



“LIFE IS FULL OF SORROWS, AND DESIRE IS THE MAIN CAUSE OF SORROWS.”

– LORD BUDDHA

SATELLITE INTERNET

A BOON TO LANDLOCKED COUNTRIES IN THE HIMALAYAS?

A Bhutanese Perspective on Transforming Connectivity

Manoj Adhikari (Consult With MJ)

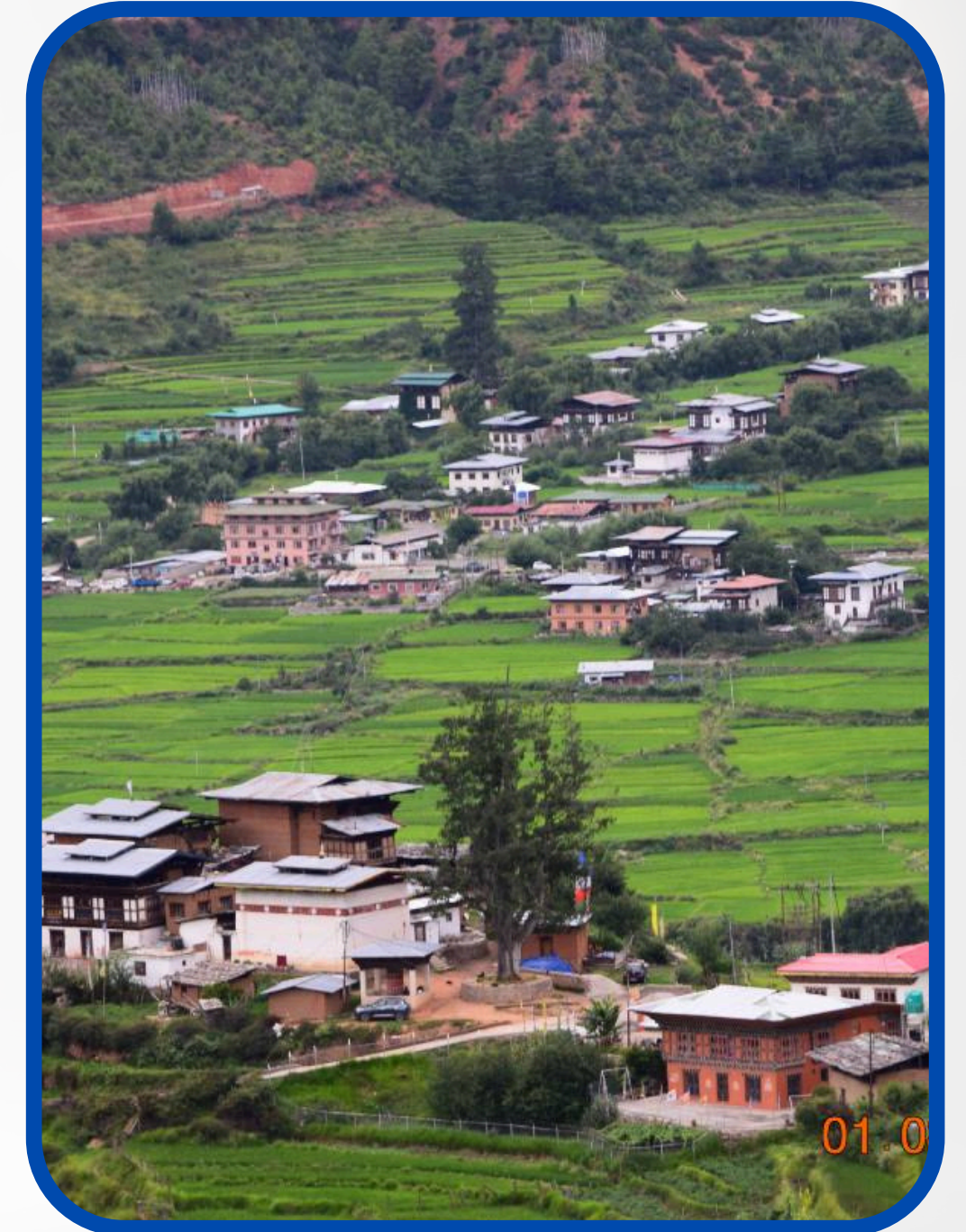
SANOG43
August 2025



LANDLOCKED, BUT NOT LEFT BEHIND

"Overcoming Geographical Barriers with Digital Bridges"

