Internet Society

COVID-19 Impact on Internet Performance

Case Study of Afghanistan, Nepal, and Sri Lanka

March 2021

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1 Introduction

Internet is an empowering tool that enables its users to learn, earn, and be entertained. Its inherent borderless, decentralized, and all-inclusive design principles encourage provision of meaningful access to everyone, without any discrimination.

When the COVID-19 pandemic hit at the turn of 2020, it challenged the foundations of social and economic norms around the world. One after the other, countries initiated lockdown protocols and social distancing procedures for public safety that shifted daily routines to telecommuting, online education, video calls, and digital banking.

As the center point of this 'new normal', Internet infrastructure came under huge stress. Global peak traffic increased by 47%, compared to a forecasted 28%, with some services like Facebook video calling (which saw a 100% increase), and Netflix (which welcomed 16 million new subscribers) driving the change and duration of the peak traffic patterns.[1] Global Wi-Fi traffic also increased PC (personal computer) uploads to cloud computing platforms and video calls surged by 80%, while Internet Exchange Point (IXP) traffic in Asia-Pacific grew by 40%.[2]

Such traffic surges have posed a question mark about the capacity and reliability of the Internet, while at the same time, reminding us that half of the world is still not online. To ensure the Internet functioned smoothly, governments and service providers launched numerous emergency initiatives, including flexible spectrum use, additional spectrum release, increased international and domestic capacity, subsidized broadband services, and free access to online resources.

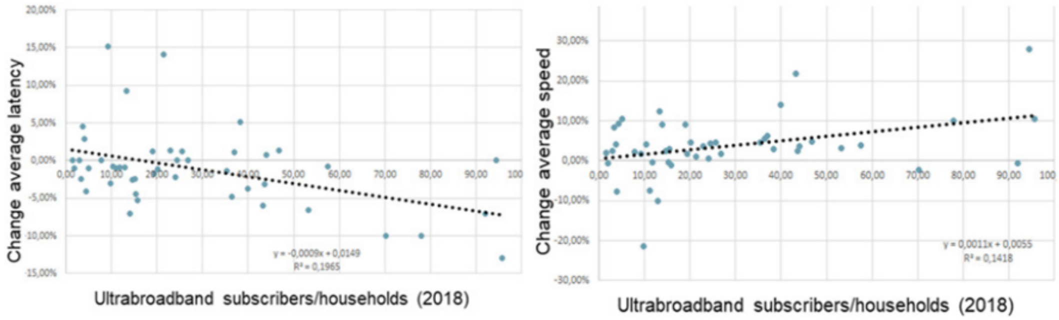
The industry also stepped forward and offered free data and voice minutes, leniency in the pay-back period, complimentary access to paid content, and cooperation in relief efforts and disseminating information on COVID-19 safety measures.

In general, the Internet remained resilient enough to respond to the traffic spikes. However, it is clear that this resilience has not been uniform across the world, simply because countries are at varying levels of digital readiness.

As figure 1 on the next page shows, countries with a higher deployment of ultra-fast broadband infrastructure responded better to the COVID-19-related traffic surge – it would appear that the more fiber there is, the fewer traffic spikes there will be. It is therefore of utmost importance that an open, secure, and globally connected Internet is equally available as a fundamental right, to everyone in the world, to survive through this and future pandemic.

1. Analysys Mason (2020), https://blog.telegeography.com/internet-traffic-and-capacity-in-covid-adjusted-terms
2. Katz, R., Jung, J. and Callorda, F. (2020). Can digitization mitigate COVID-19 damages? Evidence from developing countries. SSRN, https://www.internetsociety.org/blog/2020/07/holding-steady-how-cdns-ixps-and-network-providers-help-keep-us-online

Figure 1: Impact of COVID-19 induced traffic increase on latency and speed (Changes from November 2019 – January 2020 and March 2020)



Source: Katz, R., Jung, J. and Callorda, F. (2020). Can digitization mitigate COVID-19 damages Evidence from developing countries. SSRN

1.1 Scope of the Study

The purpose of this study is to compare network performance in Afghanistan, Nepal, and Sri Lanka, pre and post COVID-19. Section 3 shows that Internet speed in Afghanistan, Nepal, and Sri Lanka declined due to traffic surges during the COVID-19 lockdown period. In this study, we will identify the weak elements of Internet infrastructure in these three countries by analyzing the international and domestic Internet infrastructure. We will explore the factors behind reduced network performance and examine user perspectives on how COVID-19 impacted their online experience. We also suggest how these countries can address infrastructure gaps in the short and long term.

Below is a snapshot of the three countries covered by this study.

Indicator	Afghanistan	Nepal	Sri Lanka
Population (in millions)	38.04	30.4	22.9
Land area (in sq. km)	652,230	147,181	65,610
Literacy rate (in %)	43	67.9	91.9
GDP per capita (in USD)	2,294	3,558	13,620
GNI per capita (in USD, PPP)	540	1,090	4,020
Lockdown period	22 March-24 May	23 March-14 June	20 March-11 May

2 State of Internet Infrastructure

Internet infrastructure is best categorized into two parts: **access network** and **services**. Access network (or simply network) enables devices to be physically linked, while services are applications that enable networks to be used.

2.1 Network

Network, in its simplest form, consists of:

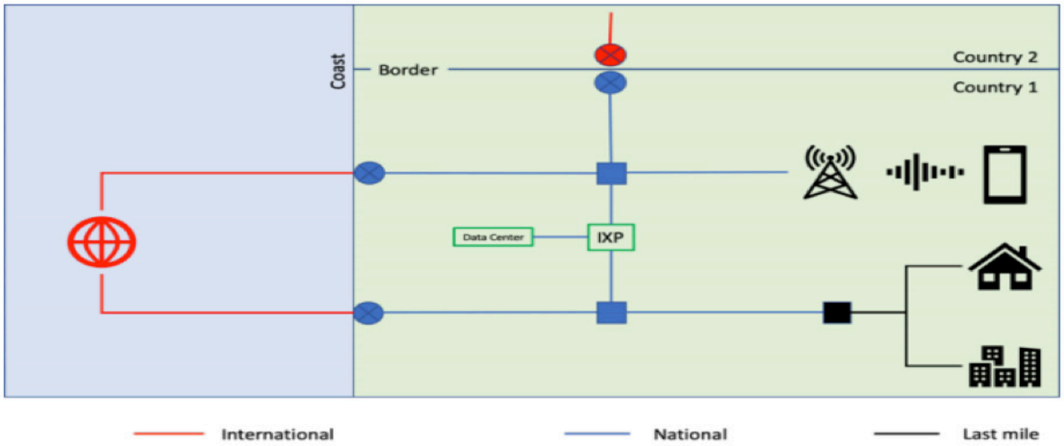
(i) international links connecting a country with rest of the world,

(ii) national backhaul that connects cities and towns within a country, and

(iii) access network that consists of middle-mile (backhaul to internet service provider (ISP)/exchange) and last-mile (fixed/wireless connection to the end user).

This is important to bear in mind when we look at the current state of the international, national and access networks in Afghanistan, Nepal, and Sri Lanka.

Figure 2: Access Infrastructure



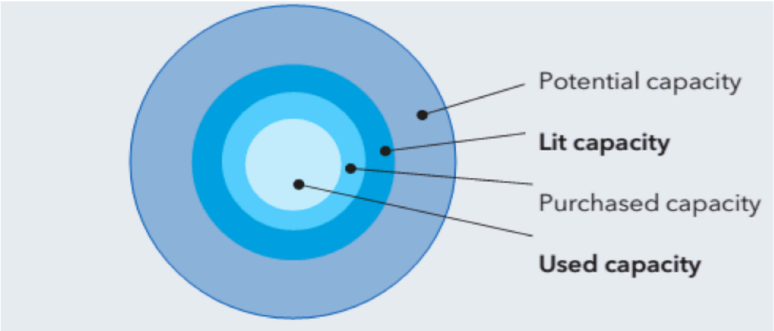
Source: Internet Society

2.1.1 International Connectivity

Much like humans travel by road, by sea or by air, Internet traffic is carried in and out of countries through terrestrial or submarine fiber links or satellite connections. Satellite connectivity is highly expensive, so terrestrial or submarine fiber links are the preferred way to carry Internet traffic across the world. How quickly and how much data are transferred in and out of each country depends on the capacity and throughput of these fiber links.

The amount of international fiber and satellite connections that a country or region has is referred to as International Internet Bandwidth.[3] This bandwidth is further segregated into potential, lit, purchased and used capacity, as you can see in figure 3 below.

Figure 3: Capacity in International Fiber Optic Cable



Source: International Telecommunication Union

In simple terms, potential capacity refers to the total available theoretical bandwidth that includes lit (turned on) and unlit (dark fiber not available for use) capacity. Lit capacity refers to the bandwidth in optical fiber networks that has been turned on and is ready for use.

Purchased (or contracted) capacity covers bandwidth that is put into service but not all of which is used, as some is held in reserve for restoration or back-up. Used capacity covers actual traffic that is carried over the international fiber links.

Afghanistan's international Internet bandwidth capacity has increased by 38% to 161 Gbps over the past year. This landlocked country is connected to its neighbors through terrestrial fiber connections, with dual-fiber links to Pakistan (135 km + 215 km) and Turkmenistan (50 km + 175 km), as well as links to Iran (10 km), Tajikistan (5 km), and Uzbekistan (100 km).[4] Some 27% of its total international bandwidth is connected with Pakistan (44 Gbps), which increased by 50% last year.

The World Bank funded the Digital Central Asia and South Asia (CASA) project that aims to connect Afghanistan, the Kyrgyz Republic and Tajikistan, with the potential for interconnection and/or future expansion to Iran, China, Kazakhstan, and other neighboring countries.[5] In addition, in September 2018, Afghanistan's Ministry of Communications and Information Technology (MCIT) officially launched the Wakhan Corridor Fiber Optic Survey Project, the first phase of a plan to install a cross-border fiber link connecting Afghanistan with China. The program aims to deploy 400 km of fiber cable to connect Fayzabad in Badakhshan province to the Chinese border via the Wakhan corridor.[6]

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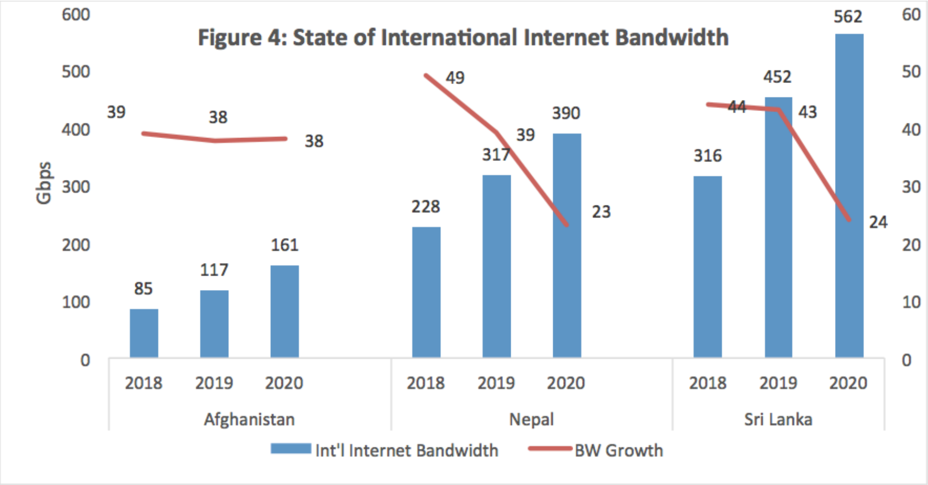
3. Total lit/equipped international bandwidth capacity refers to the total lit capacity of international links, namely fiber-optic cables, international radio links and satellite uplinks to orbital satellites in the end of the reference year (expressed in Mbit/s) (Source: ITU).
4. https://www.terabitconsulting.com/mt-content/uploads/2018/01/20150430-broadband-infrastructure-in-afghanistan-and-mongolia-v3_5a6bd1af76eff.pdf
5. https://mcit.gov.af/DigitalCASA
6. https://tolonews.com/business/afghanistan-china-connect-through-fiber-optic-network

