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A Cost Framework for the Valuation of Right of Way of Telecommunications Infrastructure in Nigeria

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ABSTRACT

The increase in growth of telecommunications services (e.g., telephone, Internet, etc.) and broadcasting services (e.g., cable television) usage necessitates the increasing demand for the expansion of telecommunications infrastructure. This need for expansion means there will be more demand for transmission and allied infrastructure that would necessitates infrastructure build out and hence the corresponding increasing need for right-of-way (RoW) to accommodate and deploy these infrastructure. This increased demand places a significant burden on all levels of governments (local, state, and federal) in the management of RoWs. An equitable, fair and competition neutral pricing practices will lead to lower RoW fees and thus accelerate the rate of deployment of telecommunications services. To support this goal, we present a RoW cost model based on the fair market value of the land to be traversed and other elements associated with RoW administration.This paper presents a simple but equitable and competition neutral RoW cost model that is practical and realistic to implement while taking into consideration the key factors of availability, affordability, and accessibility to RoW infrastructure. In addition, the paper presents some RoW management best practices that clearly define the roles and obligations of the RoW administrator and the user of the RoW. The equitable and competition neutral costing model we provide offer equal opportunity to all users of the RoWs. Adherence to the RoW best management practices would create the right environment for the quick build-up of telecommunications infrastructure in the RoWs.

Keywords: Right-of-Way, Cost Model, Telecommunications Infrastructure

1. INTRODUCTION

The economies of most nations of the world have transited from the brick and mortal model and the industrial model of the 18th and 19th centuries into the modern economic model based on digital knowledge and information (called knowledge economy). The modern economy relies on

information communications technology (ICT) (and applications) and its infrastructure. This has fuelled the pervasive and ubiquitous presence of the Internet and numerous applications on it, including electronic commerce, and other applications such as Internet of Things, mobile applications, advanced manufacturing applications, etc. In fact, the application of ICT and applications has permeated almost every aspect of our lives.

In Nigerian, from a little over 450,000 active subscriber telephone lines in 2000, the number has grown to 148,398,117 active subscriber lines by end of February 2018 [1]. This phenomenal growth is fuelled primarily by the liberalization and deregulation of the sector in 2001 by the enactment of the Nigerian Communications Act, 2001 [2]; and further supported by an unbiased and responsive regulator that provided the enabling environment and equal opportunities for all service providers. The data / internet segment of the sector has been growing steadily in the number of subscribers and the growth of infrastructure of the major carriers, including transmission and cable infrastructure. The increase in growth of telecommunications voice and data usage necessitates the increasing need for the expansion of telecommunications infrastructure. This need for expansion means there will be more demand for transmission and allied infrastructure that would necessitates infrastructure build out and hence the increasing need for right-of-way (RoW) to accommodate and deploy these infrastructure. Access to RoWs is critical to telecommunications infrastructure deployment and seamless service delivery.

In Nigeria, rental fees for accessing RoW are often artificially high and prohibitive. There is often no any correlation or relationship between the amounts of commerce carried over telecommunications lines and the value of the land on which the lines are located in determining rental fees in some localities. These pricing practices result in costly fees and discourage companies from investing in new infrastructure. Rental fees for right-of-way should be based on traditional land valuation methods such as cost and maintenance.

An equitable, fair and competition neutral pricing practices will lead to lower right-of-way fees and thus accelerate the rate of deployment of telecommunications services. This is very crucial particularly now that Nigeria's quest to further deepen her technology investment is very high. To support this goal, we present a right-of-way cost model based on the fair market value of the land to be traversed and other elements associated with RoW administration. This paper presents (i). a simple but equitable and competition neutral RoW cost model that is practical and realistic to implement while taking into consideration the key factors of availability, affordability, and accessibility to RoW infrastructure; and (ii). the RoW management best practices that clearly define the roles and obligations of the RoW administrator and the user of the RoW.

