Nigeria Telecoms Infrastructure Sharing and Colocation Technology: Key Governance and Costs Reduction

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Abstract- The Nigerian telecom industry has witnessed rapid growth, driven by increasing demand for mobile services. However, the high cost of infrastructure deployment and maintenance has posed significant challenges to operators. Infrastructure sharing and colocation technology have emerged as viable solutions to reduce costs, improve efficiency, and enhance network quality. This study examines the current state of infrastructure sharing and colocation in Nigeria, highlighting the benefits, challenges, and regulatory frameworks governing the practice. The research reveals that infrastructure sharing and collocation can lead to significant cost savings, improved network reliability, and increased coverage. However, challenges such as regulatory complexity, technical compatibility issues, and security concerns must be addressed. The study recommends standardized guidelines, industry collaboration, and investment in emerging technologies to drive the adoption of infrastructure sharing and colocation in Nigeria.

Indexed Terms- Infrastructure Sharing, Colocation Technology, Telecom, CAPEX, OPEX, Network Efficiency, Regulatory Framework.

I. INTRODUCTION

The telecommunications industry and its ecosystem in Nigeria has experienced rapid growth over the past twenty years, this is driven by increasing demand for mobile services, expansion of network coverage, and declining tariffs. However, the high cost of infrastructure deployment and maintenance has posed significant challenges to Mobile Network Operators, MNOs, affecting their profitability and ability to invest in network expansion and quality improvement. In response to these challenges, infrastructure sharing and colocation technology have emerged as viable solutions to reduce costs, improve efficiency, and enhance network quality. These challenges are made up by Nigeria's energy crisis, high inflation rates, and operational inefficiencies, which have placed considerable financial pressure on operators.

Infrastructure sharing and colocation technology have emerged as pivotal strategies to reduce these challenges and enhance sector efficiency. These approaches involve multiple operators sharing physical infrastructure such as towers, fibre optic networks, and data centres, reducing the duplication of assets and operational costs. Globally, infrastructure sharing has been recognized as a critical enabler of cost efficiency, improved service quality, and expanded network coverage, particularly in underserved and rural areas. The provision of telecommunications access to rural communities in Nigeria has faced numerous challenges over the years, often hindered by systemic corruption and flawed initiatives from the government. Efforts to achieve universal access have frequently resulted in significant setbacks, marked by wasted resources and unfulfilled promises. A notable example is the Rural Telephony Project (RTP), a loan-backed initiative involving a consortium of Chinese investors, which collapsed after consuming an estimated N5 billion without achieving its objectives (Sesan and Omo-Ettu, 2007). Beyond the issue of corruption, the drive to extend telecommunications services to rural areas is impeded by a myriad of other challenges. These include inadequate infrastructure, high operational costs, security concerns in remote areas, and limited economic incentives for operators to invest in low-revenue markets. Addressing these barriers requires comprehensive strategies that prioritize transparency, robust regulatory oversight, and innovative approaches to infrastructure deployment and service delivery (Y.A Adediran, 2016).

In Nigeria, the adoption of infrastructure sharing has been driven by both economic imperatives and

regulatory initiatives, such as the Nigerian Communications Commission (NCC)'s licensing framework for infrastructure sharing and active promotion of colocation among operators. Despite these efforts, barriers such as regulatory ambiguity, technical compatibility issues, and concerns over cybersecurity persist, hindering the full-scale implementation of these strategies.

This paper presents an examination on the current state of infrastructure sharing and colocation technology in Nigeria, exploring their benefits, challenges, and potential for driving sustainable growth in the telecommunications industry. By addressing these issues, the industry can achieve enhanced operational efficiency, reduced costs, and improved service delivery, contributing to Nigeria's broader socio-economic development.