Nepal has an international bandwidth of 390 Gbps, but its growth rate has fallen over the past year. This landlocked country is connected to the rest of the world via terrestrial fiber-optic links with China and India. Some 60% of its international bandwidth comes from multiple links with Indian telecom service providers, mainly Airtel, Bharti, BSNL and Reliance. The total length of such crossings and fiber networking with India is 1,690 KMs.[7]

Nepal is also a member of the South Asia Subregional Economic Cooperation (SASEC) network that connects it with Bangladesh, Bhutan and India through fiber-optic links, with partial funding from the Asian Development Bank. In 2018, China and Nepal also established a cross-border fiber-optic link enabling connectivity to Europe, the Middle East, Northeast Asia and North America. This new link via China is about half the distance and has much less latency (73 milliseconds) in comparison to the existing India connection (which has a 128-millisecond latency).[8]

Sri Lanka is an island, so is completely different to Afghanistan and Nepal in its topography and climate. One of the main advantages of its location is direct access to the submarine fiber-optic cables. Its international bandwidth capacity is 562 Gbps, more than that of the other two countries combined. However, the capacity growth rate dipped from 43% to 24% in 2019. Out of its 562 Gbps, 54% (301 Gbps) is connected with Singapore.

Sri Lanka has multiple submarine fiber-optic links that terminate on three cable landing stations. The Mount Lavinia Cable Landing Station hosts the South-East Asia–Middle East–Western Europe 3 (SEA-ME-WEA3)[9]) and Bharat Lanka Cable System (BLCS); the Colombo Cable Landing Station for FALCON, SEA-ME-WE4, Sri Lanka Telecom (SLT)-Dhiraagu Submarine Cable Network; and SAFE cable systems and Matara Cable Landing Station for SE-ME-WE-5. SLT is a major investor in the SEA-ME-WEA 3, 4 and 6. Bharat-Lanka and Dhiraagu-SLT Submarine Cables are dedicated submarine links with India and Maldives respectively.[10]



Source: Telegeography

7. https://www.unescap.org/sites/default/files/Broadband%20Infrastructure%20in%20South%20and%20West%20Asia%20(draft)_0.pdf
8. http://www.xinhuanet.com/english/2018-01/12/c_136891112.htm
9. SE-ME-WE stands for South East Asia-Middle East-Western Europe.
10. https://www.submarinenetworks.com/stations/asia/sri-lanka

2.1.2 Domestic Backhaul and Last-Mile Infrastructure

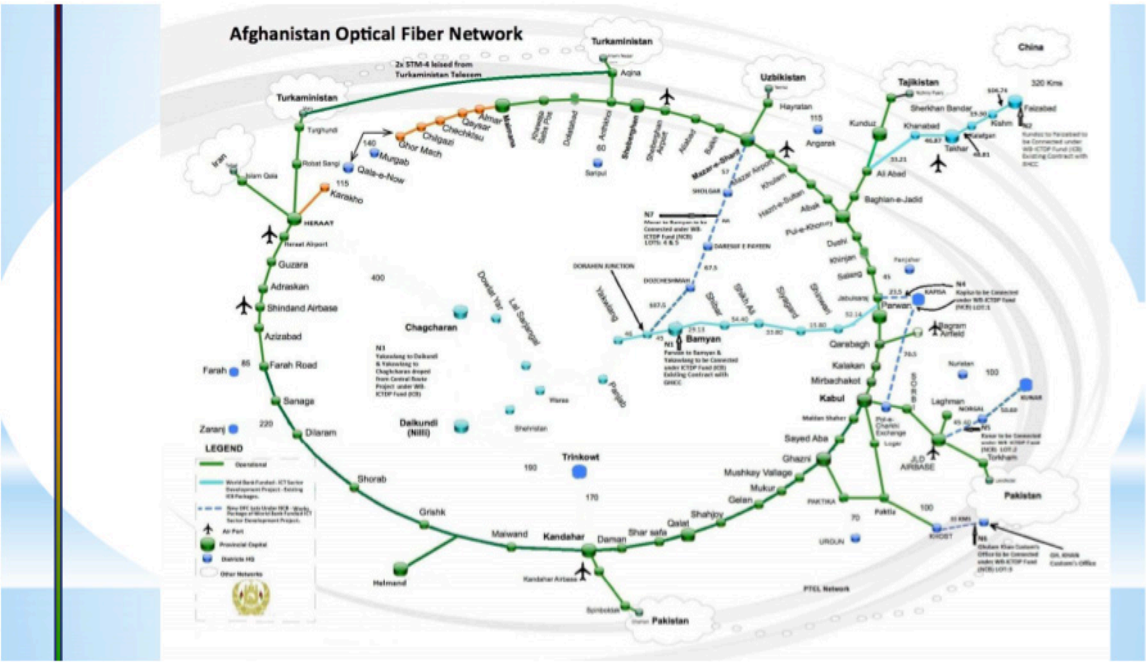
National backhaul infrastructure receives Internet traffic at the national borders from the international fiber landing stations and distributes it to service providers operating in the country. The service providers then distribute the traffic in the country through fiber-optic or microwave links (leased or owned) called 'middle mile'. As a final step, service providers deploy last-mile connectivity that terminates traffic at the end user premises over fixed or wireless media.

Since the international Internet bandwidth links are usually only operating at 50% of their capacity, domestic infrastructure is the most important component of the Internet infrastructure. It is therefore vital to review the state of this domestic infrastructure within each country to better understand the Internet value chain.

Afghanistan has five Mobile Network Operators (MNOs), one landline operator, five Optical Fiber Cable (OFC) operators and 61 Internet Service Providers (ISPs). Mobile broadband covers 59% of the population, but the Internet penetration is only 20% (7.6 million). The major fiber-optic network is known as 'Ring road', which connects 25 provinces with 6,936 km of fiber, operated by the state-owned Afghan Telecom Ltd (AFTL).[11] Several private operators have also been issued an OFC license under the Open Access Policy of the Afghan government, which is expected to lead to a US $383m investment in national fiber infrastructure.[12]

Also, there are multiple access technologies to connect the service provider with end users, such as Fiber, third and fourth generation wireless mobile telecommunications technologies (3G and 4G), Worldwide Interoperability for Microwave Access (WiMAX), and Digital Subscriber Line (DSL).

Figure 5: Afghanistan Fiber Optic Network



11. Afghanistan Telecom Regulatory Authority (ATRA), 2019.
12. https://thefrontierpost.com/government-approves-383m-project

Nepal has two MNOs, two basic telephone operators and 40 operational ISPs. The internet is predominantly accessed over wireless networks due to poor fixed-line infrastructure, but the bulk of these fixed broadband subscriptions are fiberized (75% mobile broadband, 25% fixed broadband). Mobile broadband is available to over 60% of the population, with an Internet user penetration of 73% (22 million).

Nepal's domestic backhaul network consists of a 1,000 km east-west highway route, a 115 km north-south route, and the SASEC network that includes 175 km of fiber and community e-centers. Moreover, a Nepal Information Superhighway, which aims to provide fiber connectivity to seven provinces of Nepal using the Rural Telecom Development Fund (RTDF), has been planned and commissioned by the Nepal Telecommunication Authority (NTA.[13] Public-private investment is expected to drive the roll-out of fiber-optic deployment to reach 10% of the population by the end of 2024.[14]

Sri Lanka has four MNOs, three fixed-line operators and three ISPs as main providers of Internet in the country. Mobile broadband is available to more than 90% of the population, but the penetration is only 52%, with little fixed broadband adoption. The broadband market is driven by the strong presence of 4G networks and seems ready for transition to 5G. Almost 50% (10 million) of the population uses the Internet, primarily over mobiles. Because of this dominance of mobile services and generally poor infrastructure, fixed-line infrastructure is still underdeveloped. However, the National Backbone Network (NBN), Sri Lanka's national fiber backhaul, was launched in 2014 to deploy 45,000 km of fiber to cover the country's 24 districts with high-speed broadband connectivity within five years.[15]

2.1.3 Internet Exchange Points (IXPs)

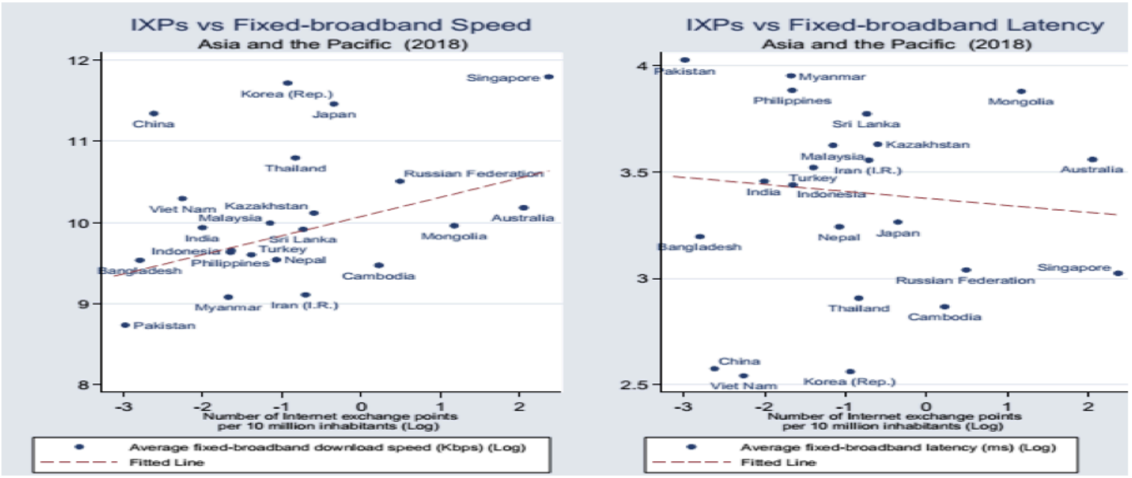
Networks and ISPs connect through either of the two modes: transit or peering. An ISP will peer with another ISP if both have similar traffic patterns, meaning no cost of traffic exchange will be charged to each other. In the case of transit, the smaller ISP pays the larger ISP to upstream its traffic on the Internet. Transit is therefore costly while peering is (almost) free.

The prime example of where peering takes place is at an **Internet Exchange Point** (IXP). IXPs enable the exchange of traffic by connecting multiple networks via a switch at a neutral location. Typically, IXPs are established between ISPs, but traffic can also be terminated (i.e., brought to a particular network point) by any entity that generates considerable traffic, such as content providers and education networks.

IXPs keep the national traffic within the country and ease pressure on the international bandwidth channels, thereby avoiding transit costs and sustaining service continuity in case of disruption on the international links. However, the most important benefit in the context of this study is the fact that, because of the shorter routing paths, IXPs reduce network latency and improve broadband speed.

