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Broadband Access For All

Deepening Nigeria's National Backbone and Middle Mile Infrastructure

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Introduction

Individuals and communities face a growing barrier to navigating the interconnected landscape of modern life without reliable and affordable internet access . [1]The resulting barriers from limited internet access range from economic to knowledge exchange barriers. Economically, reliable and affordable connectivity is crucial for economic growth, job creation, and social mobility, and its absence limits individuals' participation in the digital economy, impacting their job opportunities, income level, and overall well-being[2] . Similarly, limited internet access restricts access to information and knowledge resources, hindering individuals' and communities' ability to learn, innovate, and participate in modern knowledge-based societies.[3]

Nigeria has made commendable growth in internet adoption over the past two decades, with the estimated number of users rising from around 200,000 in 2000 to over 111 million in 2020[4]. To accelerate internet adoption and the economic opportunities afforded by widespread availability of quality and affordable access, the Nigerian government launched the first National Broadband Plan in 2013 for a period of five years. The 2013-2018 National Broadband Plan aimed to achieve broadband access; defined as a minimum download speed of 1.5Mbpsand a plan target of 30% broadband penetration [5]. Though broadband penetration rate at the end of the plan period reached 31.48%, the achievement lags the aspiration of the country due to global development in communication technologies which led to widespread deployment of 5G technologies while countries like Nigeria were yet to achieve significant 4G coverage. To this end, a committee was commissioned in 2019 to draft the revised National Broadband Plan (2019 - 2025) which aims to achieve a minimum of 25 Mbps in urban areas and a broadband penetration target of 70% [6].

However, broadband penetration currently stands at about 45.57% (NCC Website, 2023) and only about 39% of the population currently resides within 5 kilometres to fibre networks, with Lagos state having a high of 85% and Jigawa with a low of 12%. The last mile FTTx connection rate and fibre-to-tower connection rates are also considered low relative to other African countries. Similarly, the average download speed of 26.48 Mbps ranked the country 89th globally[7], and a significant digital divide exists between urban and rural areas, which calls for an urgent case for optimal connectivity strategy. Therefore, implementing the necessary infrastructure and policies to deliver high-quality and affordable internet to all citizens remains on the top agenda of President Bola Ahmed Tinubu's administration[8].

[1] Lythreatis, S., Singh, S. K., & El-Kassar, A. N. (2022). The digital divide: A review and future research agenda. *Technological Forecasting and Social Change*, 175, 121359.

[2] Lythreatis, S., Singh, S. K., & El-Kassar, A. N. (2022). The digital divide: A review and future research agenda. *Technological Forecasting and Social Change*, 175, 121359.

[3] Ragnedda, Massimo & Muschert, Glenn. (2013). The Digital Divide: The Internet and Social Inequality in International Perspective

[4] Internet World Stats, "Internet Users Statistics for Africa", 2022.

[5] *Broadband Implementation Steering Committee* (2023) Brief on the implementation of the Nigerian National Broadband Plan (NNBP 2020-2025)

[6] FMCIDE (2020), Nigerian National Broadband Plan 2020 - 2025.

[7] Speedtest Global Index, "Nigeria's average mobile download speed by Ookla", 2024. https://www.speedtest.net/global-index - Last accessed on January 5, 2024.

[8] FMCIDE (2023), Federal Ministry of Communications, Innovation and Digital Economy: Strategic Blueprint 2023

Deepening Our National Backbone and Middle Mile Infrastructures

Nations gain unprecedented benefits in speed, reliability, and future scaling when they build modern broadband infrastructures. The 2019 Broadband Plan states that at least 120,000km of fibre optic cables in non overlapping routes will be needed to achieve the target backbone and middle mile coverage. Fibre technology in this case will enable significantly higher bandwidth capacity and speeds. This is because optical fibre carries data as light pulses, thereby avoiding the electronic signalling limitations of traditional mediums[9]. This can allow backbone transfer rates up to 50Tbps over long distances. Transmission speed of fibre cables is considered fast with lower latency, as high frequencies reduce latency and improve response times.[10]. Another justification for fibre optic cable is its reliability as it suffers lower attenuation losses over distance, allowing greater signal reach, and its immunity to electromagnetic interference, which prevents environmental disruptions, resulting in lower failure rates and maintenance costs over the long term.