- "Geography has long dictated connectivity. But in the digital age, innovation knows no borders."
- Himalayan Challenges: Rugged Terrain, Remote Communities
- Digital Promise: Breaking Physical Barriers



Satellite Evolution:

1990s–2000s (GEO/VSAT):

36,000 km Altitude
High Latency, Costly
Niche Enterprise Use

Satellite Evolution:

2020s (LEO – Starlink, OneWeb, Kuiper):

550 km Altitude
Low Latency (25–50ms)
High Throughput, Global Coverage
Consumer Focus

LEO Architecture:

User Terminal (Dish) connects to LEO Satellite
Satellite relays data to Ground Station or other Sats
Ground Station connects to Internet Backbone
Result: Direct, High-Speed Data Flow

1

2

3

THE EVOLUTION & ARCHITECTURE OF LEO SATELLITE INTERNET

From Geosynchronous Giants to a Global
Mesh in Space

CONNECTING THE DRAGON KINGDOM: CURRENT REALITIES

Our Terrestrial Backbone & Its Limitations

PRIMARY GATEWAY

Via India
(Single Point of Failure Risk)

FIBER COVERAGE

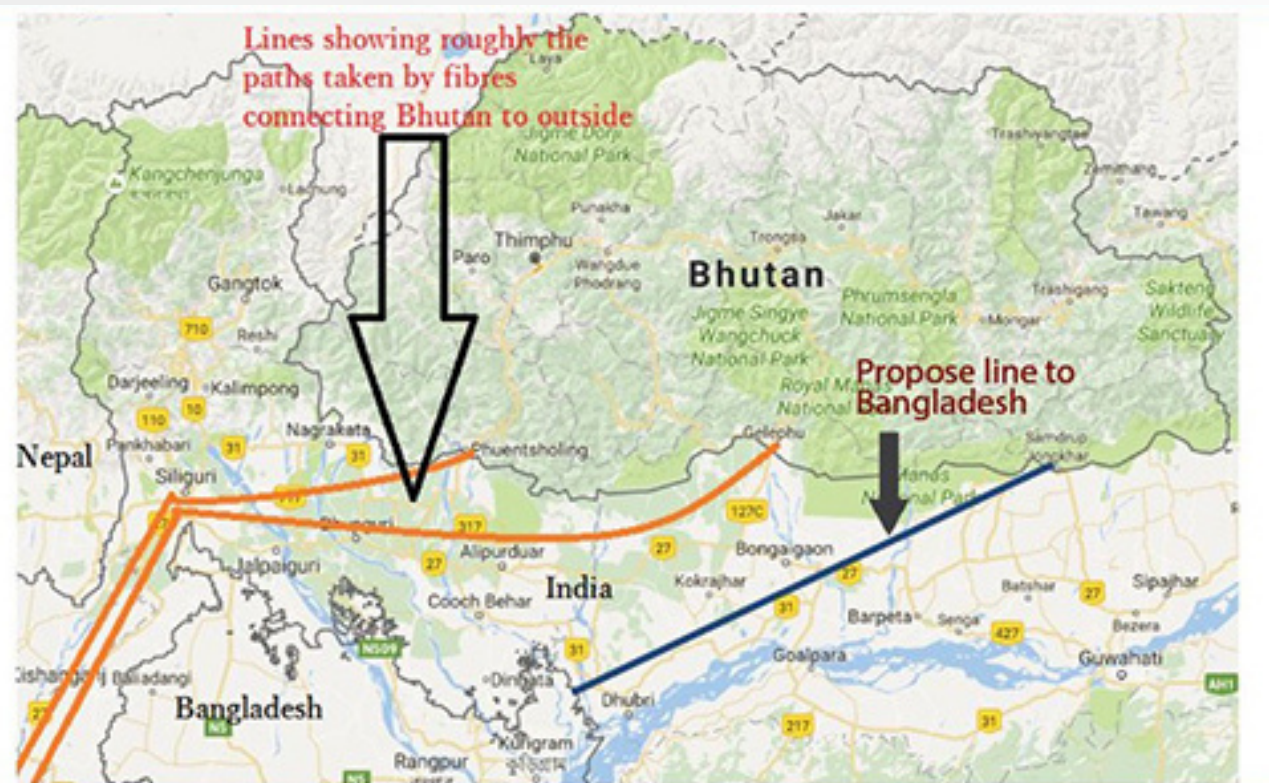