13. https://www.nepalitelecom.com/2019/05/what-is-information-highway-why-nepal-need.html
14. https://www.budde.com.au/Research/Nepal-Telecoms-Mobile-and-Broadband-Statistics-and-Analyses
15. https://www.news.lk/news/item/4250-slt-launches-100g-ultra-speed-national-backbone-network

Figure 6: IXPs vs Fixed-broadband Speed and Latency



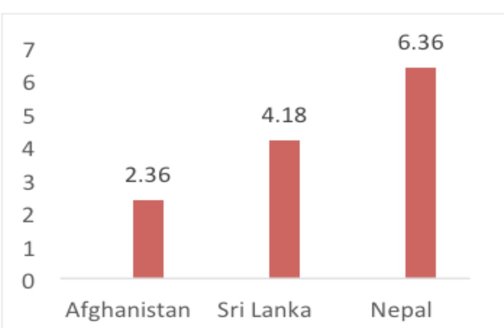
Source: UNESCAP (2019)

A recent study by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) states that for every 1% increase in the number of IXPs per 10 million inhabitants, the fixed-broadband download speed (Kbps)is expected to increase by 0.14%.[16] This fact is further corroborated by evidence that countries with a higher number of IXPs per population tend to have higher fixed broadband speed and lower network latency (see figure 6 one the next page).

Recently, the Asia-Pacific Internet Exchange Association (APIX) and the Internet Society did a comprehensive survey to understand the impact of COVID-19 on IXP operations in the region.[17] The results showed there was a significant increase of 7-40% in Internet exchange traffic. While no downtime was reported, technical support and maintenance/upgrades were adversely affected.

To establish an IXP, it is essential to have strong community leaders, since participants are usually competitors and differ in market size and traffic volume. This is why governments may also assist in bringing the ISPs and other organizations to the table. IXPs in Afghanistan, Nepal, and Sri Lanka are far less than ideal, as you can see in figure 7 below.

Figure 7: IXPs per 10 million people

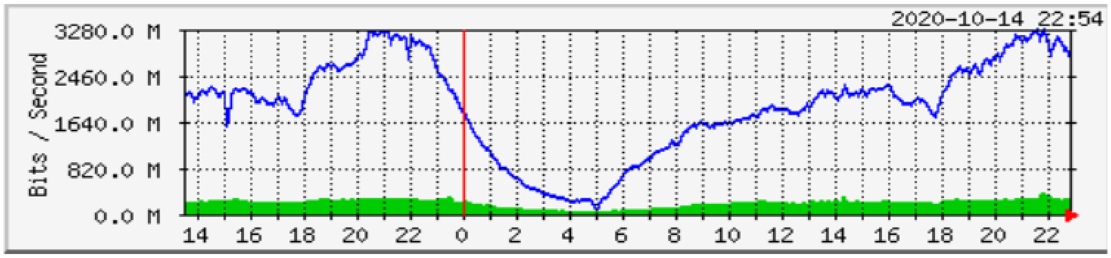


Source: GSMA

16. https://www.unescap.org/resources/estimating-effects-internet-exchange-points-fixed-broadband-speed-and-latency
17. https://www.internetsociety.org/blog/2020/07/ixps-keeping-local-infrastructure-resilient-during-covid-19

The National Internet Exchange of Afghanistan (NIXA) is hosted in the country's national data center. It became operational in 2018 and now connects 20 ISPs handling a traffic load of 1.7 Gbps.[18] However, NIXA's infrastructure can provide 1, 10 and 100 Gbps interfaces. The Ministry of Telecom and IT played a pivotal role in establishing the IXP and also provided a location for it to be deployed. Overall, there are 66 autonomous system numbers (ASNs) issued to various networks and organizations in the country.

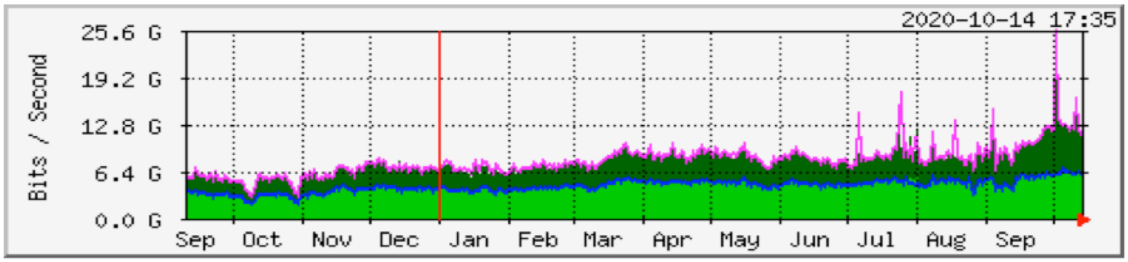
Figure 8: National IXP of Afghanistan Traffic



Source: NIXA

The Nepal Internet Exchange (NPIX) is one of the pioneers in the region, with 188 ASNs assigned to networks. As shown in figure 9 below, it had an average traffic load of 4.4 Gbps in the last 12 months, connecting 66 networks at two different locations in the country. According to NPIX, peak traffic growth increased by 19% from earlier in 2020 to 8.1 Gbps, almost double the average traffic load, during the COVID-19 lockdown. In spite of this, NPIX didn't experience any issues with bandwidth, capacity or outage.

Figure 9: Nepal IXP Traffic



Source: NPIX

Sri Lanka has a private IXP that is hosted and operated by Lanka Com (Pvt.) Ltd and connects at least six local ISPs[19]. The traffic load on the IXP is not available publicly, but the country has 26 ASNs.

18. https://nixa.af
19. https://www.slideshare.net/apnic/sltix-setting-up-an-internet-exchange-sri-lankan-experience

2.2 Services

Services are the 'soft' part of the Internet infrastructure, encompassing digital content, applications, protocols, standards and hosting solutions. While the network enables physical connection between geographies, services enable users and organizations to create, process, store, and provide access to data via content delivery networks (CDNs), data centers, and cloud servers.

2.2.1 Local Content

Digital content and services such as audio, video, text, and images are transmitted on the Internet over broadband networks. While it's almost impossible to accurately calculate the size of content created on the Internet, International Data Corporation (IDC) predicts that by 2025 there will be 463 billion GBs of data created per day. Another IDC study for Dell EMC estimates that the amount of digital information could rise up to 40 zetabytes (ZB) by the end of 2020 – a 50-fold increase from 2010.

The availability of local content and services can be analyzed through various dimensions, including:

- Number of top-level domains (TLDs),
- Availability of online government (e-Gov) services,
- Mobile social media penetration,
- Number of apps developed in the country,
- Number of apps in national language(s),
- Percentage of the population that can access and make use of the top 400 apps, and
- Country score in the International Telecommunication Union (ITU) Global Cybersecurity Index (GSI).

Table 2: Content & Services (Source: GSMA Mobile Connectivity Index 2020)

Country	TLDs per capita	e-Gov score	Mobile social media	Apps developed per person	Apps in national language	Accessibility of top 400 apps	GSI score
Afghanistan	39.41	41.18	9.39	39.36	3	5.72	17.70
Nepal	41.76	40	34.61	66.91	26	26	26
Sri Lanka	41.30	71.76	28.95	68.52	47.50	21.24	46.60

Table 2 above shows that Afghanistan requires improvement in most of the areas, but that it has performed relatively well in the TLDs per capita and e-Gov score. Of the three countries, Nepal has the highest number of TLDs per capita and percentage of population using social media, while Sri Lanka is ahead in promoting local language apps and providing a secure online experience to its Internet community.

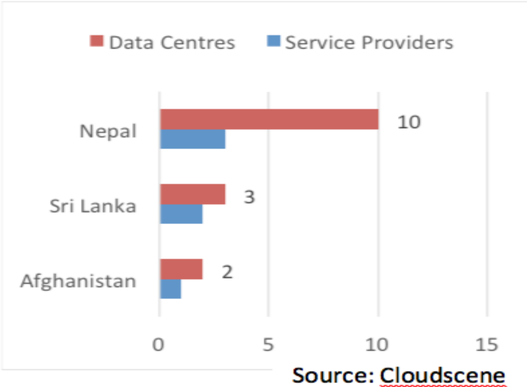
2.2.2 Data Centers

The quality of content is also related to the efficiency of the content delivery channels. For example, to access Facebook, you need to get connected to the servers located in the US. However, if you are in Australia, the data from US servers needs to travel a long distance through the fiber network to reach you, meaning it will take longer to access Facebook, thus affecting the end user experience. However, if Facebook had its proxy servers installed in Australia, or closer to it, there would be less of a distance for data to travel and therefore a better user experience.

Data centers and CDNs provide the solution to this problem. They are the actual physical locations where proxy servers are stacked together, in varying topologies and sizes, to collect, store, process, distribute, and provide access to data. Carrier neutral data centers provide redundancy and flexibility to choose multiple carriers all in the same physical space.

There are reportedly more than three million data centers of various shapes and sizes in the world today.[20] Governments prefer to establish their own data centers to protect critical national data/services, while big techs like Amazon, Facebook, Google, and Microsoft have a multitude of data centers spread across the world to improve data access and storage. Developing countries typically have fewer data centers, simply due to the low percentage of Internet content that's generated locally. However, the overall data center market in the Asia-Pacific region is expected to grow each year by almost 3% over 2019-2025.[21]

Figure 10: Hosting Infrastructure



Source: Cloudscene

Afghanistan has just one national data center, hosted by the Ministry of IT, which provides services to government institutions and applications. Nepal has 10 data centers and colocation facilities, including the Government Integrated Data Center (GIDC) which hosts government services content. It has also been reported that Nepalese mobile service provider, NCell is building Asia's largest data center in Lalitpur, which will also offer colocation services. Sri Lanka has three data centers, owned by Sri Lanka Telecom Ltd. (in Pitipana), Tata Ltd. (in Colombo) and Dialog Axiata (in Malabe).[22] Google Cache servers have three peering points in Nepal and one each in Afghanistan and Sri Lanka in order to provide fast access to its search engine and YouTube.[23]

20. https://www.nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-industry-image.html?pagewanted=all&_r=1&
21. https://www.globenewswire.com/news-release/2020/02/14/1985350/0/en/The-APAC-data-center-market-is-expected-to-grow-at-a-CAGR-of-over-3-during-the-period-2019-2025.html
22. https://datacentercatalog.com
23. https://peering.google.com/#/infrastructure

3 Internet Infrastructure Performance

Stable and affordable Internet connectivity is playing a critical role in life during the current global situation. However, the quality of Internet connections varies from country to country. Several factors reflect how strong and resilient Internet infrastructure is, including the level of fiberization, international bandwidth capacity, the state of backhaul and last-mile infrastructure, and government support. According to the Ookla Speedtest Global Index, the average download speeds for fixed broadband fell for most countries in Asia-Pacific during March and April, when the pandemic was at its peak in most parts of the region.[24]

In this study, we have reviewed Internet performance in Afghanistan, Nepal, and Sri Lanka by analyzing the technical, i.e., quality of service (QoS), and non-technical, i.e., quality of experience (QoE), factors through an end user survey before and during the COVID-19 lockdown period. We adopted this two-pronged approach to correlate the end user experience against the technical data, in order to assess the quality of Internet services in each of the three countries.

