastructure sharing involves mutualizing part of the infrastructure of a mobile network between two or more mobile operators.

8. Accelerate the construction of fiber optic network
   - **Fixed broadband**
     - Telecom operators should accelerate the construction of fiber optic network to provide high-bandwidth and high-reliability broadband services to subscribers, especially for government agencies, public services (schools, hospitals, etc.), large enterprises, etc. The recommended objectives are: FTTH population coverage will reach 10% by 2023 and 20% by 2025. Broadband access speed in urban and rural areas will be above 30Mbps and 10Mbps respectively by 2023, and 50Mbps and 30Mbps respectively by 2025. Broadband access speed in government agencies and public institutions will be above 50Mbps by 2023 and 100Mbps by 2025.
     - Telecom operators should promote the fiber-to-the-station construction, and increase the FTTs rate to 30% by 2023, and 50% by 2025.
     - Based on the fiber construction and
optimization, telecom operators should promote the optical node moving down to solve the fiber resources shortage of fiber direct-drive, and provide high-particle and long-distance access.

9. **Further clarify and improve the RoW Policy to guarantee the effective implementation of the policy.**
   – The GoP should further clarify issues including the one window operation, standard RoW tenure, etc, so that the policy can be effectively implemented and benefit the telecom sector.

10. **Adopt the aerial cable solution to realize rapid and cost-efficient rollout of broadband network.**
    – Telecom operators should adopt the aerial fiber-optic cable solution, since it is typically faster and less expensive to deploy than digging.
    – The GoP should develop and implement regulations and standards for the construction and protection of fiber-optic cables, in particular the aerial cables.

11. **Using existing public infrastructure, especially the power infrastructure, to build FTTx network becomes one of the feasible cost-reduction solution.**
    – When using power infrastructure for FTTx deployment, power companies and telecom operators are encouraged to jointly consider which business model can meet each other’s strategic goals and create a win-win situation.
    – The GoP encouraging the opening of public infrastructure and introducing charging standards for the opening of public facilities, to further promote the harmonization of tariff standards.

12. **Develop and implement regulation on fiber pre-deployment in new buildings, to get ready for large-scale rollout of FTTH in the future.**
    – The GoP should issue relevant regulation and technical standards on fiber pre-deployment in new buildings, considering fiber as a key infrastructure as water, electricity, and gas.
    – When a building is constructed, fiber should be wired at the same time. And the real estate developers will be the owner for the job of fiber deployment.
    – The fiber shall be designed, deployed, and accepted at the same time with the buildings.
    – After deployed, the fiber shall be accessed equally by operators and service providers. Fiber pre-deployment could start with new buildings for public purposes such as hospital, school, library, and government, and for commercial purposes such as business offices and industrial parks.

13. **Adopt IPv6 migration strategy to evolve to the next generation of Internet protocol**
    – MoIT&T should build a national IPv6 Council to bring together key stakeholders (government agencies, operators, academia, enterprises) and establish the ecosystem around IPv6.
    – The GoP should issue relevant regulations requiring IPv6 compatibility for new network devices on the market. The GoP could encourage IPv6 migration in fixed and mobile networks buy
binding resources like frequency and top-level domain names with IPv6 requirement
- Government networks and state-owned enterprises should take the lead to build models of IPv6 deployment.
- MoIT&T should encourage IPv6 Enhanced innovations and their deployment to fully release the potential of IPv6.

Data center
14. Issue standards/specifications for the design and construction of data centers
- The GoP should issue specifications for the design and construction of data centers, to ensure that the construction of data centers is technologically advanced, cost efficient, safe, energy saving, and environmentally friendly. By issuing the specifications, the Government can guide the intensive and standardized development of industrial and commercial data centers in Pakistan.

IoT
15. Government play a bigger role as customer and policy enabler of industrial IoT
- PTA has published the relevant framework after detailed consultation and inputs from The Ministry of IT & Telecom.
- The GoP promote IoT application in public services and facilities, including public transport, surveillance, street lighting, smart metering, and smart grid, etc.

Public Sectors

Digital government
- **G2G services**: The GoP to promote the development of common platforms that supports further service development, cross-function integration, and therefore create new models for sharing and collaboration in the public sector. These platforms will facilitate the transformation of basic transactions and services by all agencies in public sectors to provide more convenience, speed, and safety in service usage as well as provision.
- **G2C/G2B services**: The GoP to develop a central portal that delivers all government services to the citizens through simple online and mobile application interfaces.