Limited to Urban & Semi-
Urban Areas

RURAL CONNECTIVITY

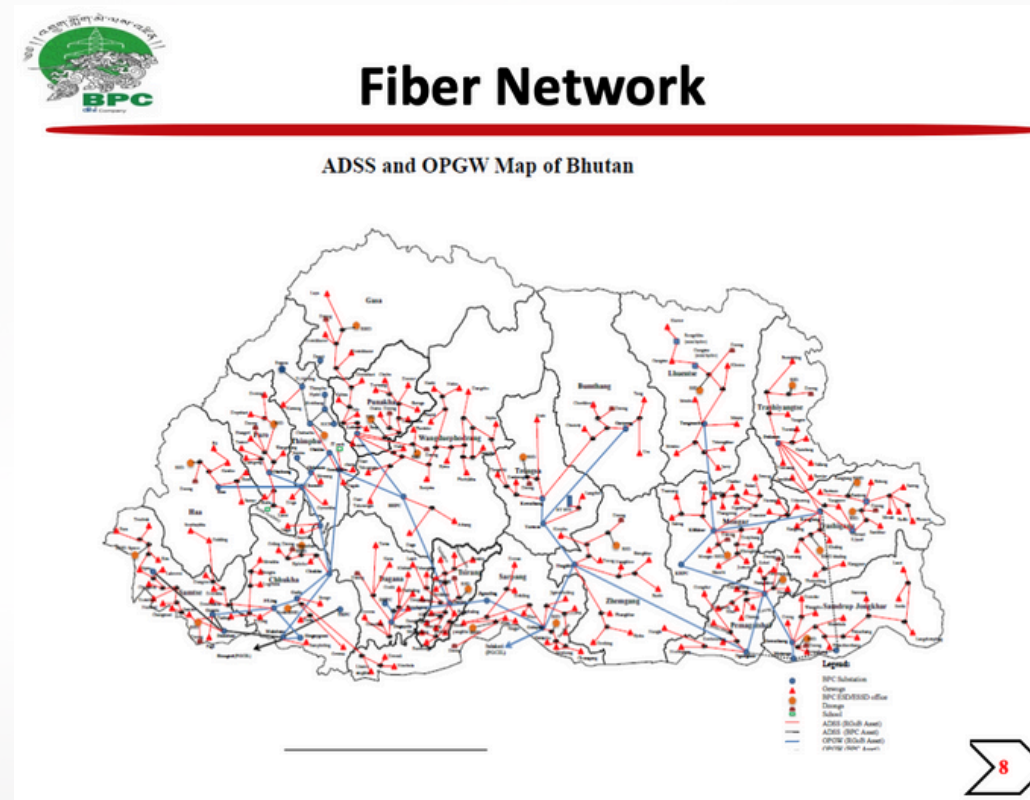
Challenging & Often Non-
existent

TOPOGRAPHICAL HURDLES

Rugged Mountains make
Fiber Deployment Costly &
Complex



Picture Courtesy: The Bhutanese



Picture Courtesy: SANOG, Anand Acharaya, BPC

National Fiber Network Reliability Report
(First Quarter, July to September, 2023)



Division of Telecom and Space
Government Technology Agency

THE STARLINK EFFECT:

BRIDGING THE LAST MILE IN BHUTAN

*EARLY ADOPTER EXPERIENCES AND
COMMUNITY SENTIMENT*

- **Early Adopter:** Starlink Residential Lite User (My Personal Experience)
- **Community Sentiment:**
Transformative for Remote Areas
- **Impact:** Enabling Digital Inclusion
- **Key Benefits:** High Speeds & Reliability in Unserved Regions



**ITS NOT
EASY**

... BEING IN BUTAN

- Roof top access
- Line of sight (North)
- Payment Issues
- Proprietary Accessories
- No Local Support
- No Public IP
- Data Privacy