1.1 LITERATURE REVIEW

Telecoms infrastructure sharing and colocation technology are crucial for reducing costs, improving efficiency, and enhancing network quality in Nigeria. The establishment of the telecommunications sector in Nigeria stands as one of the important dividends of democracy following 19 years of democratic governance after decades of military rule. A pivotal transformation occurred in 2001 during the administration of President Olusegun Obasanjo. This period marked a groundbreaking milestone with the liberalization of the sector and the granting of GSM (Global System for Mobile Communications) licenses to private operators, enabling them to commence business operations. This development revolutionized access to mobile telecommunications and laid the foundation for Nigeria's thriving telecom industry (Ugwu, 2016). This section presents a summary of related literature that is available regarding telecommunications infrastructure sharing and collocation technology in Nigeria.

As in (S. Victor, 2015) evaluated the impact of telecommunication infrastructure on Nigeria's economic growth, recognizing the critical role of Information and Communication Technology (ICT) in fostering development and sustaining emerging economies. Given the forces of globalization and rapid technological advancements, it has become imperative to analyse the influence of telecommunication infrastructure on Nigeria's economic development. The research employed secondary data spanning 2000 to 2014 and utilized the Ordinary Least Squares (OLS) regression technique to quantify the relationship between telecommunication infrastructure and economic growth. The findings underscore the significant contributions of the telecommunication industry to Nigeria's GDP, revealing a consistent year-on-year increase in its economic impact. Moreover, the industry serves as a key agent of globalization by facilitating connectivity, communication, and integration into the global economy through its services. The study's reliance on secondary data from 2000 to 2014 poses a limitation, as the telecommunication landscape has evolved significantly in recent years with advancements such as 5G technology and increased internet penetration. Additionally, the research did not explore the socio-economic disparities in access to telecommunication services or their regional impacts within Nigeria.

(U.O Mathew, 2021) In his study examined telecommunication subscriber data for 2020 based on the system report of the Nigerian Communications Commission (NCC). The findings reveal a steady increase in the number of telecommunication subscribers, reflecting the growing reliance on mobile and data services in Nigeria. In January 2020, the total number of subscribers reached 186 million, which rose to 187.4 million in February and further to 189.3 million by March, marking the end of the first quarter (Q1). This growth continued into the second quarter (Q2), with 191 million subscribers recorded in April, 192.3 million in May, and 196.4 million by June 2020. The study also highlighted significant expenditures on telecommunication services, with Nigerians spending N320 billion on calls and data in January 2020, increasing slightly to N323.2 billion by February. These findings underscore the escalating financial burden of telecommunication services on households, with potential implications for disposable incomes and economic inequality. However, the study raises concerns about the absence of robust regulatory mechanisms to control consumer spending on essential telecommunication services. Without intervention, the research suggests that many Nigerians may face unsustainable out-of-pocket expenditures by 2030, further straining household

finances and limiting access to critical communication services.

(Y.A. Adediran, 2016) worked on the issues and challenges of rural telecommunication access in Nigeria. This research was conducted because of the challenges faces with rural communities such as lack of social services and infrastructures despite telecommunication services being available in Nigeria more than two decades. In this research, the researchers investigated infrastructure sustainability issues and proffers some technological solutions to meeting the telecommunication needs of the rural areas in Nigeria with a short period of time.

(Nosiri O.C., 2015) in their research underscores the critical importance of mobile network operators in Nigeria viewing infrastructure sharing as an essential phase in the development lifecycle of the mobile telecommunications industry. It highlights the significant challenges posed by inadequate network infrastructure, an unfavorable business environment, and the growing demand for rapid network deployment. These factors have prompted the need for harmonization, collaboration, and consolidation among key service providers. The goal is to reduce both operating expenses (OPEX) and capital expenditure (CAPEX), while simultaneously ensuring quality service delivery. This paper argues that the strategy of individual operators pursuing isolated network expansion—aiming to be the first to reach a particular subscriber base—should not be pursued in the Nigerian telecom sector. Instead, the article advocates for infrastructure sharing as a model that would bring numerous benefits. These include enhanced network availability, greater reliability, increased innovation, expanded coverage, improved customer satisfaction, and long-term economic sustainability. It calls for regulatory enforcement to ensure that collaboration between telecom operators becomes a standard practice within the industry.

