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1. Background

In the age of digital connectivity, where the internet serves as the backbone of modern society, the reliability and efficiency of internet service provision stand as cornerstones of progress. At the forefront are Internet Service Providers (ISPs) and Internet Leased Lines (ILLs), the entities responsible for facilitating seamless connectivity between users and the vast array of online resources.

An Internet Service Provider (ISP) is like a bridge that connects you to the Internet. They're the ones who give you access to all the cool stuff online, like websites, videos, and games. You pay them a fee, and in return, they make sure you can surf the web smoothly. ISPs can be big companies or smaller ones in your local area. As these ISPs provide Internet Leased Line Service. It's like having a special lane on the internet highway just for you. Instead of sharing your internet connection with lots of other people, as you do with regular internet, a leased line gives you your very own dedicated connection. This means faster speeds and more reliability. So, think of ISPs as the gatekeepers to the internet, and leased line services as the VIP lanes that make sure you get where you need to go fast and without any traffic jams.

Despite the efforts of densifying mobile base stations to improve services, mobile QoS has been a serious concern. In addition, mobile broadband services are not designed and suitable for prolonged access to the Internet for communication and education. Therefore, Internet Leased Line (ILL) would be the solution for a faster and more reliable connection between yourself and your families. ILL can be beneficial for a larger family in terms of cutting costs for individual mobile data purchases.

The Authority has been facilitating and encouraging the general public to consider using Internet leased line services with dedicated speed without data limitation services for reliability, scalability, and affordability. The Authority has developed Standards for Fixed and Mobile Broadband Quality of Services. The Authority carries out monitoring visits to the various Dzongkhags as and when required. The report contains the report from the field visit. The report outlines the key activities carried out by the Authority for these three months (April-June, 2024) to enhance the effective and efficient delivery of internet service in the country.

2. ISP verifications and Monitoring of Internet Leased Line Services

2.1 Sarpang Dzongkhag

A team from the Authority visited for physical verifications of the new ISP setup in Sarpang as requested by the proprietor. The two new ISPs located at Sarpang and Pelrithang, Gelephu are known as Nadlink InfoComm Ltd. and KT Internet Service respectively. Before the Issuance of ISP License, the Authority provides an In-principle Approval License to establish the network infrastructure for the distribution of internet services. The Validity of In-Principle Approval is 6 Months. On completion of making secure Network infrastructure as required, a team from the Authority reviews, and then the license is issued by the Authority as per the Rules and Regulations for Licensing and Operation of Internet Service Providers in Bhutan, 2021.

Findings from the Site visit are:

1. Nadlink Infocomm Ltd. has an input feed of 20 Mbps bandwidth connected from Bhutan Telecom Ltd. For further distribution to the end users, small bandwidths ranging from 2-5 Mbps are used as purchased by the customers. While KT Internet Service has an input feed of 20 Mbps bandwidth and both ISPs have mentioned increasing the input bandwidth feed with the increase in the number of customers.
2. The main components used for establishing the network infrastructure are Routers, Switches, Optical line terminals (OLT), and Optical network units.
3. The employees usually have an IT background and cable work experience to operate the whole network as they also run the Cable Service Business.
4. The image below is the result of the speed test of 20 Mbps using fast.com.



Figure 1: Speedtest of 20Mbps bandwidth connected from Bhutan Telecom Ltd for Nadlink InfoComm Ltd.