THE STARLINK : **CHALLENGES?**

CURRENT INTERNET RATES & **BANDWIDTH CONSUMPTION**

Bandwidth Consumption Example:

- Netflix/Samuh (4K): ~25 Mbps
- Video Games (non-DOTA): ~100 Kbps
- Download Movies: 8-12 Mbps
- Spotify/Soundcloud: 2.5 Mbps
- Facetime/Messenger/Insta/Whatsapp VC: ~1 Mbps

Practical Use: Max simultaneous usage rarely exceeds 40 Mbps:

- BT: Nu. 22,000 per Month
- TASHI: 2,477 per Month
- Starlink: 3,000 per Month

****Data As Of May 2025**

MY SUBSCRIPTIONS



- Starlink Residential Lite: Nu. 3,000 (Unlimited but reduced speed)












- New Lease-line Traiff Up to 7 Mbps: Nu. 3,850 (Unlimited)



- 5G Office: Nu. 3777
- Max Speed: 150
- Data Capping: 590GB
- Reduces to 2Mbps (unlimited) after threshold.
- Max Users: 8

LOCAL CONTENT ACCESS: THE BTIX DIFFERENTIATOR






< Query	Route	Start
www.btix.bt (13)		
1	192.168.1.1	3.9 ms
2	100.64.0.1	95.6 ms
3		
4		
5	206.224.74.126 undefined.hostname.localhost	113.2 ms 
6	160.202.164.98	102.0 ms 
7	103.107.199.81	100.5 ms 
8	27.111.230.10 38740.sgw.equinix.com	95.7 ms 
9	43.241.139.176 po3-edge1-sg.as38740.tashicell.com	116.1 ms 
10	43.241.139.140 if200-cr1-tpu.as38740.tashicell.com	177.6 ms 
11	43.241.139.151 po1-edge1-btix.as38740.tashicell.com	178.7 ms 
12	43.241.139.226 if000-cr1-btix.as7615.tashicell.com	180.3 ms 
13	103.129.63.3 www.btix.bt	175.9 ms 

Local ISPs (Bhutan Telecom
& TashiCell):

- Direct Peering at BTIX
- Lower Latency for Local Data (e.g., bt domains)
- Direct access to Google, Meta, Akamai Caches within Bhutan

Starlink:Satellite Hops to Ground
Station

- Indirect Path to Local Caches
- Inherent Satellite Latency (even for local content)