The telecommunications industry is undergoing a profound transformation, driven by a complex network of partnerships and collaborations that are reshaping the future of infrastructure, connectivity, and services. (Spencer Itive, 2023) worked on research that focuses on this evolving landscape, exploring how these partnerships are redefining the industry and charting the path forward. This study underscores how these partnerships are redefining traditional models, fostering innovation, and laying the groundwork for a more interconnected and agile telecommunications landscape.

(Spencer Itive, 2024) conducted research that evaluates the Handoff Drop Call Rate (DCR) in a GSM network by applying a Dynamic Cut-Off Channel Allocation Scheme and analyzing its implications for tower sharing and collocation among Mobile Network Operators (MNOs). By assessing different MNOs and benchmarking their performance against the Nigerian Communications Commission's (NCC) Key Performance Indicators (KPI), the study identifies critical challenges in handoff and mobility management within shared infrastructure settings. A hybrid handoff algorithm was developed to address these challenges, aiming to reduce drop call rates and optimize the shared use of communication towers. The study evaluated the performance of this hybridized algorithm and compared its simulated results to the existing handoff performance of Nigeria's top-performing mobile communication networks. Findings revealed that the current Handoff Failure Rate (HFR) per cell stood at 5%, and the Drop Call Rate (DCR) was 10%, both exceeding NCC's maximum thresholds of 2%. These deficiencies highlight significant Quality of Service (QoS) challenges that are exacerbated in a shared infrastructure environment where resource allocation is critical.

(NCC, 2021) worked on promoting the efficient use of telecommunications resources, reduce capital and operational expenditures for Mobile Network Operators (MNOs), and enhance service quality by sharing guidelines on collocation and infrastructure sharing. These guidelines support Nigeria's efforts to foster sustainable growth in the telecommunications sector, ensuring operators collaborate to improve nationwide coverage and quality of service.

II. TELECOMS INFRASTRUCTURE MODELS

There are several forms of infrastructure sharing commonly deployed worldwide: Tower sharing, active sharing, site sharing and fiber optic sharing. These models offer different levels of collaboration

and resource utilization among telecom operators, each with distinct advantages and challenges.

- Tower Sharing: Sharing of cell towers, including site acquisition, construction, and maintenance.
- Fiber Optic Sharing: Sharing of fiber optic cables, ducts, and related infrastructure.
- Site Sharing: Sharing of cell sites, including buildings, power, and security.
- Active Sharing: Sharing of active network equipment, such as base stations and transmission gear, microwave radio equipment, common network infrastructure.

Despite this collaboration, each operator maintains its own independent home network, which includes individual subscriber databases, services, billing systems, and connections to external networks. The different telecoms infrastructure models necessitate careful planning and deployment to meet the specific capacity needs of each participating operator.

2.1 COLLOCATION TECHNOLOGY MODELS

Collocation technology models allude to the various situations and elements that telecommunications operators put into consideration to share infrastructure and improve resource usage. These models ensure efficient service delivery, cost reduction, and network scalability. Here's an overview of the common collocation technology models:

- Data Center Colocation: Hosting and managing telecom equipment in shared data centers.
- Co-location Facilities: Sharing facilities for housing telecom equipment, such as cell sites and towers.
- Edge Computing: Deploying computing resources at the edge of the network, closer to users.

2.2 KEY GOVERNANCE| REGULATORY FRAMEWORK

Governance and regulatory frameworks in the telecommunication industry are important for encouraging a stable, competitive, and efficient environment that benefits mobile network operators , end users, and the nation at large. These frameworks establish the rules, processes, and standards that govern industry operations, ensuring fair practices, innovation, and service quality. Below are the available key governance regulatory framework

- Regulatory Framework: The Nigerian Communications Commission (NCC) regulates infrastructure sharing and colocation.
- Guidelines: NCC's Guidelines on Infrastructure Sharing and Colocation provide a framework for operators.
- Licensing: Operators must obtain licenses for infrastructure sharing and collocation.
- Dispute Resolution: NCC's dispute resolution mechanisms address conflicts between operators.

2.3 KEY PLAYERS

The telecommunications industry is a dynamic environment made up of various stakeholders that contribute to its growth, innovation, and service delivery. These key players include service providers, infrastructure sharing companies, regulatory bodies, technology providers, and end users.