There is also an advantage in future adaptability, as fibre capacity can be increased essentially without limit through equipment upgrades. This future-adaptable fibre investment will allow capacity growth by simply swapping fibre terminal gear, i.e., as demand increases, speeds can be cost-effectively scaled to 100 Gbps and beyond [11]. Considering such fibre optic cable capabilities would enable Nigeria to establish a truly high-speed broadband infrastructure integrating its mobile networks. While this connectivity design promises to accelerate growth across vital areas like business development, education, healthcare, agriculture, and e-governance[12], realising these extensive benefits requires significant fibre optic deployment nationwide.

[9] Winzer, P. J. (2014). Spatial multiplexing in fibre optics The 10x scaling of metro/core capacities. Bell Labs Technical Journal, 19, 22-30.

[10] Cartledge, J. C., Guiomar, F. P., Kschischang, F. R., Liga, G., & Yankov, M. P. (2017). Digital signal processing for fibre nonlinearities. Optics express, 25(3), 1916-1936.

[11] Winzer, P. J. (2011). Energy-efficient optical transport capacity scaling through spatial multiplexing. IEEE Photonics Technology Letters, 23(13), 851-853.

[12] Olusola, A., Oluwadare, S., Olaojoyetan, E., & Christianah,M. (2014). Fibre Broadband Developmen in Nigeria: A Catalyst to Economic Growth and Social Development. Global Advanced Research Journal of Engineering, Technology and Innovation, 3(5), 83-99.

Fibre Network, Coverage and Reach

The NCC report indicates that Nigeria's fibre links are mainly owned by the MNOs (MTN, Airtel, Globacom) and other players such as IHS, Phase3, and EMTS, amongst others, with about 25% of the fibre distances in metro fibre networks. The metro network is also highly concentrated in the major cities of Lagos, Edo, Abuja, Oyo and Ogun states, while many other areas remain unserved or underserved.

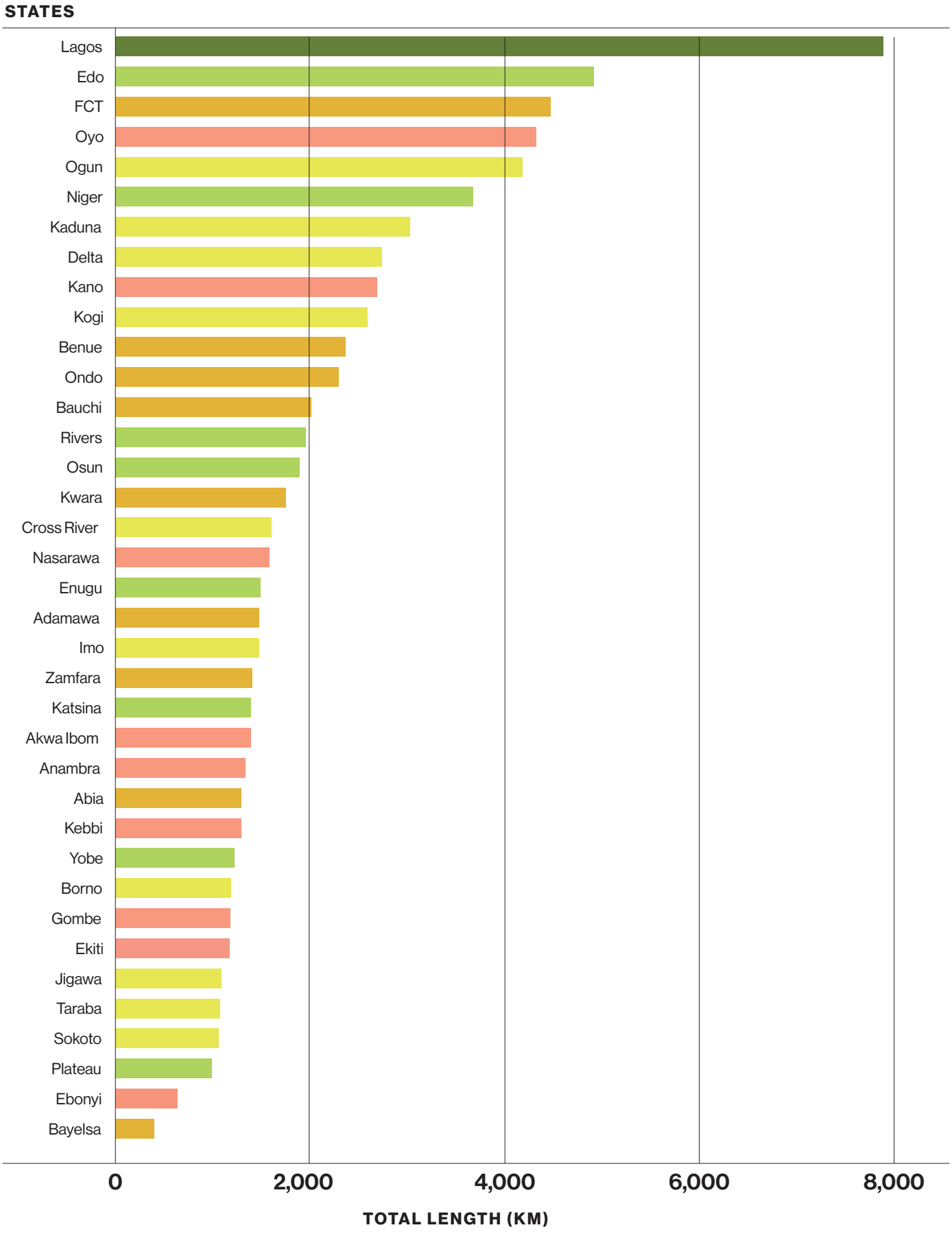
S/N	STATE	TOTAL LENGTH PER STATE (KM)
1	Lagos	7,864.50
2	Edo	4,892.71
3	FCT	4,472.03
4	Oyo	4,328.62
5	Ogun	4,189.18
6	Niger	3,681.66
7	Kaduna	3,028.88
8	Delta	2,750.42
9	Kano	2,697.72
10	Kogi	2,602.25
11	Benue	2,375.89
12	Ondo	2,302.34
13	Bauchi	2,018.52
14	Rivers	1,962.65
15	Osun	1,902.05
16	Kwara	1,753.82
17	Cross River	1,611.10
18	Nasarawa	1,590.01
19	Enugu	1,499.57