3.1 User Experience Survey

We conducted an online survey through the Internet Society chapters and members in Afghanistan, Nepal, and Sri Lanka to collect primary data about online user experience before and during the COVID-19 pandemic.[25] A total of 202 respondents (80% male and 20% female) from the three countries took the survey, which gave us insightful information about the Internet and its impact on end users' socio-economic activities.

These are the major survey findings:

- More than 98% of the respondents said they used the Internet every day.
- Social media remained the top user activity before (89%) and during (84%) the pandemic.
- The highest net change in online activities was in information search (34%), while the second-highest increase (31%) was in online education. This emphasizes the positive use of the Internet during the COVID-19 period.
- Smartphones (94%) and portable devices like laptops (84%) are the respondents' primary devices to access the Internet.
- 41% of the respondents subscribed to a new Internet connection after COVID-19 lockdowns were implemented. However, their primary Internet connection for home before and during COVID-19 remained fixed broadband.
- Respondents' satisfaction level with their Internet speed declined from 69% to 49% during the COVID-19 lockdown period.
- Reliability and steadiness of Internet connections went down from 66% to 42% during the COVID-19 lockdown period.
- Customer dissatisfaction with service providers increased from 14% to 34% during the lockdown period.

24. https://www.spglobal.com/marketintelligence/en/news-insights/blog/asia-pacific-markets-improve-broadband-speeds-despite-covid-19-impact
25. For in-depth analysis, see https://www.internetsociety.org/blog/2020/12/new-report-explores-covid-19s-impact-on-the-internet-in-afghanistan-nepal-and-sri-lanka

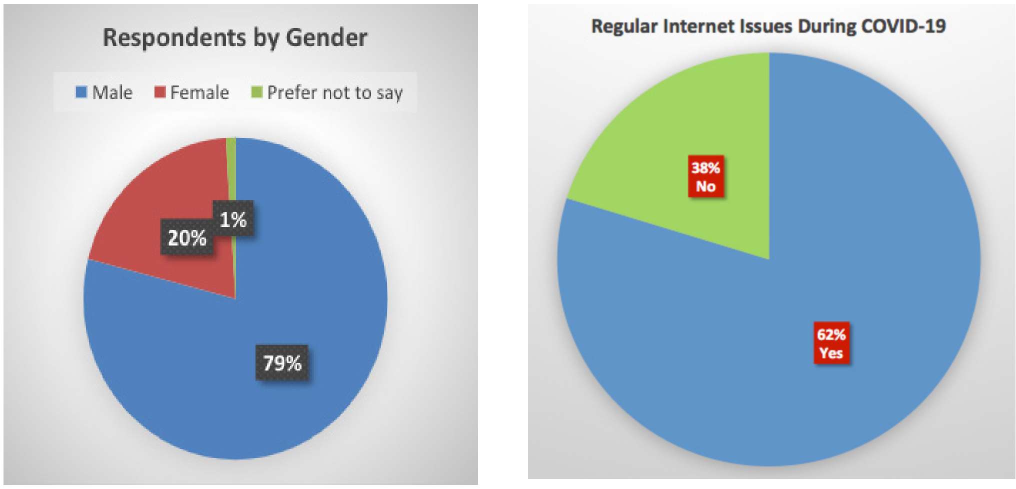
- Value for money, i.e., respondents' satisfaction level with their Internet connection's price vs performance decreased slightly from 44% to 38% during lockdown.
- 62% (126) of the respondents said they faced regular performance issues with their Internet connection. Out of these, 50% reported frequent disconnection, 22% faced voice quality issues and 32% experienced deteriorating video quality, while 37% were subject to all three issues stated above.

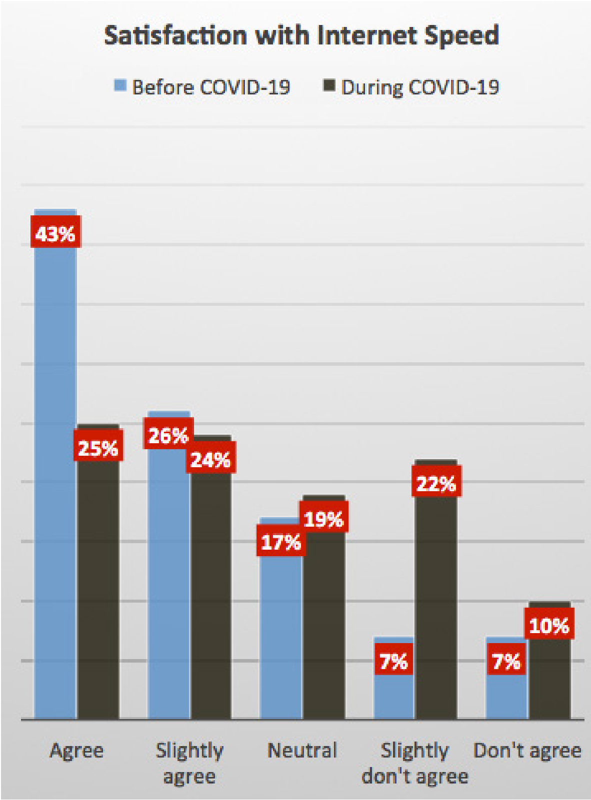
When asked about the problems faced as a result of regular Internet performance issues:

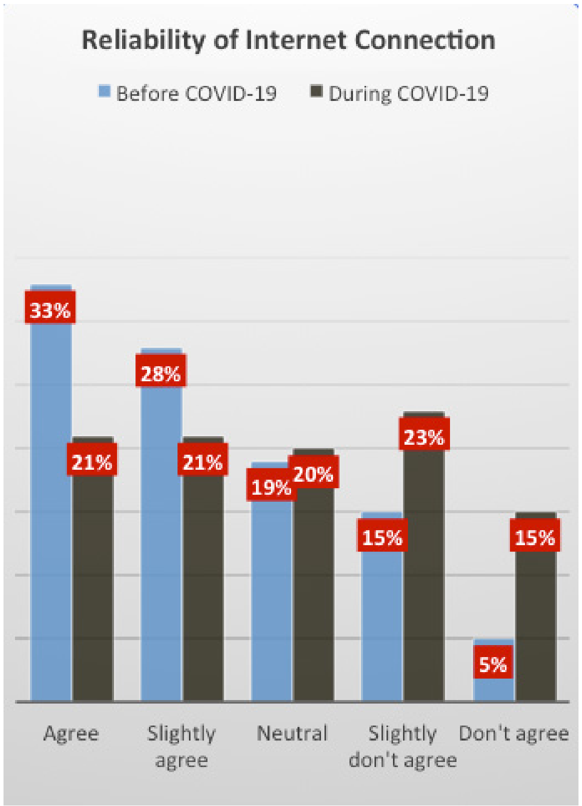
- 50% stated that it became difficult to work from home,
- 49% had problems with taking online classes/remote education,
- 38% could not communicate properly with relatives and friends,
- 32% had access issues with entertainment portals and digital platforms,
- 18% were not able to regularly search for information about the pandemic,
- 17% had difficulty in accessing banking or financial services, and
- 29% reported all of the listed issues during the COVID-19 lockdown period.

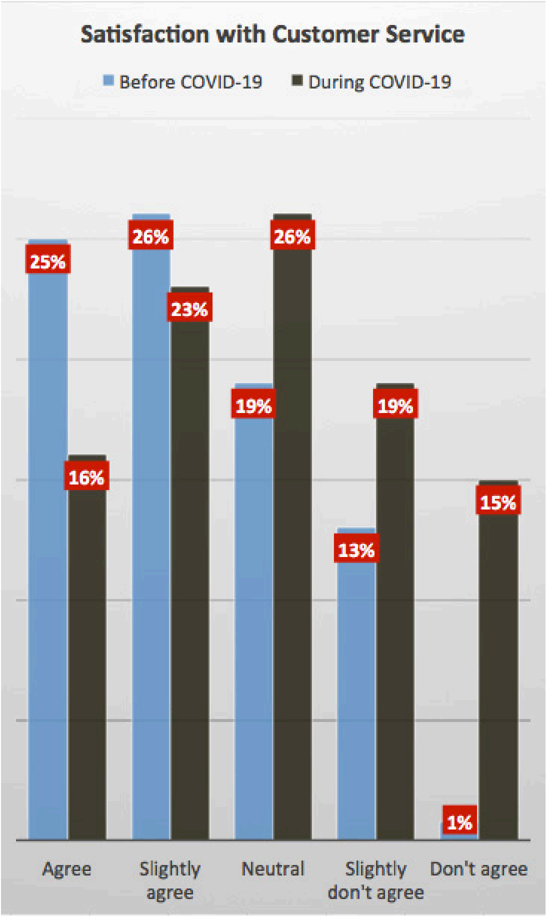
It is evident from the survey results that Internet user experience was adversely affected during the COVID-19 lockdown, significantly impacting citizens' abilities to adjust to the 'new normal'.