1. Mobile Networks Operators:

- MTN Nigeria: MTN is the leading GSM operator in Nigeria and Africa at large with about 61.6 million of subscribers in Nigeria alone. MTN happens to be the first GSM network to make a call in Nigeria according to the Nigerian communication commission in 2001 (C.A Nwabueze, 2016).
- Airtel Nigeria: This is a GSM operator in Nigeria formerly known as Zain with about 13 million subscribers in Nigeria as at 2019. This network provider company started from ECONET in the year 2000 before VMOBILE took over and then again CELTEL took over till it became AIRTEL.
- Globacom: Globacom is the second leading GSM operator in Nigeria with 45 million subscribers as at December 2018. This network provider company was launched in 2003, and it was able to build the first submarine cable from UK to Nigeria so that the bandwidth which connects the cable together is sufficient (C.A Nwabueze, 2016).
- Emerging Market Telecommunications Services (EMTS)(9mobile): This network was formally known as ETISALAT which was established by a partnership between Mubadala development company and Etisalat of the United Arab Emirates with Nigerian government license in 2007 (C.A Nwabueze, 2016).

Table 1: Four Nigerian Mobile Network Operators and subscriber rate

MNO	MTN	AIRTEL	GLOBACOM	EMTS
NO OF SUBSRIBER	81,799,666	63,357,061	62,191,448	11,657,703
% NO OF SUBSCRIBER	37.32	29.03	28.57	5.07

Source: (National Bureau of statistics, 2024)

2. Nigerian Communications Commission (NCC) – The Chief Regulator
3. Infrastructure sharing companies:

- Helios Towers,
- IHS Towers, and
- American Tower Corporation, ATC
- Pan African Towers, PAN.
- Africa Data Centres
- Digital Realty
- Rack Centre
- MDXi (MainOne)
- Zenlayer

2.4 NIGERIAN TELECOM OPERATORS' INFRASTRUCTURE INITIATIVES/ CASE STUDIES

Here are different infrastructure sharing and colocation technology initiatives by Mobile Network Operators (MNOs) in Nigeria:

- Tower Sharing: MTN Nigeria, Airtel Nigeria, and 9mobile share towers through the Nigerian Tower Interference Reduction Initiative.
- Fiber Optic Sharing: MTN Nigeria and Airtel Nigeria share fiber optic cables through the Fiber Optic Cable Sharing Agreement.
- Site Sharing: Globacom and 9mobile share cell sites through the Site Sharing Agreement.
- Passive Infrastructure Sharing: IHS Towers, Helios Towers, and American Tower Corporation provide shared passive infrastructure to MNOs.

2.5 COLOCATION TECHNOLOGY INITIATIVES

- Data Center Colocation: MTN Nigeria's data center provides colocation services to other MNOs.
- Co-Location Facilities: Airtel Nigeria's co-location facilities offer hosting services for other MNOs' equipment.
- Edge Computing: Globacom deploys edge computing solutions for reduced latency and improved QoE.
- Cloud Services: 9mobile offers cloud services through its partnership with Microsoft Azure.

III. GUIDELINES IN OPERATION AND MAINTENANCE

1. *Fault Management*

- The Infrastructure Provider shall be responsible for clearing all faults associated with the network element(s) it is sharing, except where such fault is traced to the Infrastructure Seeker's interface, in which case the Infrastructure Seeker shall be responsible for clearing such faults.
- In case of dispute after third level escalation, both vendors of the equipment should be called in for resolution.

2. *Network Availability*

- The Infrastructure Provider shall make every effort to ensure the Infrastructure Seeker enjoys the same level of availability as its own customers and maintain such level as contained in the Quality-of-Service Regulations, or such directions and other regulatory instruments as may be developed by the Commission.
- The Infrastructure Provider shall be responsible for any infraction due to non-compliance with the availability requirements on the network element(s) being shared.

3. *Quality of Service and Experience*

- The Infrastructure Provider shall offer the same quality of service to the Infrastructure Seeker on the network element(s) being shared.
- The Infrastructure Provider shall ensure it meets all quality-of-service requirements under the Quality-of-Service Regulations and other relevant regulations, Directions and guidelines developed by the Commission.