This paper is significant for the following reasons: (i) The equitable and competition neutral costing model we provide offer equal opportunity to all users of the RoWs. (ii) Adherence to the RoW best management practices would create the right environment for the quick build-up of telecommunications infrastructure in the RoWs. The remainder of this paper is organized as follows: Section 2 provides basic explanation of RoWs necessary for the contextual understanding of the materials that follow. Section 3 examines the need for RoW infrastructure in Nigeria. Section 4 presents the design of our RoW cost model. In Section 5 we relate the RoW cost model to the Nigerian environment by providing some suitable values for the model. We present the RoW management best practices in Section 6 while Section 7 presents our conclusions and our future extension of the paper.

2. RIGHT OF WAY EXPLAINED

The right-of-way (RoW) is the area on, below, or above the present and future streets, alleys, roads, highways, boulevards, bridges, bikeways, parkways, sidewalks, or other land dedicated as RoW [3, 4, 7, 8]. Ideally, any user of the RoW should use the RoW in a competitively neutral, non-discriminatory manner that maximizes the efficient use of and conserves the RoW and minimizes the burden on the RoW, physically and aesthetically. In general, facilities that require RoW use include lines, pipes, irrigation systems, wires, cables, conduit facilities, poles, towers, manholes, vaults, pedestals, boxes, appliances, antennas, transmitters, gates, meters, splice pits, wells, drains, sewer lines, appurtenances, or other equipment pipes, drains, sewer lines, irrigation systems, or other structures.

In the present context, our focus is on telecommunications infrastructure development that need to construct, install, erect, build, affix or otherwise place any fixed structure or object, in, on, under, through or above the RoW, particularly those that require the need to cut, dig, excavate, tunnel, bore, grade or otherwise alter the surface or subsurface material or earth in the RoW.

The use of RoW may results in a larger area of influence [3]. The area of influence of an RoW is that area around a street excavation where the pavement and sub-grade is impacted by the excavation and is subject to more rapid deterioration. The rapid deterioration of the area of influence of RoW may lead to degradation; the accelerated depreciation of a street caused by excavation in or disturbance of the street, resulting in the need to reconstruct such RoW earlier than would be required if the excavation did not occur.

Construction on RoW may lead to temporary disruption --- to place an object, materials, or debris in the RoW or to interfere with the RoW so as to obstruct or hinder free and open passage over any part of the RoW, including landscape maintenance and excluding ordinary vehicular or pedestrian traffic. Restoration of the RoW --- the process by which an excavated RoW and surrounding area, including pavement and sub-base, is returned to the same condition, or better, that existed before the commencement of the work --- is therefore a necessary precondition for granting RoW permit. Governments have an obligation to manage the land on behalf of taxpayers. To accomplish this, it has been and continues to be an appropriate practice to charge developers and others who wish to alienate street space for their purposes, a fee for use of the public space. In view of the new telecommunications environment and the compounding use of scarce underground utility space for competing services, it is now appropriate to charge telecommunications companies a fee for the for-profit use of street space.

An enabling environment, such as [4], that authorizes fees for all utilities, telecommunications providers, and others that dig in the RoW, thus impacting the life expectancy of the road infrastructure is required. Such an environment encourages coordination so that all those engaged in trenching minimize the cost, impact, and inconvenience. Although a city may yet to experience a high demand for the use of the public RoW by telecommunications service providers [as is reasonably true of most towns and cities in Nigeria], but to responsibly manage its public RoW the city has to anticipate such demand in the future and plan accordingly by enacting appropriate laws, such as [5], which requires the installation of conduit for telecommunications facilities whenever a new street is constructed, and authorizes the city infrastructure managers to prepare standards.

The regulations [6] are progressive in providing for installation of empty conduit when RoW work is being done and prohibiting street cuts to roads that are less than ten years old. These facilitate economic development while minimizing future road costs and RoW disruption.

The Government should charge an "Administrative Fee" to recover its cost incurred for RoW management; including, but not limited to, costs associated with registering applicants; issuing, processing, and verifying RoW permit applications; inspecting job sites and restoration improvements; determining the adequacy of RoW restoration; revoking RoW permits; and other costs the Government may incur in managing the RoW.