S/N	STATE	TOTAL LENGTH PER STATE (KM)
20	Adamawa	1,487.77
21	Imo	1,448.50
22	Zamfara	1,406.23
23	Katsina	1,405.15
24	Akwa Ibom	1,396.11
25	Anambra	1,343.20
26	Abia	1,296.46
27	Kebbi	1,291.22
28	Yobe	1,233.31
29	Borno	1,190.04
30	Gombe	1,182.40
31	Ekiti	1,178.04
32	Jigawa	1,100.53
33	Taraba	1,076.58
34	Sokoto	1,066.56
35	Plateau	997.45
36	Ebonyi	651.65
37	Bayelsa	407.88

Source: Nigerian Communication Commission (2023)

The numbers above can be discounted by 20 - 25% to account for duplication in reporting same/similar routes across providers and damage to routes eroded due to construction and poor maintenance.

Fibre Length by State



Despite the unprecedented benefits of fibre technologies (FTTT: Fibre to the Towers , FTTH: Fibre to the Home and FTTX: Fibre to Anywhere inc data centres, enterprise locations, public institutions, etc), realising nationwide connectivity has some challenges such as the feasibility of access and installation across different terrains (forests, hills, wetlands). Construction and permit issues are also some of the challenges to be navigated for new fibre, particularly in urban areas. Rights of way negotiations and, in some cases, routing fibre through existing infrstructure and public utilities require top-level coordination. While government agencies at national and sub-national levels are committed to collaborating to eliminate many of these challenges, investors are still faced with the critical question of market viability - vis-a-vis cost of investment and return on investment (particularly in unserved and underserved areas). Similarly, once installed, there is the need to account for the costs of maintenance, repairs, and operation, as routine maintenance helps preserve its uptime and performance. Secondly, the viability of the investment raises a fundamental challenge i.e., consideration of payback period.

The main explanation for poor ROI is usually the low or non-consumption of internet services in many parts of the country; particularly in rural and underserved communities.

The Broadband Alliance

Accelerating our collective prosperity through connectivity

To tackle the low and non-consumption challenge and its resultant poor ROI in nationwide fibre network, the Ministry of Communications, Innovation and Digital economy has initiated a National Broadband Alliance for Nigeria (NBAN) to foster collaboration for broadband development and adoption, as well as position Nigeria at the forefront of the global digital landscape.