- The Infrastructure Provider shall be responsible for any infraction due to non-compliance with quality-of-service requirements in line with sub-paragraph (b) above on the network element(s) being shared.

4. Billing

- The technicalities for billing shall be based on the type of active sharing service being offered.
- For transmission capacity sharing, billing shall be based on kilometres, capacity and availability as agreed by the parties.
- For traffic-based services in MORAN, MOCN and GCN, billing shall be based on parameters agreed by parties.
- For services such as SMS, VAS etc, billing shall be based on parameters agreed by parties.

3.1 TELECOM KEY DRIVERS

Telecommunications key drivers are the factors that has the capacity of influencing the growth, innovation, and direction of the telecommunications industry. These drivers These drivers can be categorized into several dimensions, such as technological innovations, economics, regulation, societal needs, and environmental concerns. Here's an overview of the key drivers:

- Increasing demand for data services and digital transformation.
- Growing need for cost savings and operational efficiency.
- Government initiatives for infrastructure development.
- Expanding mobile broadband coverage.
- Emerging technologies (5G, IoT, edge computing).

Growth Projections

- Compound Annual Growth Rate (CAGR) of 15%–20% (2023–2028).
- Estimated market size: $1.5 billion–$2.5 billion (2025).
- Tower sharing market growth: 12%–15% CAGR (2023–2028).
- Colocation market growth: 20%–25% CAGR (2023–2028).

Project Costs - OPEX & CAPEX Management.

a) OPEX Management: OPEX is the ongoing cost for running a product, business or system
- Energy Costs: Shared energy costs for powering infrastructure.
- Maintenance Costs: Shared maintenance costs for infrastructure.
- Security Costs: Shared security costs for protecting infrastructure.

b) CAPEX Management: CAPEX is an expense a project/business incurs to create a benefit in the future
- Initial Investment: Shared initial investment in infrastructure development.
- Upgrade Costs: Shared costs for upgrading infrastructure.
- Replacement Costs: Shared costs for replacing infrastructure.

III. BENEFITS OF TELECOM INFRASTRUCTURE SHARING

There are numerous benefits accrued in telecommunication infrastructure sharing. Some of the benefits are listed thus

1. Cost Savings: Infrastructure sharing helps to reduce CAPEX and OPEX for operators. Telecom infrastructure sharing can significantly enhance cost-efficiency and resource utilization for telecom operators. By sharing infrastructure, operators can achieve approximately 15% savings in OPEX and 30% in CAPEX.

2. Improved Efficiency: Enhanced network quality and reliability. Infrastructure sharing can expand coverage into rural areas, and meeting up with the universal service target

3. Increased Coverage: Expanded network coverage and reach.

4. Environmental Sustainability: Reduced carbon footprint and environmental impact.

5. Quick Return on Investment, ROI

6. Risk Management & transfer.

7. Industry Collaboration: Increased collaboration among operators and infrastructure providers.

VI. CHALLENGES OF INFRASTRUCTURE SHARING

Some of the significant challenges hindering infrastructure sharing in Nigeria :

1. The intense competition among operators. In their efforts to capture market share, operators are engaged in a fierce race to attract customers, often at the expense of collaboration.

2. Lack of enforceable legislation or regulations that mandate infrastructure sharing. This regulatory gap is often exploited by established operators, who impose stringent demands on others seeking to share their infrastructure. These incumbent operators are frequently reluctant to open their networks to competitors and new entrants, making it difficult for them to gain access to necessary sites. This lack of trust can result in deliberate delays, further hindering the rollout of new networks.

However, the Nigerian Communications Commission (NCC) has recently taken steps to address these challenges by licensing Co-location vendors such as Helios Towers, IHS towers PLC, and Swap Technology (PAN African). These initiatives are expected to reduce some of the barriers to infrastructure sharing and improve the overall network deployment process, fostering a more collaborative environment in the industry.