The need to recover its cost incurred for RoW management must be carefully balanced with the need for telecommunications infrastructure development in Nigeria.

3. NEED FOR INFRASTRUCTURE

Information and Communication Technology (ICT) is the bedrock of economic development of the world in this new millennium. The need for ICT development cannot be overemphasized hence, the various initiatives of the Federal Government of Nigeria to reform the ICT sector so as to create room for the associated socio-economic development.

It is a well known fact that Nigerian is a developing nation with very little ICT infrastructure which are only concentrated in few developed cities like Lagos, Port Harcourt, and Abuja. There is need to have an appropriate geographical spread the ICT development of the nation in order to record a meaningful impact in the ICT sector which will in the long run manifest a well planned economic development. Adequate ICT backbone infrastructure is necessary to position Nigeria in a well balanced information technology rich economy. In particular, for telecommunications and Internet services, a good network of telecommunications backbone infrastructure is a *de facto* requirement. One approach of building telecommunications backbone infrastructure is to use the fibre optic cable (and other telecommunications cable). This approach involves burying the telecommunications cables in the ground in some path / route, which requires soil excavation, cutting of the roads, etc. This effort, however, must be coordinated and regulated to prevent unnecessary degradation of the public infrastructure (roads, walkways, etc). Thus, the government must manage the public infrastructure well. To do this appropriately, the government establishes RoWs for the deployment of telecommunications services and other utilities (water, electricity, gas, etc). The RoWs can then be leased to providers at a fee.

The charging of providers for use of the RoW is complex and challenging. It is complex because of the need to consider various factors and their inter-relationships. It is challenging because of the difficulty in the valuation of certain elements of the costs. One must, therefore, strike a delicate balance between accuracy and equitability on one hand, and simplicity of computation and administration on the other.

In the next section, we provide a simple but equitable RoW cost model that is practical and realistic. The details of the formulation and the parameters of the model follows.

4. RoW COST MODEL

The RoW cost model should clearly distinguish between Road Shoulder RoW and Road Across RoW. The distinction becomes necessary in order to appropriately assign cost values to cost elements involved in each type of RoW since each affects the road infrastructure to a different degree. According to [3] and [11], several factors affect the value and variations in the value along any particular highway / roadway. These factors include:

- Location (urban, suburban, rural) and section of the country, including the terrain.
- Location within the highway right-of-way (road median or road shoulder) affects installation costs and thus value of right-of-way access from the view point of the lessee.
- Security of the infrastructure, which is related to the type of right-of-way and to location within that right-of-way.
- Risk of damage and relocation.
- Terms and length of contract of right-of-way.
- Connectivity to other right-of-way required for system completion.
- Type of infrastructure.
- Time element, as the demand for right-of-way of any kind strengthens or weakens as market situations shift, competition changes, and technology advances.

The RoW fee shall, therefore, include but not be limited to:

- an amount for the Government's costs of administration of the permit (***CoAdmin***);
- an amount for the degradation costs associated with the decrease in the useful life of the pavement caused by an excavation, if applicable (***DegradeC***);
- an amount for the disruption costs associated with disruption of the RoW, if applicable (***DisruptC***); and
- an amount for the market value for the street / roadway space occupied by provider (***MarketV***).

In this paper, we abstract away the details of the constituents of each cost element, *CoAdmin*, *DegradeC*, and *DisruptC* and use aggregate cost values of each element in order to maintain focus and not burden the reader with unnecessary details. To illustrate this point, the aggregate cost value for *CoAdmin* would be computed as follows:

C = { ▪ Costs associated with registering applicants;
▪ Issuing, processing, and verifying RoW permit applications;
▪ Inspecting job sites and restoration improvements;
▪ Determining the adequacy of RoW restoration;
▪ Revoking RoW permits;
▪ Costs the Government may incur in managing the RoW such as
  • Office Time used
  • Proportionate salary
  • Per diem allowances
  • Travel costs
  • Office Resources used }

Thus, $\boldsymbol{CoAdmin} = \sum_{i=1}^{n} C_i$

where C_i is the aggregate value of each cost element in C.