The National Broadband Alliance for Nigeria is a multi-stakeholder collaboration aimed at spearheading a concerted effort to achieve universal broadband access across the nation. Recognising the imperativeness of broadband in economic development, the alliance will bring together key stakeholders from the public and private sectors, as well as civil society, to collaboratively develop sustainable business model(s) for driving the adoption and consumption of internet in key critical public institutions (schools, hospitals, government offices, libraries and markets etc) across the nation.

State Public Institutions

S/N	STATE	SCHOOLS	HEALTHCARE FACILITIES	MARKETS	RELIGIOUS CENTRES
1	Abia	2,955	1,218	394	894
2	Adamawa	3,143	1,575	380	1,442
3	Akwa Ibom	1,854	842	770	3,233
4	Anambra	2,031	1,567	426	1,050
5	Bauchi	3,059	1,331	175	2,828
6	Bayelsa	1,109	387	107	944
7	Benue	3,974	2,191	982	3,773
8	Borno	1,551	840	235	4,711
9	Cross River	2,494	1,395	334	1,278
10	Delta	3,075	909	305	1,830
11	Ebonyi	3,216	1,112	1,657	2,401
12	Edo	1,814	972	187	174
13	Ekiti	1,963	679	136	353
14	Enugu	3,405	1,384	402	385
15	Fct	1,237	576	57	761
16	Gombe	2,284	776	195	3,616
17	Imo	3,337	1,661	497	1,094
18	Jigawa	2,498	729	150	689
19	Kaduna	5,380	1,103	177	2,360
20	Kano	5,927	1,561	362	1,196
21	Katsina	3,473	2,228	118	1,063
22	Kebbi	2,075	1,091	88	590
23	Kogi	2,112	1,496	51	608
24	Kwara	2,413	888	90	539
25	Lagos	7,947	2,320	498	1,981
26	Nasarawa	2,095	1,127	107	2,648
27	Niger	3,834	2,010	142	2,553
28	Ogun	4,305	1,644	186	857

State Public Institutions (CONTD.)

S/N	STATE	SCHOOLS	HEALTHCARE FACILITIES	MARKETS	RELIGIOUS CENTRES
29	Ondo	2,345	1,025	147	945
30	Osun	2,366	1,576	290	-
31	Oyo	3,375	1,685	124	1,111
32	Plateau	3,406	1,348	438	2,396
33	Rivers	1,958	723	160	892
34	Sokoto	2,194	914	80	617
35	Taraba	2,787	1,380	303	1,124
36	Yobe	950	597	48	58
37	Zamfara	1,953	916	51	1,358

Source: GRID3 Dataset. https://grid3.org/

The alliance will also serve as a platform for government agencies, telecommunication companies, technology providers, and civil society organisations to coordinate efforts and share resources in support of the Ministry's agenda for nationwide expansion of broadband services. With the national desk at NCC, the NBAN nodes hosted by sub-national governments (states) will work closely with regulatory bodies to streamline processes and remove obstacles hindering the swift deployment of broadband networks. It will also drive digital inclusion and awareness to ensure the inclusion of all segments of society in the digital economy and benefit from the advantages of broadband connectivity. The alliance will collaborate with international partners and organisations to leverage expertise and resources for accelerated implementation and adopt a phased approach, with short-term, medium-term, and long-term goals aligning with the National Broadband Plan.

The pilot of this initiative will kick off in 7 states of the country before the end of Q1 2024. The initial states are Edo, Ogun, Kwara, Katsina, Imo, Abia, Borno and Nasarawa. These initial states have been considered using their present broadband investment and management of fibre optic challenges in their respective states such as such as waiver of the Right of Way fee.

Impact Cases

Education

A national fibre optic rollout will bridge the geographical gap by connecting remote communities and schools to the internet. High-speed internet will allow teachers to access professional development resources, collaborate with their peers, and utilise technology-driven teaching methods which will ultimately enhance the quality of education in Nigeria. It will also promote lifelong learning and skill development, regardless of age, location or background as it enables access to online courses, MOOCs, and educational resources that can be accessed at any time, any place and at any pace. In addition, *'connected schools'* will enable students to access online learning platforms, educational resources, and facilitate virtual classrooms. This will revolutionise our education by providing access to quality education regardless of individuals' location, offering diverse learning opportunities beyond the limitations of physical classrooms we have in the country, facilitating interaction and collaboration with students and educators from around the world. The afore-mentioned, will reduce educational inequalities in the country and improve general learning outcomes besides its ability to empower teachers[16].