3. Complexity in regulatory frameworks,
4. Interoperability and technical compatibility issues,
5. Ensuring security and integrity of shared infrastructure,
6. Risk Management,
7. Community | Stakeholders Engagement & Management.

VIII. RISK MANAGEMENT STRATEGIES

1. Clear Contractual Agreements: Well-defined contracts outlining terms, conditions, and responsibilities.
2. Service Level Agreements (SLAs): Establishing performance metrics and penalties for non-compliance.
3. Regular Maintenance and Upgrades: Ensuring infrastructure reliability and minimizing downtime.
4. Redundancy and Backup Systems: Implementing redundant systems to mitigate single points of failure.
5. Cybersecurity Measures: Protecting against cyber threats and data breaches.
6. Insurance Coverage: Maintaining adequate insurance coverage for infrastructure and operations.
7. Compliance with Regulations: Adhering to regulatory requirements and industry standards.

Colocation Pricing Models

Colocation providers in Nigeria typically offer a range of pricing models, including:

- Monthly Recurring Cost (MRC) for white space capacity, which includes the physical space and infrastructure to power and cool IT equipment.
- Non-Recurring Cost (NRC) for project initialization and management.
- Bundled Energy models, where the entire energy capacity subscribed to is billed monthly in advance.
- Metered Energy models, where energy consumed per rack PDU is metered and billed separately.

Conflict Resolution Mechanisms

1. Dispute Resolution Clauses: Including dispute resolution clauses in contracts.
2. Mediation and Arbitration: Establishing mediation and arbitration procedures.
3. Regular Communication: Fostering open communication among operators and stakeholders.
4. Collaborative Problem-Solving: Encouraging collaborative problem-solving and issue resolution.
5. Independent Third-Party Audits: Conducting regular audits to ensure compliance and fairness.

Key Performance Indicators (KPIs) & Tracking

1. Uptime and Availability: Monitoring infrastructure uptime and availability.
2. Mean Time to Repair (MTTR): Tracking time to resolve issues and restore services.

3. Mean Time Between Failures (MTBF): Measuring time between infrastructure failures.
4. Customer Satisfaction: Monitoring operator satisfaction and feedback.

6.1 FUTURE PREDICTIONS

Infrastructure sharing and colocation technology will continue to play a critical role in Nigeria's telecom industry growth. As the demand for data services and digital transformation increases, operators must adapt and innovate to remain competitive.

- Infrastructure sharing and collocation can reduce costs by up to 30%
- Colocation can improve network reliability by up to 25%
- Nigeria's telecom industry is expected to grow by 15% annually
- Infrastructure sharing and collocation can create jobs and stimulate economic growth

Infrastructure Sharing Best Practices

1. Transparency and Accountability: Ensuring transparency in operations and decision-making.
2. Open Communication: Fostering open communication among stakeholders.
3. Collaboration and Cooperation: Encouraging collaboration and cooperation among operators.
4. Continuous Improvement: Regularly assessing and improving risk management and conflict resolution processes.

IX.   RECOMMENDATIONS

1. Standardized Guidelines: Develop standardized guidelines for infrastructure sharing and collocation.
2. Regulatory Clarity: Provide clarity on regulatory frameworks and licensing requirements.
3. Industry Collaboration: Encourage collaboration among operators for shared infrastructure development.
4. Investment in Emerging Technologies: Invest in emerging technologies like 5G and IoT.

CONCLUSION

Infrastructure sharing and colocation technology have emerged as vital strategies for Nigerian telecom operators to reduce costs, improve efficiency, and enhance network quality. The benefits of infrastructure sharing and collocation are numerous, including Cost savings, Improved network reliability and quality, Increased coverage and accessibility, Reduced environmental impact, Enhanced competitiveness. Despite these benefits, challenges persist, such as: Regulatory complexity, technical compatibility issues, Security concerns, and Commercial challenges. To overcome these challenges, the Nigerian government, regulatory bodies, and industry stakeholders must: Develop clear and standardized guidelines for infrastructure sharing and colocation, encourage industry collaboration and knowledge sharing, invest in emerging technologies (5G, IoT, edge computing), and foster a competitive market environment.

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