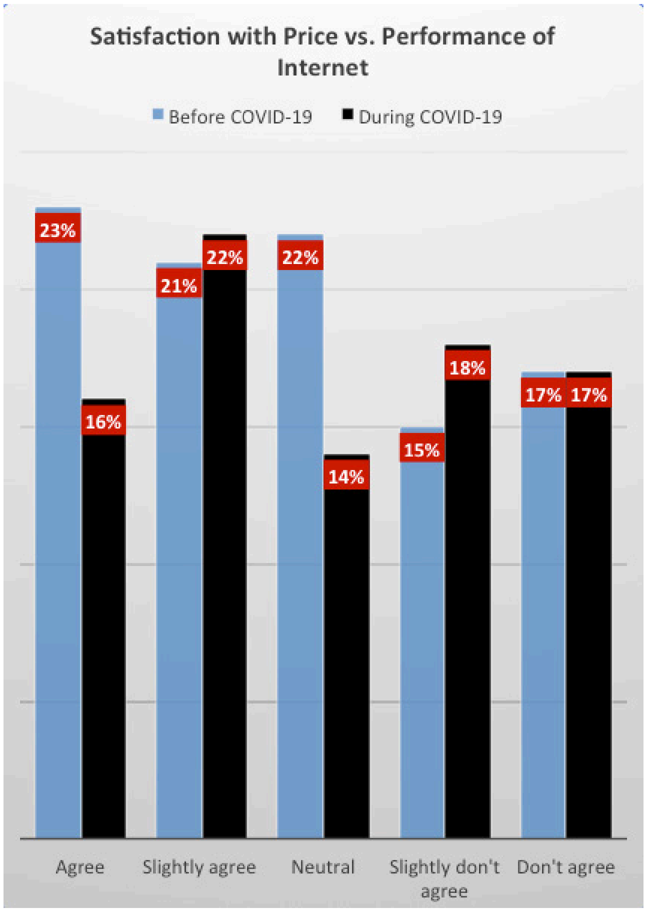
Figure 11: Cumulative Survey Results

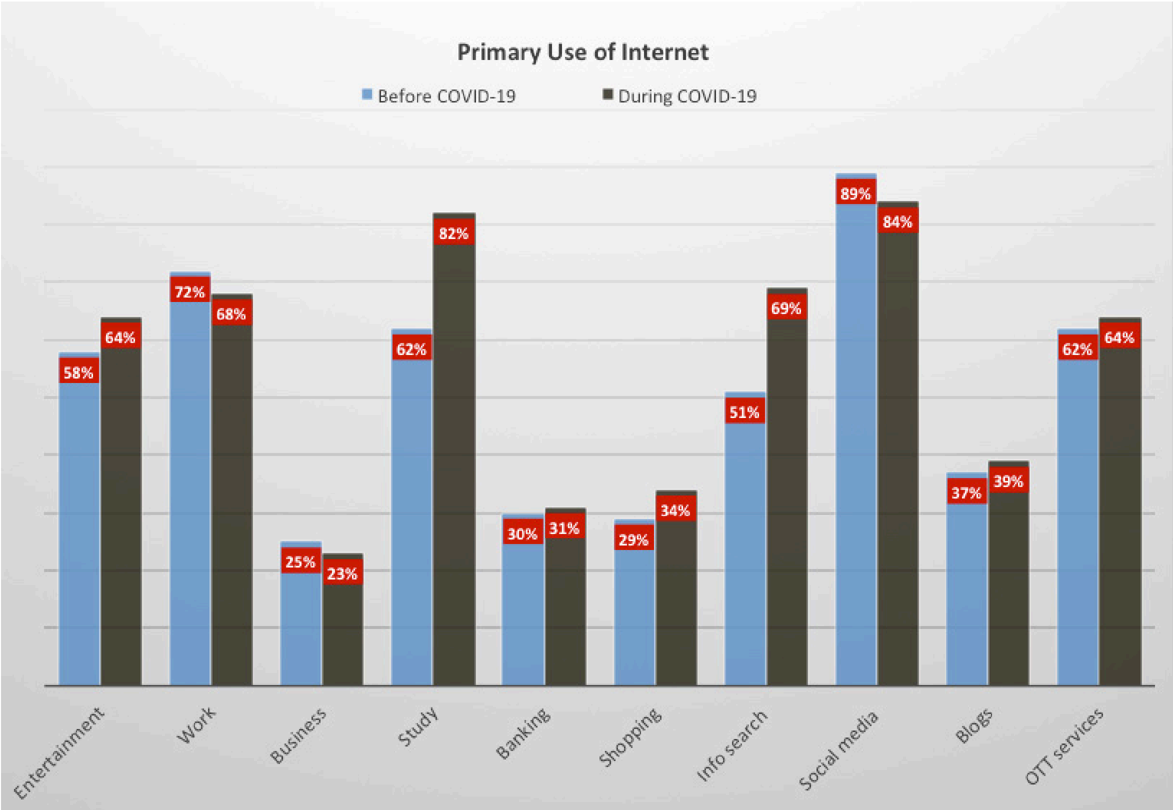


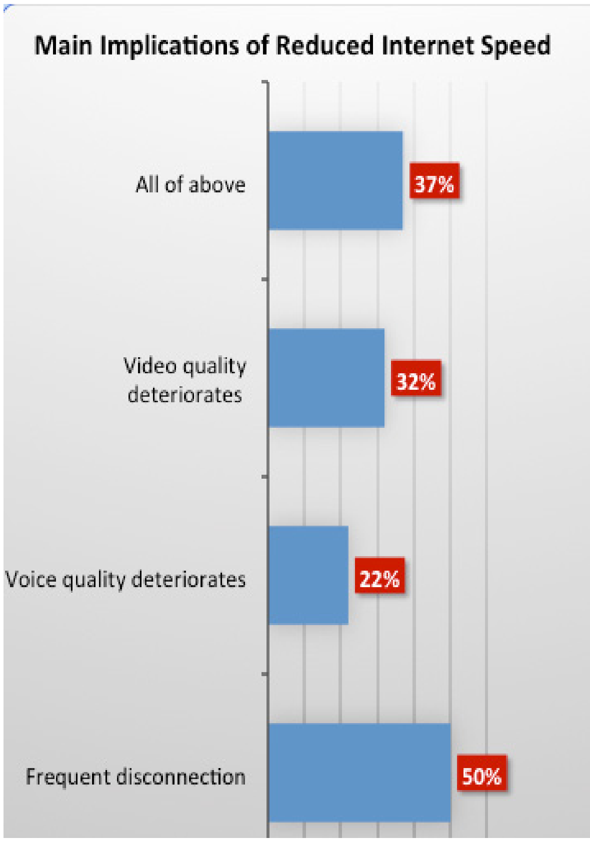

Satisfaction with Internet Speed
Before COVID-19
During COVID-19
43%
25%
26%
24%
17%
19%
7%
22%
7%
10%
Agree
Slightly agree
Neutral
Slightly don't agree
Don't agree

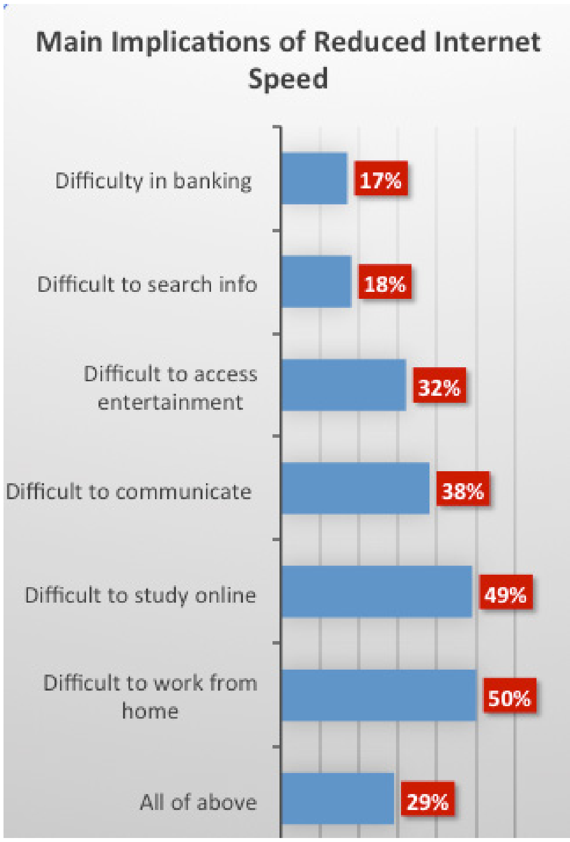

Reliability of Internet Connection
Before COVID-19
During COVID-19
33%
21%
28%
21%
19%
20%
15%
23%
5%
15%
Agree
Slightly agree
Neutral
Slightly don't agree
Don't agree


Satisfaction with Customer Service
Before COVID-19
During COVID-19
25%
16%
26%
23%
19%
26%
13%
19%
1%
15%
Agree
Slightly agree
Neutral
Slightly don't agree
Don't agree


Satisfaction with Price vs. Performance of Internet
Before COVID-19
During COVID-19
23%
16%
21%
22%
22%
14%
15%
18%
17%
17%
Agree
Slightly agree
Neutral
Slightly don't agree
Don't agree

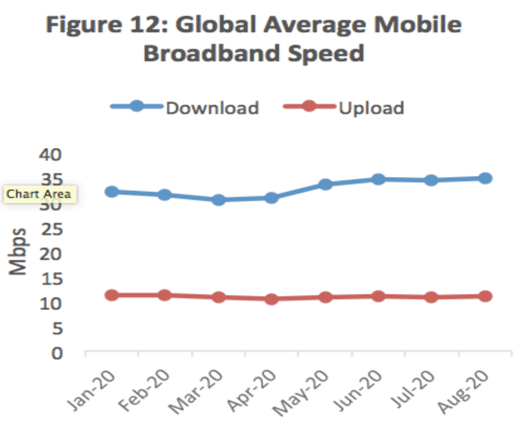

Primary Use of Internet
Before COVID-19
During COVID-19
58%
64%
72%
68%
25%
23%
62%
82%
30%
31%
29%
34%
51%
69%
89%
84%
37%
39%
62%
64%
Entertainment
Work
Business
Study
Banking
Shopping
Info search
Social media
Blogs
OTT services

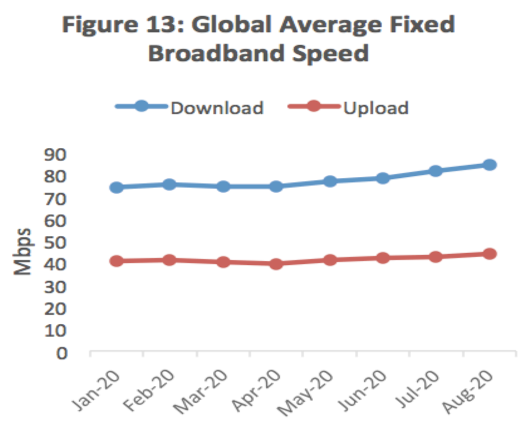

Main Implications of Reduced Internet Speed
All of above
37%
Video quality deteriorates
32%
Voice quality deteriorates
22%
Frequent disconnection
50%


Main Implications of Reduced Internet Speed
Difficulty in banking
17%
Difficult to search info
18%
Difficult to access entertainment
32%
Difficult to communicate
38%
Difficult to study online
49%
Difficult to work from home
50%
All of above
29%

3.1 Internet Speed Test

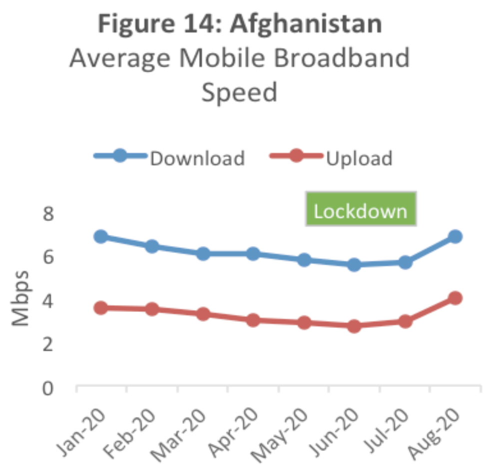
According to the Speed Test Global Index (from Ookla Insights), COVID-19 had a slight impact on the global average Internet speed. This speed has now stabilized – in fact, global average Internet speed for both fixed and mobile increased in 2020, as compared to 2019, as you can see in figures 12 and 13 below.

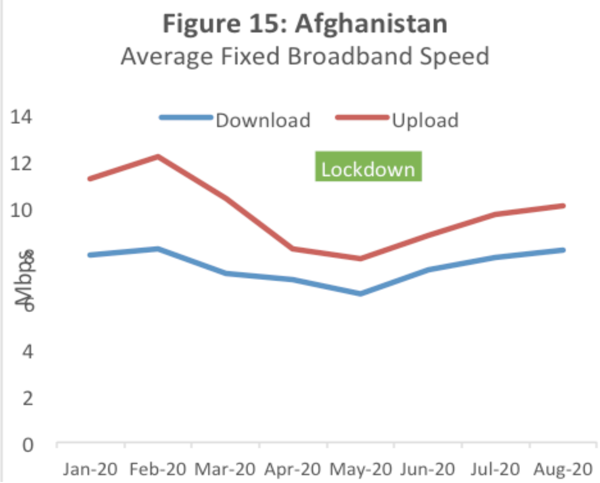




Looking at the impact of COVID-19 on the Internet speeds in **Afghanistan** (see figures 14 and 15 below), we can see a clear decline in the average Internet speed during the COVID-19 lockdown, which started in mid-March 2020.