5. The image below is the Snapshot of WINBOX software used to route the IP address.

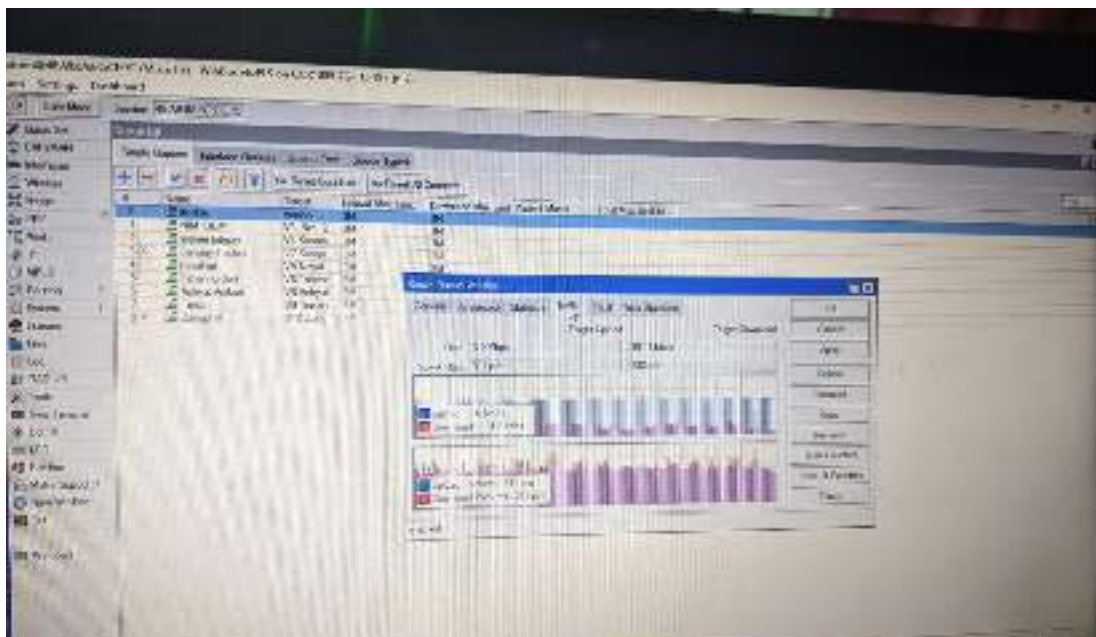


Figure 2: 3Mbps bandwidth from the router for distribution at KT Internet Service.

2.2 Paro Dzongkhag

A team visited for physical verifications of the new ISP setup in Paro as requested by the proprietor. The new ISP located in Paro town is known as Sigma Internet Service. Before the Issuance of the ISP License, the Authority provided an In-principle Approval License to establish the network infrastructure for the distribution of Internet services. The Validity of In-Principle Approval is 6 Months. On completion of making secure Network infrastructure as required by the Authority, and on physical site verification review the ISP license is issued by the Authority as per the Rules and Regulations for Licensing and Operation of Internet Service Providers in Bhutan, 2021.

Findings from the Site visit are:

1. Sigma Internet Service has an input feed of 10 Mbps bandwidth connected from Bhutan Telecom Ltd. For further distribution to the end users, small bandwidths ranging from 2-5 Mbps are used as purchased by the customers. However, they have mentioned increasing the input bandwidth feed with the increase in the number of customers.
6. The main components used for establishing the network infrastructure are Routers, Switches, Optical line terminals (OLT), and Optical network units.
7. The employees usually have an IT background and cable work experience to operate the whole network as they also run the Cable Service Business.
8. The image below is the result of the speed test of 10 Mbps using the website speedtest by Ookla.



Figure 3: Speed test at the Core Router of 10Mbps.

9. The image below shows the Network setup

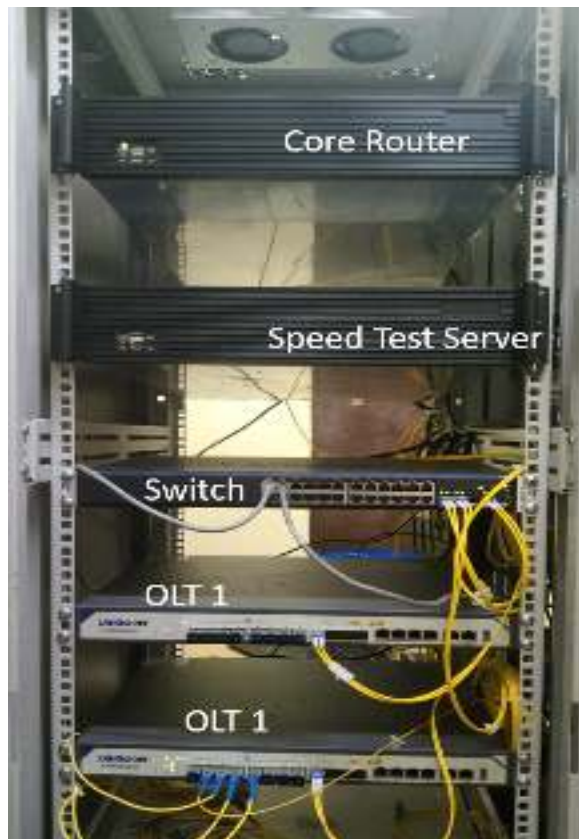


Figure 4: Network Setup of Sigma Digital Networking

10. The image shows the Customer-connected result with a connectivity result of 5Mbps.



Figure 5: At the customer's house showing 5Mbps of Bandwidth.