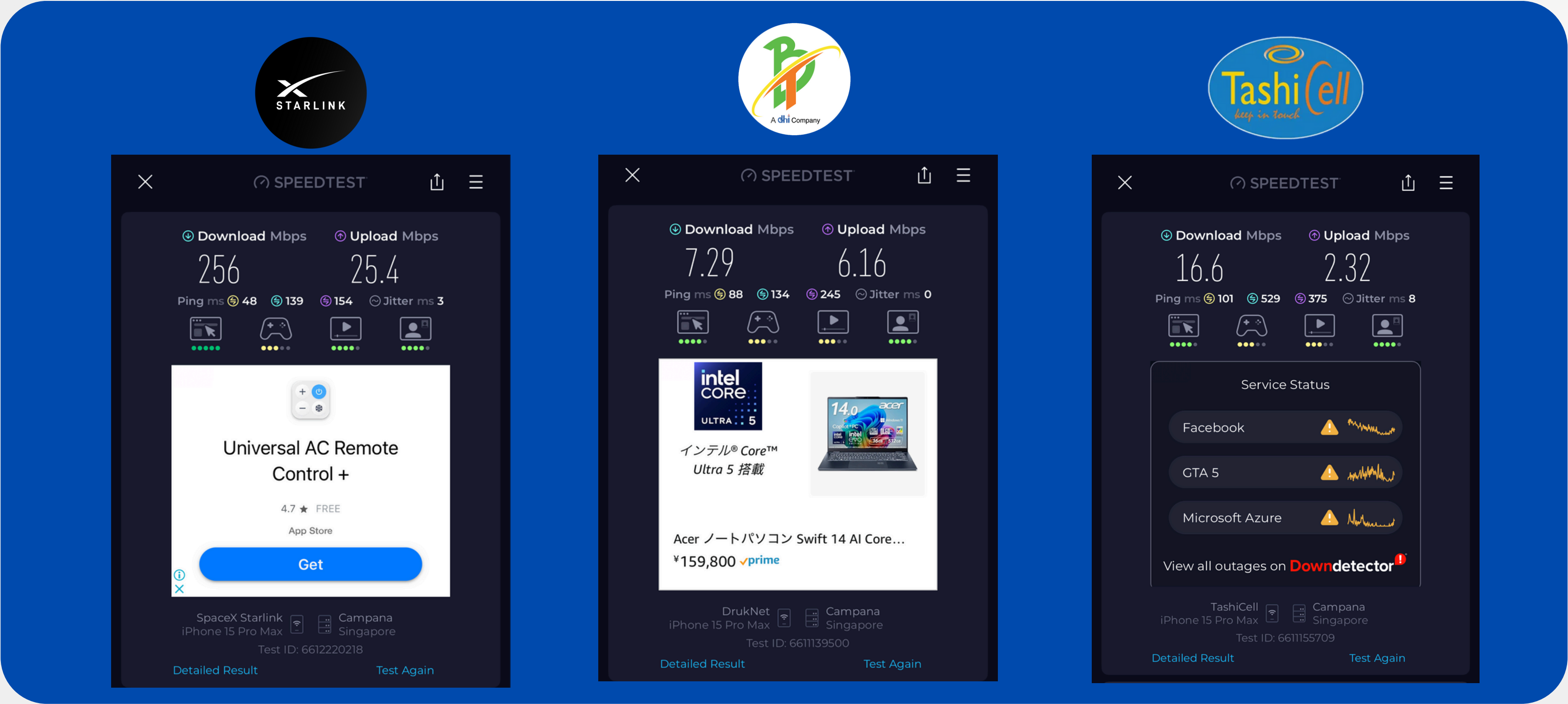
< Query	Route	Start
btix.bt (10)		
1	192.168.0.1	3.1 ms
2		
3	100.64.33.130	63.6 ms
4	100.64.29.54	53.7 ms
5		
6	43.241.139.172 if101-cr1-gpu.as38740.tashicell.com	40.7 ms 
7	43.241.139.192	75.0 ms 
8	43.241.139.151 if200-edge1-ln.as38740.tashicell.com	64.9 ms 
9	43.241.139.226 if000-cr1-btix.as7615.tashicell.com	53.4 ms 
10	103.129.63.3 www.btix.bt	24.1 ms 

****Data As Of May 2025**

MY CONNECTIVITY JOURNEY: A DEEP DIVE INTO PERFORMANCE

SPEED TEST

*** Using mobile for infographic comprasion (as of May 2025)



Campana Singapore

MY CONNECTIVITY JOURNEY: A DEEP DIVE INTO PERFORMANCE

LATENCY
(BTIX.BT)

*** Using moblie for infographic comprasion (as of May 2025)



<	Query	Ping	Start
www.btix.bt (12)			
● 12	103.129.63.3 www.btix.bt	150.1 ms	
● 11	103.129.63.3 www.btix.bt	224.6 ms	
● 10	103.129.63.3 www.btix.bt	209.2 ms	
● 9	103.129.63.3 www.btix.bt	204.0 ms	
● 8	103.129.63.3 www.btix.bt	258.4 ms	
● 7	103.129.63.3 www.btix.bt	238.1 ms	
● 6	103.129.63.3 www.btix.bt	212.6 ms	
● 5	103.129.63.3 www.btix.bt	189.6 ms	
● 4	103.129.63.3 www.btix.bt	170.6 ms	
● 3	103.129.63.3 www.btix.bt	246.3 ms	
● 2	103.129.63.3 www.btix.bt	223.0 ms	
● 1	103.129.63.3 www.btix.bt	151.1 ms	