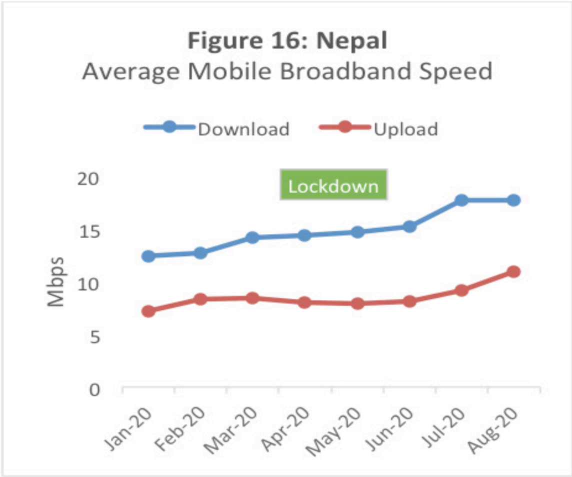
The speed drop is more evident in the fixed broadband sector, as compared to mobile broadband. This is possibly because mobile operators usually have better optimization and load-balancing tools to manage network congestions compared to fixed-line operators.

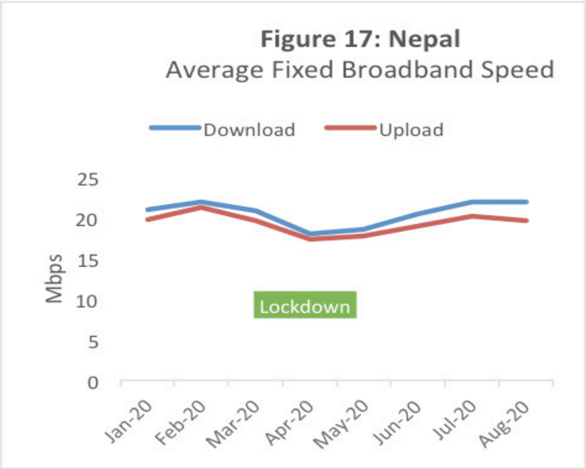




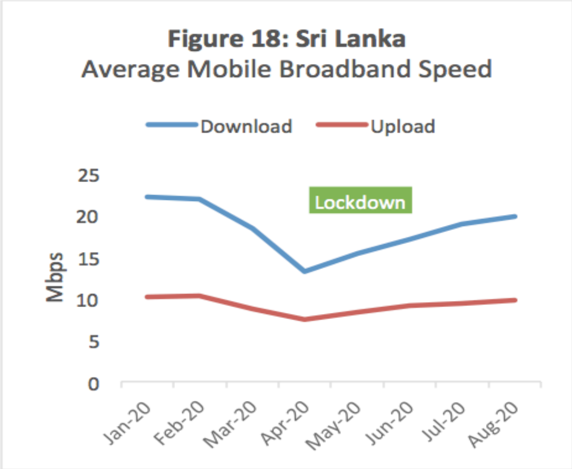
Internet speed in **Nepal** during the COVID-19 lockdown that started from the last week of March 2020 shows a disparate picture (see figures 16 and 17 below). Average mobile broadband speed remained stable in the weeks immediately after lockdown.

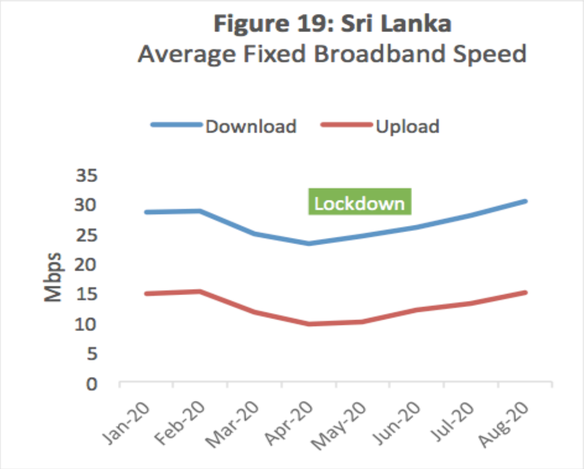
On the other hand, fixed broadband speed dropped considerably in April 2020 and started to stabilize thereafter. By the end of July 2020, both fixed and mobile broadband speeds stabilized, following measures taken by the industry. By August, in fact, the mobile broadband speed was considerably higher than the pre-COVID level, and fixed broadband also touched the pre-COVID mark.





Sri Lanka went into lockdown in the third week of March 2020 and restrictions were lifted as the spread of the virus was successfully controlled over the next two months. However, as you can see in figures 18 and 19 below, Internet speed dropped substantially during the lockdown period in both the fixed and mobile broadband sector. It is encouraging to see that the broadband speeds started to normalize in the following few months, though.





Analysis of the QoS and QoE of Internet performance in Afghanistan, Nepal, and Sri Lanka shows it is evident that both broadband speed and reliability were affected during the COVID-19 lockdown period. We also note that it took months for Internet speeds to stabilize back to re-COVID level. This points towards major flaws in the digital infrastructure of these countries that we will review in the next section.

For the end user, reduced Internet speed posed serious questions on the meaningful use and value proposition of having an Internet connection.

One of the survey respondents summarized his online experience in Nepal: *'I got logged out of online conference due to poor Internet and [had to] log in multiple times, for which the organizer has to admit me several times. It was embarrassing when he pointed it out later.'*

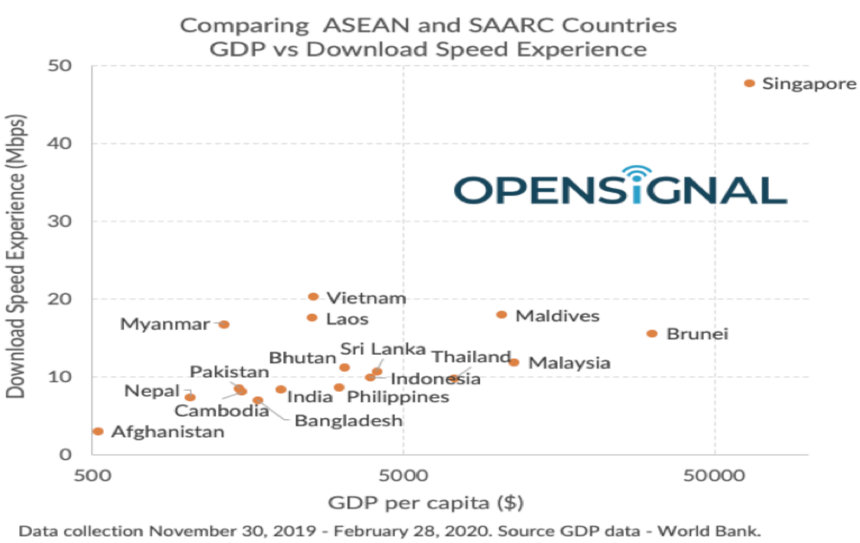
Another respondent from Afghanistan wrote: *'During COVID-19 I lost my job and tried to work from home on the internet [but] the cost was not affordable. So, my ISP disconnected my connection several times for pending payments.'*

4. Review of Network

As the previous section shows, Internet infrastructure in Afghanistan, Nepal, and Sri Lanka all experienced a drop in network quality during the COVID-19 pandemic. There are network 'pain points' in the existing infrastructure of these countries that make a huge difference in the overall Internet experience.

In this section, we will focus on the infrastructure gaps, key demand, and supply-side drivers that contributed to the traffic surge in the three countries. It is important to note that Internet speed is generally higher in countries that have a better economic status. As you can see in figure 20, countries with higher GDP per capita, like Singapore, have a far better average download speed compared to Afghanistan, Nepal, and Sri Lanka. The reason is simple: operators invest a lot more into the broadband infrastructure and backhaul connectivity of developed countries, since there is higher return on investment.

Figure 20: Economic Stability vs Broadband Speed



Source: OpenSignal

4.1 Weak Infrastructure

Afghanistan is surrounded by five countries without any dedicated link to the submarine fiber-optic cables. It relies on the Digital Central Asia and South Asia (CASA) project to fundamentally upgrade its fiber-optic deployment status within five years.

However, it is also important to maintain the quality of the existing infrastructure that dwindles for several reasons, including the extensive deployment of jammers, damage to fiber-optic cables and cell sites by militants, limited fiber backbone infrastructure, and restrictions on distributing additional spectrum resources. For example, the Afghanistan Telecom Regulatory Authority (ATRA) revealed that 30% of its telecom services were shut down due to the destruction of 220 cell towers by insurgents in 2019. More recently, ATRA imposed fines of US $15.7 million on the five major telecommunications services (telcos) for not meeting QoS standards.[26]

According to Global System for Mobile Communications' (GSMA's) Mobile Connectivity Index 2020, Afghanistan's Network Performance score stands at 20.81, less than half of the South Asian average of 42.76. The usage gap between mobile broadband coverage (59%) and Internet adoption (20%) is also quite high.

Nepal is another landlocked country that depends on its neighbors for international connectivity, since it has no direct access to the submarine fiber-optic cables. More than 80% of its population lives in rural mountainous areas that make up 83% of the total land area.[27] So, it is a difficult and expensive terrain to cover with fiber cables.

While the Nepalese government has shown a commitment to strengthen the digital infrastructure, and multiple cross-border and domestic fiber-optic projects are underway, reliable connectivity is still a big area of concern. Mobile broadband infrastructure and its performance have been at par with its regional peers, but the fixed broadband sector requires significant upgrades. In addition, mobile broadband coverage of 60% is well below the South Asian average of 82%. This leaves behind a significant chunk of the population without the opportunity to use the Internet.

Neither Afghanistan nor Nepal has direct access to international submarine fiber-optic cables that exchange Internet traffic across the world. Instead, they must connect through intermediary countries. During the COVID-19 pandemic, when global demand for bandwidth substantially increased and the capacity of these fiber-optic links came under great pressure, countries with no direct access links such as these two were the most severely affected.

Sri Lanka, being an island country, does have direct access to the submarine fiber-optic cables, but Internet performance still saw a significant drop during the COVID-19 lockdown. One of the major reasons for this deterioration is Sri Lanka's weak backhaul and last-mile infrastructure.

26. https://tolonews.com/afghanistan/220-telecom-towers-destroyed-eight-months-atra and https://www.developingtelecoms.com/telecom-business/telecom-regulation/9324-afghan-regulator-hands-out-qos-penalties.html
27. World Bank

Approximately 30% of Sir Lanka's telecom towers are connected with fiber, but the country has the lowest fiber-to-the-building take-up in Asia (<1%).[28] In addition, its network capacity has not grown in proportion to the high growth in cellular subscriptions – the number of International Internet bandwidth (bits/s per user) dropped by 24% during 2015-2019.[29]

The weak infrastructure in Afghanistan, Nepal, and Sri Lanka is further exacerbated by inadequate content and service availability. The low number of IXPs, data centers, and cloud service providers mean that a large chunk of traffic is routed through the last and middle-mile to the international fiber links. This increases the pressure on the whole infrastructure and makes it expensive for service providers to transit through this path. IXPs, coupled with CDNs and data centers, provide the natural solution to this problem by reducing transit requirements through local peering.

4.2 Demand-Side Drivers

The unprecedented increase in data traffic caused by the COVID-19 related lockdown put great pressure on local broadband infrastructure.

In 2020, peak international Internet traffic increased by 47%.[30] In response, global Internet bandwidth increased by 35% and now stands at 618 Tbps. Meanwhile, Internet traffic in Asia jumped by 52%, while bandwidth increased by 41%.

Peak global Internet traffic increased by 15% during the COVID-19 pandemic, whereas bandwidth increased by just 8%. The difference is even bigger in the Asian region in general, where bandwidth increase (4%) was just one-third of the traffic surge (12%). One of the major factors behind the demand surge is video calling for online education and virtual meetings. For products like Zoom, this led to an increase in daily usage of 300% during the COVID-19 lockdowns. The Internet user survey results in Section 3.1 show that online social networking, remote education, and information search for health/government services were the top online activities in Afghanistan, Nepal, and Sri Lanka during COVID-19.