It is, therefore, more expedient to use an aggregate value in our discussion rather than get entangled in minute details.

Various approaches to valuation of the market value for the street / roadway space occupied by provider (***MarketV***) are available. These approaches are:

- Competitive auction
- Valuation of adjacent land
- Cost of next best alternative
- Needs-based compensation
- Historical experience; and
- Market research

These are extensively examined in [11] and will not be repeated in this paper.

In computing ***MarketV***, several models exist. These models are:

- RoW fees expressed as a percentage of revenues,
- RoW fees expressed as value of telecommunications services or products, and
- RoW fees expressed as a linear basis.

The linear basis model is used in this paper because it looks at the actual value of the RoW as adequately reflected in the essential constituent elements. In addition, this model is non-discriminatory, thus it enables the administering authority to apply the fee formula in an equitable manner; similar users of the RoW would be charged equitably for similar use / occupation of RoW.

In computing the market value for the street / roadway space occupied of telecommunications infrastructure, [3] evaluates the following cost elements:

$$\boldsymbol{MarketV} = (A \times B \times C \times D \times E \times F)$$

where

A = Land value of RoW by unit area
B = Length of area occupied
C = Width of area occupied
D = Rate of Return
E = Factor to recognize degree of alienation of area
F = Use factor

Land Value is the market value of private lands adjoining the right-of-way for the purpose of the model. To simplify calculation and administration of the market value, we recommend that zones be developed in which property values are averaged to arrive at one rate per zone. As many zones can be established as seems reasonable, with the trade offs being the effort needed to develop the average values and the sensitivity of the changes from zone to zone. In most cases, a few zones should be sufficient.

These might be the:

- central core;
- commercial and industrial areas outside the core;
- residential areas and;
- perimeter area.

Also the different regions of the country could be delineated into the following groups:

- urban areas;
- semi-urban areas;
- rural areas; and
- un-inhabited areas.

The combination of the zones and the area delineation would result in the appropriate pricing of the market value of each segment of the RoW.

Length of Area Occupied is the length of street occupied by one or more cables or ducts.

Width of Area Occupied is the width alienated for other purposes which is the width of the duct plus half the minimum clearance required on either side that would be used to assign space to other major utilities. In most cases, this width calculation will accommodate access holes and vaults which typically are considerably wider than the actual ducts and occupy valuable space at intersections.

Rate of Return is the annual rate of return that a government expects to receive on the market value of it's property. A common rate of return is 10%.

Degree of Alienation of Area is the market value of property that relates to the exclusive use of that property. Occupation of property by a duct bank allows some temporary use of the surface for other purposes, although typically utilities can not be placed under the duct bank in the same alignment. A reasonable factor being used in a number of jurisdictions is to value the subterranean space thereby alienated by 50% of the full market value.

Use Factor is average value for describing the use of the RoW. For most telecommunications installations, a number of factors might be considered under this category by the government to modify the charge based on special conditions, such as those identified in [3], among others are:

Sharing Factor — If a number of users share a duct bank or an alignment, the rate can be modified for each utility. This will encourage sharing and conservation of street space.

Exclusive Rights Factor — An occupant that is an exclusive for-profit franchise holder within the city will pay an increased rate.

Depth and Disruption Factor — In general, shallow utilities (i.e. less than 1.5m depth) create more conflicts, and are exposed and relocated more often than deeper utilities. The deeper utilities, therefore, pay a reduced rate.

From the forgoing, the following simple formular can be formulated as a useful guide for the computation of the fees for RoW:

$$\text{RoW Fee} = CoAdmin + DegradeC + DisruptC + (\sum MarketV)$$

The quantities that compose **RoWFee** may exhibit the following properties, depending on the choice of the administering authority:

CoAdmin may be fixed or variable. We recommend that it should have two components --- fixed part which would account for the cost of application and processing and variable part which would account for the expenditures for inspecting job sites and restoration improvements and determining the adequacy of RoW restoration.