Healthcare

A national fibre optic rollout will improve access to healthcare. It will facilitate telemedicine platforms which will connect patients in rural areas to medical professionals in urban areas, thereby enabling provision of critical medical consultations and diagnoses remotely. This will not only provide timely medical attention for urgent cases (saving lives) but also reduce non-essential travel and consultations costs[17]. Investing in national fibre optic rollout will also strengthen our healthcare systems, as the investment will enable real-time data sharing between healthcare providers, and access to databases and medical resources. This will also enhance disease surveillance and outbreak control by facilitating big data analysis and communication.

Financial Services

National investment into fibre optic will promote financial inclusion, as it will enable access to online banking, mobile money platforms, and digital financial services irrespective of location. This will also increase access to financial services for the unbanked and underbanked populations, particularly in rural areas. The spillover effect of this is facilitation of economic growth by boosting entrepreneurship and small business growth[18].

E-commerce

Investing in the national backbone and middle mile assets will foster the growth of online businesses, e-commerce platforms, and digital services, creating new job opportunities and entrepreneurial ventures[19]. This has the potential to not only diversify the country's economy and reduce dependency on traditional sectors but will promote innovation and creativity within the digital economy (job creation and entrepreneurship) as individuals will have access to a vast array of information.

E-governance

The national backbone will also strengthen governance and transparency as individuals will have access to government services and information. The resulting access to government services online will improve efficiency, reduce corruption, and empower citizens[20]. It is also expected to increase civic engagement and participation, thereby strengthening democracy.

16. Matthew, U. O., Kazaure, J. S., Kazaure, A. S., Nwamouh, U. C., & Chinonso, A. (2022). ICT Policy Implementation as Correlate for Achieving Educational Sustainability: Approaching Development in Multi ICT Dimensions. *Journal of Information Technology,* 4(4), 250-269.

17. Idowu, P. A. (2014). Information and communication technology: a tool for health care delivery in Nigeria. In *Computing in Research and Development in Africa: Benefits, Trends, Challenges and Solutions* (pp. 59-79). Cham: Springer International Publishing.

18. Jeremiah O. Ejemeyovwi, Evans S. Osabuohien & Ebenezer I. K. Bowale (2021) ICT adoption, innovation and financial development in a digital world: empirical analysis from Africa, Transnational Corporations Review, 13:1, 16-31, DOI: 10.1080/19186444.2020.1851124

19. Hussain, S., Gul, R., & Ullah, S. (2023). Role of financial inclusion and ICT for sustainable economic development in developing countries. Technological Forecasting and Social Change, 194, 122725.

20. Abah, E. O., & Nwokwu, P. M. (2019). Problems and prospects of e-governance in an emerging state: The Nigerian example. *Journal of humanities and Social Science,* 24(9), 14-21.

Conclusion

In addressing the question of how we can spur and sustain consumption after driving national investments in fibre optic cables, the strategic approach in this white paper attends to the issue of invesment viability by assesing the extent communites can uptake broadband and linking investment in broadband to scaled cosumption. This approach anticpates attehndant benefits on price and affordability of broadband.

One clear example of how to achieve this is by delivering digital educational resources in in schools and colleges amongst other infrastructures we have highlighted that will mitigate investors' concern on sustainable RoI from investing in national fibre optic network roll-out by addressing low uptake of capacity on these networks. Looking at international internet requirements for schools, it shows for instance that the UK government requires a leased line or fibre to the premises (FTTP) of all educational establishments with primary schools expected to have at least a minimum of 100Mbps download speed and a minimum of 30 Mbps upload speed. Secondary schools and further education are required to have connection capacity to deliver at least 1 Gbps download and upload speed[21]. Implementation of similar standards for public buildings in Nigeria will instantly activate subsisting but unexplored demand. At the national level, aggregating the potential consumption of 19,567 schools, 10,035 healthcare facilities, 5,394 religious centres, 1,584 markets, 507 government buildings[22] amongst others give us a purview of internet consumption that are economically beneficial and at the same time will translate into income for investors who ordinarily cite consumption as a problem to fibre optic investments.

[21] DfE (2023), Meeting digital and technological standards in schools and colleges. https://www.gov.uk/guidance/meeting-digital-and-technology-standards-in-schools-and-colleges/broadband-internet-standards-for-schools-and-colleges

[22] Data aggregated from GRID3