Figure 21

Impact of COVID-19 on International Internet Bandwidth and Peak Traffic Growth, 2019-2020

	Bandwidth			Peak Traffic		
	Forecasted	Observed	Implied COVID-19 Acceleration Effect	Forecasted	Observed	Implied COVID-19 Acceleration Effect
Africa	42%	42%	0%	36%	51%	10%
Asia	36%	41%	4%	36%	52%	12%
Europe	23%	34%	9%	25%	44%	15%
Latin America	26%	32%	5%	30%	51%	16%
Middle East	34%	39%	4%	32%	42%	8%
Oceania	24%	35%	9%	26%	47%	16%
U.S. & Canada	23%	29%	5%	26%	44%	14%
Global	26%	35%	8%	28%	47%	15%

Notes: Data reflects the bandwidth and peak traffic connected across international borders. Data as of mid-year. Forecasted values from TeleGeography's Global Bandwidth Forecast Service Q2 2020.

Source: TeleGeography © 2020 PriMetrica, Inc.

28. FTTH Council APAC Market Panorama 2019
29. ITU WTID 2020
30. https://blog.telegeography.com/internet-traffic-and-capacity-in-covid-adjusted-terms

Nepal Telecommunications Authority (NTA) estimates that Internet usage increased by 30-40%, which slowed down the speed of the Internet in Nepal. It issued a public notice urging the citizens to use the Internet responsibly during the lockdown period to avoid congestion and service disruption.[31] Sri Lanka Telecom reported a 25% increase in traffic and added 50 Gbps of additional network capacity to diffuse the network load.[32]

4.3 Supply-Side Drivers

Ministries, regulators, service providers, vendors, and tech giants from around the global Information and Communications Technology (ICT) fraternity launched community initiatives and technical measures to keep the world connected. Operators helped consumers by offering free services, reduced tariffs, awareness messages, and complimentary access to online health and education resources. However, these commendable efforts also contributed to the data surge and bandwidth issues that ultimately affected the end user experience. Here we will analyze some of such initiatives that had a direct impact on the overall data usage in Afghanistan, Nepal, and Sri Lanka.

Figure 22: Internet Usage Triggered by COVID-19

Area	Service provider	Area of usage percent increase	Source
	AT&T (US)	Core network traffic (22%)	AT&T
Telecommunication traffic	British Telecom (UK)	Fixed network traffic (60% on weekdays)	British Telecom
	Telecom Italia (Italy)	Internet traffic (70%)	Telecom Italia
	Vodafone	Mobile data traffic in Italy and Spain (30%)	Vodafone
		Facebook Messenger (50%)	Facebook
Over The Top (OTT)	Facebook	WhatsApp (Overall: 50%; Spain: 76%)	WhatsApp
		Video calling (100%)	Facebook
	Netflix	Subscriber base (9.6% or 16 million)	Netflix
	E-commerce (Mexico)	Number of Users (8%)	Competitive Intelligence
	Zoom	Daily usage (300%)	JP Morgan
Video conferencing	Cisco Webex	Subscribers (33%)	Cisco
	Teams (Italy)	Monthly users (775%)	Microsoft

Source: Analysis Mason (2020)

Afghanistan set a great example when the MCIT, ATRA, and telecom service providers came together and announced plans and packages that included lowering rates, introducing new packages, and using telecommunication networks and technology to provide free or low-cost access to educational content online. Etisalat, for instance, announced a Stay Home, Stay Connected package which doubled data for any top-up of 4, 7, and 10 GB, while Salaam's offer included a 20% discount and special student packages. The Afghan Wireless Communication Company (AWCC) offered attractive discounts of an average of 30% on various packages and wholesale prices for ISPs.

31. https://www.nepalitelecom.com/2020/03/nta-requests-use-internet-corona.html
32. https://www.slt.lk/sites/default/files/files/SLT-Covid19.pdf

Nepal telecom service providers offered a 100% recharge bonus at the direction of the Nepal Telecommunications Authority (NTA), transferred free credits, discounted data bundles, special packages for education, and work from home to facilitate the customers. Nepal Telecom and NCell also launched a survey in collaboration with the government, asking their customers to answer questions about their health status and their contact with foreign country returnees.

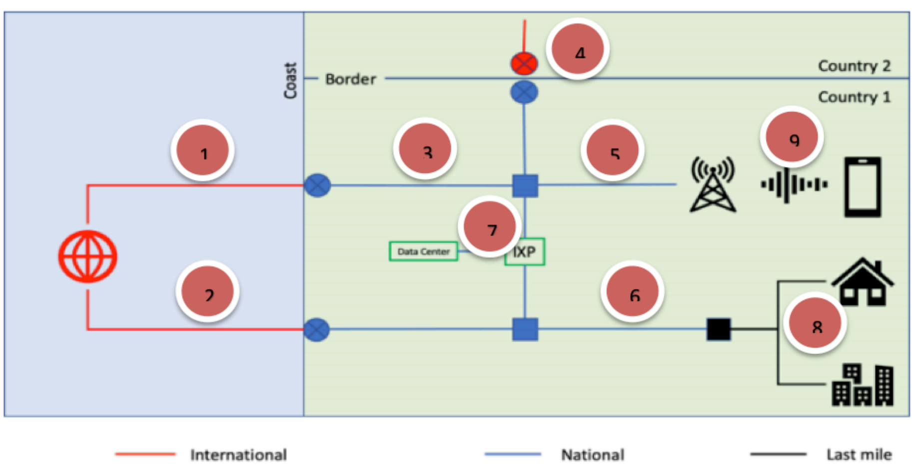
Sri Lanka's telecoms sector also rolled out incentives and free offers to customers during the COVID-19 pandemic. The Telecommunications Regulatory Commission of Sri Lanka made all operators provide emergency credit and extra talk time for prepaid customers and extend the grace period for bill payments. In terms of commercial efforts, Sri Lanka Telecom provided free voice calls, video calls, and messages on major over-the-top (OTT) platforms. Mobitel offered unlimited YouTube streaming, increased bundles, and special packages for remote workers and students. Dialog Axiata and Mobitel also provided double data, while Hutch offered a 25% discount on all data packages.

5 The Way Forward

When the threat of COVID-19 pandemic reached its peak, the Internet brought salvation to the world. While no one in any country could have predicted that this virus would have such a universal impact, the state of Internet infrastructure was well known to many. The pandemic-induced traffic demand became a testbed for countries to review the state of their digital resilience. However, it is essential to see the COVID-19 challenge as an opportunity to bridge the shortfalls in the existing digital infrastructure in order to better prepare for the future.

In this last section, we will see (i) how the Infrastructure reforms can help Afghanistan, Nepal, and Sri Lanka improve their network resilience, and (ii) what institutional steps can help accelerate those reforms. Our recommendations are common to these three countries, but may equally apply to similar countries that struggled to meet service quality standards during the COVID-19 pandemic.

Figure 23: Way Forward



1 Increase international fiber optic links

2 Reduce transit prices

3 Accelerate fiberization

4 Incentivize infrastructure operators

5 Encourage infrastructure sharing, Accelerate fiberization

6 Resolve Right of Way issues

7 Policy reforms for IXPs and data centers

8 More fiber to the home, QoS review

9 Release more and allow flexible use of spectrum, QoS review

5.1 Infrastructure Reforms

As we did to explain Internet infrastructure in Section 2, here we will look at how the two main constituents – i.e., network and services – can improve to make a positive impact on Internet performance.

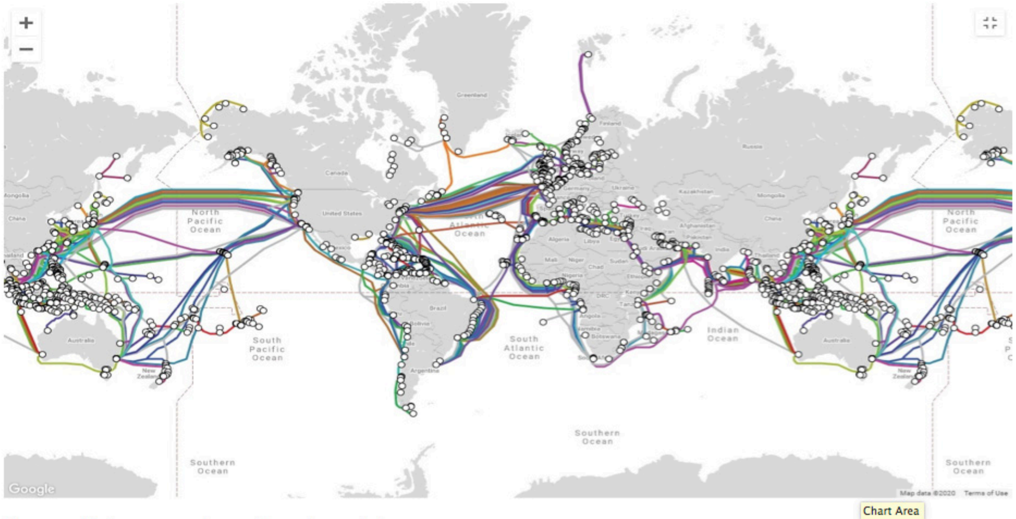
5.1.1 Network

Network improvement requires concerted efforts by the industry and policymakers alike. Telecom operators are business ventures that look at the returns before making any investment decisions, except for license or community obligations. Unless there is a business case to expand coverage or introduce new technology, they may not make a move. On the other hand, governments are responsible for providing a supportive and business-friendly environment through intelligent regulations and clearing the path for both fixed and wireless sectors to adopt technology.

When it comes to international connectivity, all countries should keep a tab on the international transit prices and make efforts to increase capacity, while also keeping traffic projections in view. If the operators can bring in Internet traffic at cheap rates, then broadband prices across the Internet value chain will decline as well. Also, the fact that countries like Afghanistan and Nepal have a heavy reliance on their neighbors to access the Internet may create bandwidth problems when demand becomes high within those countries. Redundancy in the international fiber-optic links and capacity enhancement should therefore be prioritized.

Fiberization is the gold standard of robust networks, since the fixed line extends from International connectivity to the backhaul and down to the last mile. The more components of the Internet path get fiberized, the better the network capacity, quality, and performance. For example, as shown in figure 24, fiber is being used to connect continents and countries through a massive network of international fiber-optic cables. This fiber deployment brings two significant benefits: cost-saving by avoiding expensive satellite connection, and throughput, since fiber has more capacity and speed to carry traffic from one point to another.

Figure 24: World Submarine Cable Map



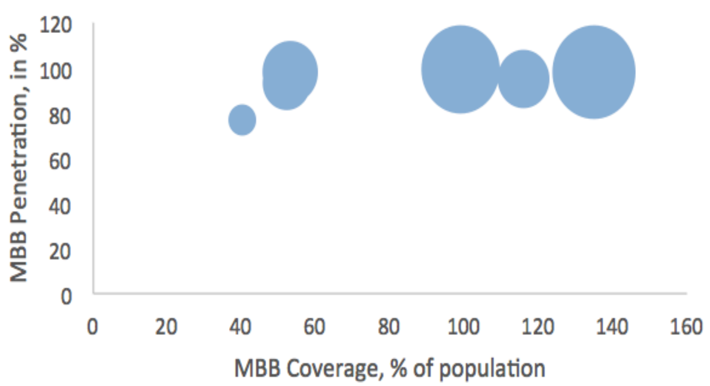
Source: Telegeography, submarinecablemap.com

Because these fiber-optic cables are usually owned by a consortium of companies, this part of the Internet infrastructure is usually reliable and well-maintained. However, it is up to the national ISPs to buy sufficient capacity from these submarine cables that can sustain the predicted level of their customers' traffic requirements.