DegradeC should be constant for each zone and area delineation combination.

DisruptC should be constant for each zone and area delineation combination.

$\sum^{'}$ ***MarketV*** is sum of each segment market value. This quantity would appropriately discriminate highway / road shoulders RoW and the road cut-through RoW.

5. SUGGESTION FOR THE NIGERIAN ENVIRONMENT

Using the **RoWFee** formula above, the following three categories of fee structure is proposed for the users of the RoW in Nigeria. These categories are:

1. Cutting Across Roads and other city structures
    - City Roads: =N=2000.00 / meter + Nominal Permit Fee
    - Dirt Roads: =N=1000.00 / meter + Nominal Permit Fee

2. Underground Conduit Across City Roads and other structures that does not require cutting of the road infrastructure.
    - City Roads: =N=1000.00 / meter + Nominal Permit Fee
    - Dirt Roads: =N=700.00 / meter + Nominal Permit Fee

3. Infrastructure along road / highway shoulders.
    - City Roads: =N=50.00 / meter + Nominal Permit Fee
    - Developed Area Roads: =N=35.00 / meter + Nominal Permit Fee
    - Undeveloped Area Roads: =N=20.00 / meter + Nominal Permit Fee

The above fee structure differentiates the amount of efforts required to monitor and secure each category and the differential degradation costs, disruption costs, and the market value of each segment of the RoW infrastructure. The Government may limit the number of service providers in the RoW based upon, but not necessarily limited to, specific local considerations such as:

- The capacity of the RoW to accommodate service facilities;
- The impact on the community of the volume of facilities in the RoW;
- The disruption arising from numerous excavations of the RoW;
- The financial capabilities of the service provider and its guaranteed commitment to make necessary investments to erect, maintain, and operate the proposed facilities; or
- Any other consideration based upon the interests of the public safety and welfare.

However, the Government shall not exercise this limitation to deter competition or discriminate against any service provider. We suggest the following specifications for the standardization of fibre optic and other telecommunications cable deployment in the RoW in Nigeria.

1. Only providers that have the right to lay cables should be granted RoW permit.
2. The depth of the cables should be at least 1.5 meters below the ground level.
3. The cables should be placed within high quality cable duct with good resistance to underground heat and possible cut.
4. Where the cables are deployed in conduit RoWs accessible to humans, an alarm system must be put in place to signify any unplanned cut or shift in the cable.
5. Where the RoW is by the bridge, river bank, or a gorge, the cable must be placed within a heat, chemical, and cut resistant duct and fasten to the edge of the bridge, river bank or gorge.
6. Strict adherence to the RoW management best practices, discussed in Section 6 below, that clearly define the roles and obligations of the RoW administrator and the user of the RoW.

Interested should see the following resource [12] for additional details.

6. RoW MANAGEMENT BEST PRACTICES

Many authorities [4, 6, 7, 8, 9, 10] recognized the need for effective management of the RoW. In using the RoW, each user must provide some legal guarantees / relieves for the Government. The following are some key responsibilities of the users of the RoW.

(1) It shall be the responsibility of the user of the RoW to take adequate measures to protect and defend its facilities in the RoW from harm and damage.

(2) The Government shall not be liable for any damage to or loss of any of the ROW-user's facilities within the RoW as a result of or in connection with any construction, excavation, grading, filling, or work of any kind, including public improvements, by or on behalf of the Government.

(3) The user of the RoW shall be responsible to the Government and its agents, representatives, and authorized contractors for all damages suffered by them including but not limited to delay damages, repair costs, construction delays, penalties, or other expenses of any kind arising out of the failure of the user of the RoW to timely perform any of its obligations in the use of the RoW to the extent caused by the acts or omissions of the user of the RoW.