Avg:
< 206 ms >



<	Query	Ping	Start
btix.bt (12)			
● 12	103.129.63.3 www.btix.bt	9.6 ms	
● 11	103.129.63.3 www.btix.bt	10.6 ms	
● 10	103.129.63.3 www.btix.bt	5.1 ms	
● 9	103.129.63.3 www.btix.bt	6.9 ms	
● 8	103.129.63.3 www.btix.bt	8.2 ms	
● 7	103.129.63.3 www.btix.bt	8.7 ms	
● 6	103.129.63.3 www.btix.bt	5.4 ms	
● 5	103.129.63.3 www.btix.bt	8.4 ms	
● 4	103.129.63.3 www.btix.bt	10.2 ms	
● 3	103.129.63.3 www.btix.bt	8.8 ms	
● 2	103.129.63.3 www.btix.bt	8.6 ms	
● 1	103.129.63.3 www.btix.bt	9.3 ms	

Avg:
< 8.3 ms >



<	Query	Ping	Start
btix.bt (12)			
● 12	103.129.63.3 www.btix.bt	27.7 ms	
● 11	103.129.63.3 www.btix.bt	28.7 ms	
● 10	103.129.63.3 www.btix.bt	30.5 ms	
● 9	103.129.63.3 www.btix.bt	65.9 ms	
● 8	103.129.63.3 www.btix.bt	57.1 ms	
● 7	103.129.63.3 www.btix.bt	27.7 ms	
● 6	103.129.63.3 www.btix.bt	39.1 ms	
● 5	103.129.63.3 www.btix.bt	30.6 ms	
● 4	103.129.63.3 www.btix.bt	37.2 ms	
● 3	103.129.63.3 www.btix.bt	76.1 ms	
● 2	103.129.63.3 www.btix.bt	63.5 ms	
● 1	103.129.63.3 www.btix.bt	45.4 ms	

Avg:
< 44.1 ms >

MY CONNECTIVITY JOURNEY: A DEEP DIVE INTO PERFORMANCE

LATENCY
(NYSE.COM)

*** Using mobile for infographic comprasion (as of May 2025)



<	Query	Ping	Start
nyse.com (12)			
● 12	104.16.104.50 nyse.com	54.2 ms	
● 11	104.16.104.50 nyse.com	62.6 ms	
● 10	104.16.104.50 nyse.com	59.6 ms	
● 9	104.16.104.50 nyse.com	56.6 ms	
● 8	104.16.104.50 nyse.com	93.7 ms	
● 7	104.16.104.50 nyse.com	130.8 ms	
● 6	104.16.104.50 nyse.com	62.4 ms	
● 5	104.16.104.50 nyse.com	67.2 ms	
● 4	104.16.104.50 nyse.com	65.5 ms	
● 3	104.16.104.50 nyse.com	62.9 ms	
● 2	104.16.104.50 nyse.com	67.9 ms	
● 1	104.16.104.50 nyse.com	59.8 ms	

Avg:
70.27 < 206 ms



<	Query	Ping	Start
nyse.com (12)			
● 12	104.16.103.50 nyse.com	9.2 ms	
● 11	104.16.103.50 nyse.com	9.1 ms	
● 10	104.16.103.50 nyse.com	7.4 ms	
● 9	104.16.103.50 nyse.com	9.0 ms	
● 8	104.16.103.50 nyse.com	4.4 ms	
● 7	104.16.103.50 nyse.com	4.2 ms	
● 6	104.16.103.50 nyse.com	10.3 ms	
● 5	104.16.103.50 nyse.com	10.4 ms	
● 4	104.16.103.50 nyse.com	10.5 ms	
● 3	104.16.103.50 nyse.com	10.4 ms	
● 2	104.16.103.50 nyse.com	4.2 ms	
● 1	104.16.103.50 nyse.com	4.7 ms	

Avg:
7.8 < 8.3



<	Query	Ping	Start
nyse.com (12)			
● 12	104.16.103.50 nyse.com	28.3 ms	
● 11	104.16.103.50 nyse.com	54.1 ms	
● 10	104.16.103.50 nyse.com	29.9 ms	
● 9	104.16.103.50 nyse.com	31.2 ms	
● 8	104.16.103.50 nyse.com	32.9 ms	
● 7	104.16.103.50 nyse.com	33.6 ms	
● 6	104.16.103.50 nyse.com	37.5 ms	
● 5	104.16.103.50 nyse.com	34.8 ms	
● 4	104.16.103.50 nyse.com	21.8 ms	
● 3	104.16.103.50 nyse.com	27.6 ms	
● 2	104.16.103.50 nyse.com	45.9 ms	
● 1	104.16.103.50 nyse.com	24.8 ms	