17. Be prepared for a massive increase in the amount of data.
- The GoP to develop databases and data management platform that link data from all government agencies, regardless of ownership, and promote integration of data and services among government agencies. Pilot projects, e.g. data sharing platform, should be carried out in more viable provinces such as Punjab to formulate best practice for future promotion.
- The GoP to make preparations for a massive increase in the amount of data, in both data storage and data analytical capability. Data processing should be allowed in order to bring the benefits of big data to Pakistan.
18. **Adopt cloud as an enabler to digital government**
   - The GoP should adopt cloud as a preferred deployment tool (Cloud First Policy) for administration as well as delivery of public services. The only two exceptions should be: (i) when special circumstance, e.g. sensitivity of data, requires otherwise, or (ii) when the alternative is more cost efficient.

19. **Build physically distributed and logically centralized government data center**
   - Government data center should be deployed at "national – provincial – municipal" three levels. All levels of data center should be built unified to avoid duplication and system isolation. At the national level, the government data center should be deployed in Islamabad and Karachi to form mutual backup situation and meet the needs of all government ministries. At the provincial level, the government data center should connect to the national-level and municipal-level data centers. At the municipal level, the city data center should be deployed to meet the local governments’ needs, e.g. smart city, safe city.

20. **Promote coordination at the organizational level**
   - The GoP establish a mechanism under the direct supervision of the Prime Minister of Pakistan to manage the national digital strategy, which could promote coordination at the organizational level and enable different government ministries and agencies to effectively communicate and exchange information.

21. **E-education**
   - **Make internet connectivity and content available for all levels of school.**
     - The GoP provide network accessibility at all levels of educational institutes across Pakistan.
     - The GoP integrate computing courses into the curriculum.

22. **Universal service fund**
   - **Develop an appropriate and well-defined legal and regulatory framework**
     - The GoP should provide for periodic review and adjustment of the overall USF vision, policy and administrative mechanisms.
     - The GoP to develop and define clearly of measurable overall Fund objectives which can subsequently be tracked and monitored. The objectives need to include detailed coverage (e.g. geographic, population) and service targets tied into a specific time frame. The objectives and performance against objectives subject to annual review and adjustment in consultation with the stakeholders.

23. **Upgrade the minimum service requirements for Universal Service Fund**
   - The GoP to refer to the global prevalent bandwidth minimum requirements for a good experience, in consultation with industry and stakeholders, evaluate the demand in rural and remote areas annually and then
gradually upgrade the minimum access rate to 4 Mbps by 2025.

### Private Sectors

#### E-agriculture

24. **Provide more agriculture information portals with local-language content.**

   - The GoP and the private sector should collaborate in creating mobile agriculture information portals for collection and dissemination of the up-to-date knowledge regarding market fluctuations in price, weather updates, planting technologies, etc., in local languages.

#### E-commerce

25. **Provide more applications for various sectors to boost e-commerce.**

   - Private sector should be encouraged to develop more mobile applications for various sectors such as transportation, tourism, media in local languages, to boost e-commerce in those sectors.
   - Private sector should be encouraged to develop a secure e-payment gateway to promote e-commerce development and financial inclusion.

### Cybersecurity

26. **Enhance cybersecurity in organization, legislation, and innovation dimensions.**

   - The GoP should further enhance cybersecurity by improving the organization and legislation. An authority fully committed to cybersecurity could be established and equipped with enough resources. Legislation on cybersecurity should be enhanced by introducing the national strategy on cybersecurity, and regulation on protection of critical infrastructure, etc.
   - The GoP should work together with the academia and the private sector to enhance innovation and talent development in cybersecurity.

27. **Improve the regulatory framework for the administration of cross-border transfer of personal data and important data.**

   - The GoP, by referring to the experience of data classification abroad, reasonably determine the definition and scope of “critical personal data”.
   - In accordance with the classification standards for important industries, the definition and scope of "important data" shall be reasonably determined. All sectors, e.g. IT & Telecom, finance, education, health, and transportation, should be encouraged to formulate regulations on important data classification and management for their own sector.
   - The GoP classify the risk levels of "important data" cross-border transferring, and apply different regulation methods.

### Digital Adoption & Utilization

28. **Policy & Laws: All ministries synergize their digital policy efforts**
All ministries, under the guidance of the Digital Pakistan Policy, should enact relevant laws or issue policies to promote the application and adoption of ICTs in their own sectors.

All ministries should carry out pilot project / zone to set examples for digital transformation. In the pilot zone/project, favorable policies or incentives could be used to promote the digital adoption that are aligned with best global practices.

29. Ecosystem: provide abundant applications on the market

The GoP should Encourage digital APP R&D and innovation through policy and tax incentives provide abundant applications on the market.

30. Enhanced Awareness: get citizens/users on board

The GoP that more promotional efforts are needed to enhance citizens/users’ awareness that online services are more efficient, safe, up-to-date, and reliable.