In the next step, increased penetration of fiber in the domestic and last-mile infrastructure then ensures that the speed and capacity at which the traffic was brought into the country is not compromised within the national borders. This involves deploying fiber to the telecom towers and to households and buildings. Tower fiberization is critical to providing a solid backbone to the mobile broadband infrastructure, which is by far the primary means of Internet access across the globe.

Microwave links between towers cannot match the throughput level and speed of the fiber connections. This is why we see that countries with high mobile penetration and coverage tend to have more towers connected to the fiber, as in figure 25. It is important that governments remain vigilant to the requirements of this fiberization process and work with operators to resolve right-of-way issues, provide investment incentives, encourage infrastructure sharing, ease import policies for equipment and reduce barriers to entry.

Figure 25: Fiberized Cell Sites

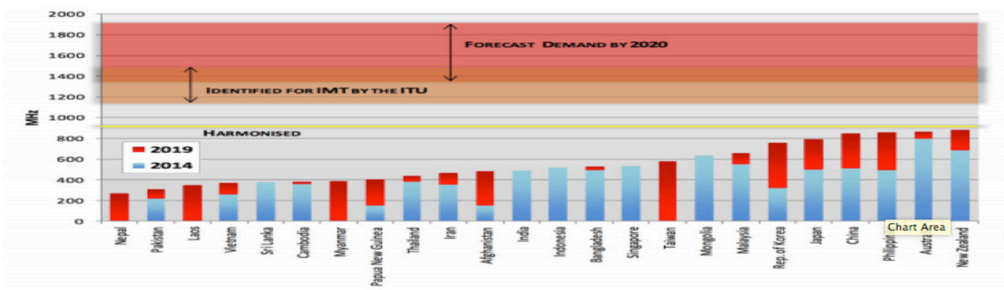


Spectrum is a predefined range of radio frequencies that are used to carry telecom signals by wireless technologies over the air. Mobile networks are a prime example of spectrum use for wireless communications that have transformed the world's communication landscape over the past few decades. Another revolution in the wireless sector is the delivery of broadband services over mobile networks. It meant that communication became personal and on-the-go, as users were no longer required to share the same telephone and didn't have to be at a fixed location to access telephony or Internet services.

However, spectrum is a scarce and finite national resource. Its high revenue potential means that spectrum is not just allocated, but licensed in most countries through various methods. Therefore countries, especially developing ones, look for a double advantage out of spectrum management: influx of revenue and technology. Spectrum, though, is like an invisible pipe in the air which has limited capacity to carry traffic. The bigger the size of the pipe, the better the throughput.

As figure 26 below shows, much less broadband International Mobile Telecommunications (IMT) spectrum has been assigned to the operators in Afghanistan, Nepal, and Sri Lanka compared to their regional peers. Nepal has the lowest amount of IMT spectrum, while Sri Lanka and Afghanistan also fall in the lower half of the comparison graph. These three countries must allow flexible use of spectrum, enforce QoS standards and view spectrum as a technology enabler rather than a revenue source.

Figure 26: Spectrum Licensed for IMT Services



Source: LSTelcom, Analysis of the World-Wide Licensing and Usage of IMT Spectrum

If a country establishes a reliable, fast, and robust network, it is up to the content infrastructure to make sure that the traffic is being managed efficiently. In this context, IXPs play a pivotal role in improving the affordability and quality of broadband connectivity.

We have already seen that there aren't very many IXPs in the three countries under study. This means the traffic is taking longer routes to reach the destination, at a higher cost and a slower speed. Imagine if you wanted to send a gift to your neighbor. The most efficient way is to knock at the door and hand over the parcel. If you go instead to the courier office in the nearby market, pay for the carrier fee and get it delivered to your neighbor, it will be a slow, costly and inefficient process. This is what happens when countries do not establish peering between their ISPs – which s the core concept behind IXPs.

In addition, big platforms such as Amazon, Facebook, and Google prefer to connect their content delivery networks with the IXPs to efficiently handle the traffic load on their servers. Despite the benefits to IXPs, establishing them is a complex and lengthy process because of competition and trust issues among operators. If operators do not reach a consensus, a government may intervene and lead the IXP deployment with all stakeholders on board.

Governments can create an enabling policy environment for interconnection and peering that supports the deployment of IXPs. The policy may also include provisions for subsidized neutral land, uninterrupted power supply and reduced duties on the related IT equipment. That being said, IXPs make a compelling business case for the operators to focus on saving valuable economic and technical resources. This will then help to reduce network latency and improve broadband speeds for consumers, as well as keep their data inside the national territory.

5.1.2 Services

If networks are roads, services are the traffic. And while it may be impossible to quantify the scale of Internet services, we will focus here on two key types of services that could improve Internet performance in Afghanistan, Nepal, and Sri Lanka.

Data centers make a big difference in the broadband experience by hosting the data on local servers, rather than foreign websites. Although the fee is charged to the clients in both cases, there are two major benefits to the local data center approach:

(i) data remains within national boundaries, which helps with compliance of data protection laws, and

(ii) upstream/downstream traffic on international networks is reduced.

In a national context, governments have come to realize that their critical national data should be physically located inside the country for the sake of security and fast-track access. But data centers are also a lucrative business opportunity for the private sector.

Lack of local content is one of the key issues that Afghanistan, Nepal, and Sri Lanka should address as a priority. Locally produced applications, websites and digital solutions not only promote a culture of entrepreneurship among the youth, but also improve the Internet experience of end users. For example, if an Internet user in Kabul initiates a Zoom video call to his relative in Kandahar, that request will be routed to one of the closest Zoom servers near Afghanistan that will then connect with the device of the relative in Kandahar.

However, if there was a similar video calling app made by Afghan developers, hosted inside a data center in Afghanistan, this whole communication could be done over domestic infrastructure, without any need to use international bandwidth. Of course, this ideal scenario will require additional infrastructure resources as well, but the core concept remains the same – i.e., that local content has a same – i.e., that local content has a positive effect on Internet performance.

There are several things these countries could do to boost local content and services. The government may take the lead by using digital technologies for public service delivery. Youth may be encouraged to adopt a tech entrepreneurship culture through the set-up of more incubation centers and startup accelerators programs. Apps and services in the countries' national languages should also be developed to make it easier for end users to use the Internet.

5.2 Institutional Reforms

Telecom and ICT laws, policies, regulations, guidelines, and decisions are meant to set a strategic direction of a communications infrastructure that provides robust, widespread, inclusive and meaningful connectivity to all citizens. Institutional preparedness is as important as operational preparedness to face a disaster situation like that of the COVID-19 pandemic. Governments and decision-makers should support the infrastructure reforms process by devising a collaborative regulatory approach. This would fill any policy and regulatory gaps with a digitalization mindset that prioritizes consumer demands and industry issues.

The reduced Internet performance in Afghanistan, Nepal, and Sri Lanka during the COVID-19 pandemic points towards policy and regulatory shortcomings that should be addressed in both the short and long term by their state institutions.

5.2.1 Short-Term Measures

Having an Internet connection will not be enough if its quality does not meet the user expectation. Therefore, broadband speed should be the key priority of regulators, both in the fixed and wireless sectors. Governments and operators should focus on a few immediate steps to sustain Internet performance in future disasters:

(i) Establish a predefined national telecom coordination body, with representatives from all stakeholders,
(ii) Release emergency spectrum and allow flexible spectrum use,
(iii) Defer license payments and penalties for operators to invest more in the network,
(iv) Monitor use of the Internet and issue public advisories,
(v) Engage with streaming services to downgrade the video quality, and
(vi) Work with the education sector to provide it with subsidized and uninterrupted Internet.

5.2.2 Medium to Long-Term Measures

Internet speed has largely stabilized around the world, including in Afghanistan, Nepal, and Sri Lanka. However, it is high time that the countries start working on important policy and regulatory tools to improve infrastructure resilience.

Quality of Service (QoS) Framework Review

Broadband QoS is usually carried out by the regulators or operators and/or both, under the respective QoS monitoring model being followed by the country. However, with the influx of smart devices, it has become much easier to intertwine the technical QoS audit (automated tool, network data etc.) with the Quality of Experience (QoE) that is measured at the end user level.

QoS assessment frameworks should add a special category that defines the minimum QoS levels to be maintained during disasters. Moreover, the regulatory approach towards QoS should be shifted from ‘evaluate and penalize’ to ‘anticipate and reform’, with the cooperation of service providers.

National Telecom Emergency Planning

In the event of a disaster/pandemic, the response and recovery process relies on uninterrupted communications between government institutions. Policymakers and regulators develop National Telecom Emergency Plans, in consultation with national disaster management stakeholders and service providers, to outline the responsibilities and step-wise plan of each stakeholder.

Afghanistan Telecom Regulatory Authority (ATRA) is developing a National Emergency Telecommunications Plan (NETP), with the support of the International Telecommunication Union and Commercial Law Development Program of the USA.

In 2016 Nepal Telecommunications Authority issued a consultation paper on National Emergency Telecommunications Continuity Plan (NETCP), but no further development has been reported since then. That said, the UN's Emergency Telecommunications Cluster (ETC) started the ETC Pilot Project in Nepal, during the Internet Society's INET Conference, which was also in 2016. It aims to support government, humanitarian, media, and private sector actors to develop a preparedness plan for responding to future disasters, with a specific focus on enabling faster and better communication among communities in times of disaster.

Sri Lanka, which was ranked second most affected by extreme weather events over the past 20 years in the Global Climate Risk Index, doesn't yet have any telecom-specific legislation. However, it does have the Disaster and Emergency Warning Network (DEWN), developed by Dialog Axiata after the devastating tsunami of 2004. This system connects subscribers, emergency responders, community leaders and the general public to a national emergency monitoring center, housed at Sri Lanka's Disaster Management Centre.

Whole-of-Government Approach (WGA)

WGA refers to the joint activities performed by different government institutions to address a particular issue that a country is facing. In the Internet world, this refers to cross-sectoral collaboration and support for efficient use of resources, information dissemination and relief to the public. For example, Right-of-Way is a crucial facilitation required by the operators to deploy digital infrastructure (fiber, towers etc.), but it may get hampered due to inefficient laws and lack of coordination among the telecom and municipal institutions.

Digital Infrastructure Roadmap

Many countries produce digital transformation and broadband plans that set specific targets for digital inclusion of unserved communities. However, developing countries also need to work on a national roadmap that is specific to infrastructure improvements. To do this, regulators must carry out a detailed situational analysis of the status of digital infrastructure and its components, based on reliable data from the operators and measured at the user end.

Based on the outcomes of this assessment, major gaps should be identified that serve as a basis to developing the infrastructure roadmap for the next three to five years to work on a national roadmap that is specific to infrastructure improvements. To do this, regulators must carry out a detailed situational analysis of the status of digital infrastructure and its components, based on reliable data from the operators and measured at the user end.

Based on the outcomes of this assessment, major gaps should be identified that serve as a basis to developing the infrastructure roadmap for the next three to five years.