The user of the RoW has certain obligations in the use of the RoW. Some of these obligations are:

(4) The service provider shall coordinate the placement of facilities to minimize adverse impact on any public improvement, as reasonably determined by the Government. The facilities shall be placed with adequate clearance from such public improvements so as not to impact or be impacted by such public improvement.

(5) All earth, materials, sidewalks, paving, crossing, utilities, public improvement or improvements of any kind damaged or removed by the user of the RoW shall be fully repaired or replaced promptly by the user of the RoW at its sole expense and to the reasonable satisfaction of the Government. After any excavation, construction, or

disruption, at its own expense, user of the RoW shall restore all portions of the RoW to agreeable standards. If no standards are published for the restoration, user of the RoW shall restore the RoW to the same condition or better condition than it was prior to the excavation.

(6) The Government Engineer has the authority to inspect the repair, replacement, or restoration of the of the RoW, and, if necessary, to require the user of the RoW to do additional repair, replacement, or restoration. Notice of the unsatisfactory restoration and the deficiencies found will be provided to the user of the RoW and a reasonable time not to exceed a certain time limit (say 15 days) will be allowed for the user of the RoW to correct the deficiencies.

(7) In addition to repairing its own street cuts, the user of the RoW must restore any area within five feet of the new street cut including the pavement and its sub-base, unless the Government Engineer has waived such requirement in writing.

(8) If, in the judgment of the Government Engineer, the user of the RoW fails in a timely manner to restore the RoW, the Government may complete the restoration by contract or otherwise. The user of the RoW and its surety shall be liable to the Government for all cost incurred by the Government in completing the restoration.

(9) The user of the RoW warrants and guarantees for a period of 5 years that the excavation and restoration is free from all defects due to faulty materials or workmanship, and the user of the RoW shall promptly make corrections as may be necessary by reason of such defects and shall promptly make repairs of any damage to other improvements, including damage to adjacent existing improvements, utilities, and pavement, resulting from such defects. A maintenance bond may be required and shall remain in full force and effect through the guarantee period.

(10) Payment of a degradation fee shall not relieve the user of the RoW of the obligation to complete the necessary RoW restoration.

These RoW best management practices clearly define the roles and obligations of the RoW administrator and the user of the RoW. Adherence to these RoW best management practices would create the right environment for the quick build-up of telecommunications infrastructure in the RoWs.

7. CONCLUSION AND FUTURE WORK

The penetration of ICT products and services (particularly, telephony and Internet services) into the Nigerian society is highly dependent of the available ICT infrastructure in the country. The quick rollout of telecommunications backbone infrastructure is dependent, among other factors, on the ***availability***, ***affordability***, and ***accessibility*** to RoW infrastructure from the RoW administrator. Where the RoW infrastructure is near non-existent, telecommunications service providers should be able to develop the RoW the ***acquisition*** cost is not overstated and the process streamline and less cumbersome. No doubt, Nigeria needs ubiquitous deployment of telecommunications backbone infrastructure in order to engender rapid ICT transformation of the Nigerian social, political, economic, scientific, and educational subsectors.

There is the need for a study whose primary objectives shall include (but not limited to) the following:

(a) To recognize the Government's role as primary steward of the RoW and its duty to its citizens to recover the costs of managing the RoW and incursions into it;
(b) To clarify and regulate conditions of occupancy and construction for the users of the RoW occupying space within the Government's RoW given the anticipated increased use of the RoW by various Users of the RoW throughout the country;
(c) To recognize the necessity for sound management practices in light of the increased use of the RoW and the fact that the RoW is a limited resource;
(d) To treat each user of the RoW equitably and in a competitively neutral manner with considerations that may be unique to the technologies and situation of each particular RoW-user; and
(e) To minimize disruption, visual impact or inconvenience to the public, and to preserve the public health, safety and welfare.

While we recognized the need for the government to recover the costs of managing the RoW and incursions into it, equitable and competition neutral costing model should be used. In addition, such a costing model should encourage the development of telecommunications infrastructure backbone, which is currently at minimal level in Nigeria, rather than impedes its rapid growth.

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