Avg:
32.7 < 44.1 ms

MY CONNECTIVITY JOURNEY: **A DEEP DIVE INTO PERFORMANCE**



TECHNOLOGY

LEO Sattalite

Fiber-Optic

Cellular/Fixed Wireless (5G)

SPEED

65-220 Mbps

4 Mbps - 10 Mbps

60-120 Mbps (5G)

LATENCY (TTL)

60-90ms (High)

5-7 ms (avg 5.5)

30-65 ms (avg 45.9)

REALIBILITY

Weather-Dependent (Rain/Storm)

Highly Reliable (Minimal Disruptions)

Moderate (Signal/Congestion)

CONNECTIVITY FIT: COST, COVERAGE & TARGET AUDIENCE

ALIGNING SOLUTIONS WITH NEEDS IN THE BHUTANESE ECOSYSTEM



**Cost to Customers
/ROI**

HW: 20-40k (One Time)
Subs: 3000-4200 (Monthly)

HW: 3-5k (One Time)
Subs: 1100-10,000 (Monthly)

HW: 5k (One Time)
Subs: 3000-10,000 (Monthly)

**Cost to
Providers**

Expensive (Satellite Constellations)

Moderate (Fiber Laying, Scalable)

Low-to-Moderate (Towers,
Spectrum)

Coverage

Global (Remote/Underserved
Areas)

Limited (Urban/Semi-Urban Fiber)

Extensive (Urban/Rural Cellular)

Target Audience

Rural/Remote Users

Urban/Suburban (Home/Office)

Mobile Users/Flexible Access

VISION: TRULY BORDERLESS DIGITAL LANDSCAPE FOR THE HIMALAYAS



*** Ai Generated Images (as its future)

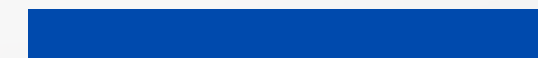
BEYOND THE HORIZON: SEAMLESS, UBIQUITOUS CONNECTIVITY

*Mesh Networks, eSIMs, and the Future of
Digital Inclusion*

Key Trends: PI TAB – TESLA

- Hybrid Connectivity (Satellite + Terrestrial)
- Intelligent Switching (Device chooses best network)
- Mesh Networks (Local Wi-Fi from Satellite Backhaul)
- eSIMs (Flexible network access)

Impact: Enabling Remote Healthcare,
Distance Education, New Economic
Opportunities



REFERENCES

SOURCES AND FURTHER READING

- Bhutan Internet Exchange (btIX). (n.d.). About us. Retrieved from <http://www.btix.bt/>
- Bhutan Telecom. (n.d.). Internet Leased Line (ILL) Services. Retrieved from <https://www.bt.bt/business-services/internet-leased-line/>
- Bhutan Information, Communication, and Media Authority (BICMA). (n.d.). Starlink Services FAQ. Retrieved from https://www.bicma.gov.bt/?page_id=8781
- Starlink. (n.d.). Starlink for Bhutan. Retrieved from <https://www.starlink.com/bt>

BTIX

TASHICELL

BT.BT

GOVTECH

BICMA

STARLINK

- TashiCell. (n.d.). Internet Leased Line Rate. Retrieved from <https://www.tashicell.com/internet-leased-line-rate>
- TashiCell. (n.d.). What is Internet Leased Line. Retrieved from <https://www.tashicell.com/leased-line/what-is-internet-leased-line>
- Wangchuk, J. S. (n.d.). (Quoted widely in various publications and speeches on Gross National Happiness).
- GovTech. National Fiber Network Reliability Report (First Quarter, July–September 2023).

THANK YOU & KADRINCHEY



scan (Linkedin)

"If the purpose of human life is to achieve happiness, then for all Bhutanese, the purpose of existence and the duty of the government is to ensure happiness." – Jigme Singye Wangchuck (Fourth Druk Gyalpo of Bhutan)

CONTACT



+97577102200



<https://www.linkedin.com/in/manojmjadhikari/>

QUESTIONS & DISCUSSION

Your Insights are
Valued

LET'S CONNECT AND DISCUSS



+97577102200



<https://www.linkedin.com/in/manojmjadhikari/>



scan (Linkedin)