2.3 Punakha and Wangdue Phodrang

Upon notice to verify the ISP set-up, a team from IID visited the site for Physical verification. There were two ISP setups namely G&S Net and Nilo fiberNet located at Bajo town, Wangdue Phodrang. The parameters adopted for the tour to monitor the Leased line connection was:

1. Throughput(Internet speed) using the **Speedtest** Site by Ookla
2. Latency (Ping RTT test) for Google, YouTube, Tiktok, and Facebook sites for Fixed data services (leased line services).
3. Packet Loss (Ping test) for Google, YouTube, Tiltok, and Facebook sites for Fixed data services (leased line services).

The findings of the Site Visit are:

- a. For G&S Net the input feed of 20 Mbps from Bhutan Telecom was connected to the core router. However, they intend to increase the bandwidth with an increase in the number of customers. The estimated number of customers within the town area is 300 users. For Nilo FiberNet, The input feed of 100 Mbps from Nano Ltd. was connected to the core router at Bajo and Lobesa. The estimated number of customers within the town area is 400 users.
- b. They have provided 3Mbps bandwidth services as a pilot phase to the customer end. From the ports of OLT, 8 decibels(db) power is supplied to the fiber.
- c. Following are the Figures showing the result of the Speed test.



Figure 6: Speed test at the Core Router of 20 Mbps at G&S Net.



Figure 7: Speed test at User end of 4Mbps bandwidth at G&S Net.

d. Latency (Ping RTT test)

In line with the benchmark set by the Authority, the overall Latency results conducted for Google, Facebook, TikTok, and YouTube were found within the range.

For Example:

Table 1: Google Ping RTT Test.

Operator	Location	Average RTT	Threshold(As per Standards for QoS fixed)	Remarks
G&S Net	Bajo, Wangdue	81ms	<=150ms	Within Range
Nilo FiberNet	Bajo, Wangdue	56ms	<=150ms	Within Range
	Lobesa, Wangdue	64ms	<=150ms	Within Range
	Lobesa, Wangdue User end	66ms	<=150ms	Within Range

For the latency test carried out, table 1 shows the average result of Round Trip Time(RTT) below the threshold, fulfilling the standard set by the Authority. The test was done using the *ping* command at G&S Net such as:

```

C:\Users\Dekilling>ping www.facebook.com -n 15
Pinging star-mini.c10r.facebook.com [31.13.64.35] with 32 bytes of data:
Reply from 31.13.64.35: bytes=32 time=15ms TTL=53
Reply from 31.13.64.35: bytes=32 time=16ms TTL=53
Reply from 31.13.64.35: bytes=32 time=20ms TTL=53
Reply from 31.13.64.35: bytes=32 time=14ms TTL=53
Reply from 31.13.64.35: bytes=32 time=14ms TTL=53
Reply from 31.13.64.35: bytes=32 time=14ms TTL=53
Reply from 31.13.64.35: bytes=32 time=14ms TTL=53
Reply from 31.13.64.35: bytes=32 time=14ms TTL=53
Reply from 31.13.64.35: bytes=32 time=16ms TTL=53
Reply from 31.13.64.35: bytes=32 time=14ms TTL=53
Reply from 31.13.64.35: bytes=32 time=14ms TTL=53
Reply from 31.13.64.35: bytes=32 time=14ms TTL=53
Reply from 31.13.64.35: bytes=32 time=14ms TTL=53
Reply from 31.13.64.35: bytes=32 time=14ms TTL=53
Reply from 31.13.64.35: bytes=32 time=14ms TTL=53
Ping statistics for 31.13.64.35:
    Packets: Sent = 15, Received = 15, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 14ms, Maximum = 20ms, Average = 14ms
C:\Users\Dekilling>_

```

Packet Loss (Ping test)

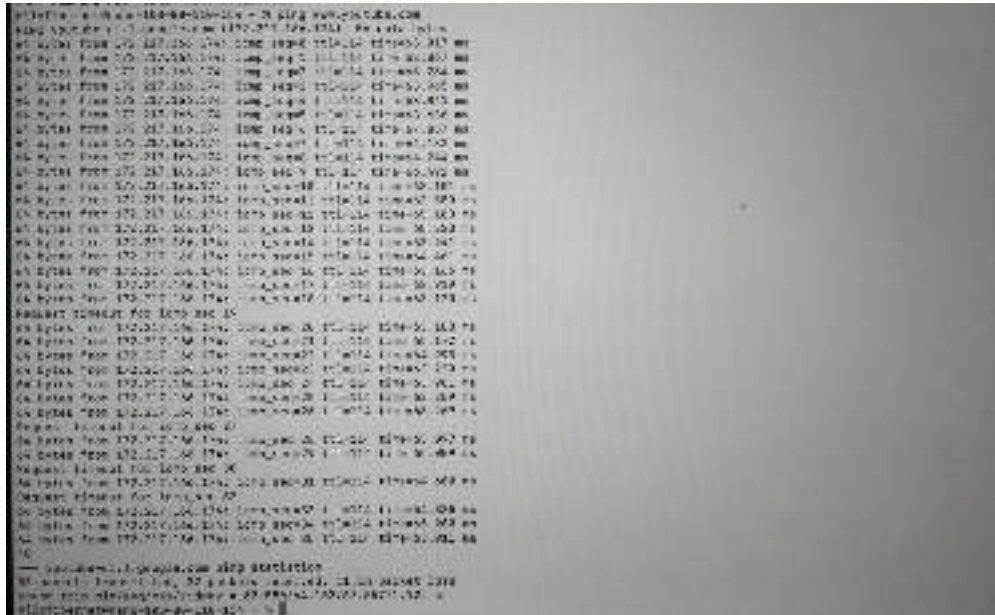
For Packet losses, a benchmark set by the Authority is used to maintain the optimal requirement to ensure transmission of data packets from source to destination is achieved.

For example:

Table 2: Tiktok Ping Test(Packet Loss)

Operator	Location	Packet Loss Percentage	Threshold(As per Standards for QoS fixed)	Remarks
G&S Net	Bajo, Wangdue	0%	<=2%	Within Range
Nilo FiberNet	Bajo, Wangdue	0%	<=2%	Within Range
	Lobesa, Wangdue	24.3%	<=2%	Not Within Range
	Lobesa, Wangdue User end	24%	<=2%	Not Within Range

For the Packet loss test carried out, table 2 shows the Packet loss percentage. For G&S Net the Packet loss percentage is within the threshold however for Nilo FiberNet located at Lobesa, the packet loss percentage exceeds the threshold set by the Authority. The test was done using the *ping* command such as;



3. Actions taken based on the field visit

Overall, the leased line connection showed reliable results as per the standards set by the Authority. However for Packet loss QoS the results do not meet the minimum threshold set by the Authority. In order to improve customer service, it was advised to carry out timely router optimizations, network upgrades, routine troubleshooting, and any other required actions.

When ISP owners get complaints from customers, they are advised to do periodic speed tests to confirm the bandwidth they have purchased.

4. Customer Complaint Filings

Table 3 shows the record-keeping by the IID for filing the complaints made by the ISP customers to help identify and address quality of service issues, such as slow internet speeds, poor connection, or technical issues, which can impact customer satisfaction and retention. Therefore the Authority facilitates handling these complaints effectively, so the ISPs can improve their services and maintain a positive reputation.

Table 3: Customer Complaints from April to June

Date	Customer	Mode of Complaint	Service provider	Complaint Details	Actions by Authority
4/4/2024	Deepak Upreti	Email	Bhutan Telecom	Upgrade of Infrastructure caused discontinuation of services.	Enquired about the details of the issue with Customer and resolved on 15/4/2024
04/06/2024	Pema Yuden	Email	Digitech World ISP	Issues with poor service and outdated equipment from our service provider, resulting in frequent disconnections, inadequate internet speeds, and unresolved complaints despite timely payments.	The Digitech owner was advised to replace the faulty router by June 12, 2024, but due to equipment unavailability, the replacement was delayed until June 14, with a refund of the router cost paid in installments if the replacement fails.

5. Recommendations/Way forward

1. The Authority will take up the monitoring, verification, and inspections of ISP and ILL services regularly.
2. Compile and publish the quarterly report for the Internet Service Provider to facilitate the Authority in taking proper regulatory measures for improving the Quality of Services of Internet services.