Investigating the Applicability of Dynamic Pricing to Ghana's Telecom Infrastructure Market

Alexander Osei-Owusu, Stephen E Armah

Abstract- Telecom operators in Ghana are likely to face large infrastructure investment needs over the coming decade because of rising demand for mobile phone and other related services due to population pressure and an expanding economy. This raises questions about the traditional model of single ownership of physical telecom infrastructures and network layers. The situation has led to infrastructure sharing (IS) among Ghana's major telecom infrastructure owners. However, IS has not been very successful as a cost effective solution to the ever increasing need for infrastructure capital. This is probably because current owners of infrastructure typically employ the "fixed" pricing model in implementing IS. This research investigated the applicability of Dynamic Pricing (DP) to Ghana's Telecom Infrastructure Market. DP involves price discrimination over the time dimension and is likely to be a more useful pricing strategy compared to fixed pricing. The study adopted mainly exploratory and descriptive analysis as well as a combination of qualitative and quantitative data collection approaches. Purposive sampling and simple random techniques were used in selection and administering of questionnaires to employees and subscribers of Telecom infrastructure companies from some selected regions in Ghana. The findings of the research identified challenges facing the current "fixed" pricing model, which include surplus inventory, inability to attract new customers and insecurity. The research also confirmed that the market is made up of a variety of customers. They include customers that buy: at an initial full price, when discounted price is sufficiently low, when price is anticipated to remain the same for the entire period and when prices can be bargained. The study also finds that "dynamic Pricing" can boost revenues and it is also the most likely effective strategy for Ghana's Telecom Infrastructure market.

Index Terms— Dynamic pricing, Infrastructure sharing, fixed pricing, price discrimination, Ghana telecom sector.

I. INTRODUCTION

Well-functioning infrastructure networks are the backbone of every telecommunication network operator. For wide coverage and strong competitive advantage, network companies must expand their coverage equipment or infrastructure to every possible geographical area.

Telecommunication operators in Ghana are facing a large infrastructure investment cost from year to year for expansion and growth. According to a report by [1] on infrastructure development and financing. This raises questions about the traditional model of single ownership of Physical infrastructures and network layers.

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A possible solution is to consider how individual organizations can come together to raise sizeable capital to confront the ever increasing need for infrastructure capital, so that such facilities can be shared with much reduced cost. The ability of the operators to share such physical and network equipment is what we termed Infrastructure Sharing (IS). Ghana's Ministry of communication encouraged operators to share towers in a National Communication policy document [2]. Infrastructure sharing, however, has not lived up to its billing as a cost effective solution to the ever increasing demand for infrastructure capital, and this is most likely result of the pricing model being applied by owners of infrastructure.

Infrastructure owners today in Ghana have endorsed a fixed pricing model with fixed minimum space (i.e. Occupancy on tower infrastructure) that can be allocated to the requesting party (i.e. Network operator). However different requesting parties with different valuations and expectation typically do not require the same type of pricing strategy and in fact price differentiation or price discrimination may be a better option. [3] as well as [3] asserts that, the term "price differentiation" exists when sales of identical goods or services are transacted at different prices from the same provider. Under price discrimination, the seller is able to charge different prices to different types of consumers based on each client's ability to pay in the same time frame [4] In comparison, under dynamic pricing, the seller charges different prices across time because the characteristics of the same consumers may change over time or the seller may encourage different customers with different abilities to pay over time [5]. In this sense, dynamic pricing can be considered a type of price discrimination in the time dimension.

The fixed pricing model applied in Ghana's infrastructure market has rather compounded the problem associated with the high cost of infrastructure capital that confronts both new entrants and the existing network providers or Telecom operators in establishing or expanding their network coverage. In the fixed cost model, prices are sticky. [6] as well as [6] assert that, the term "sticky price" refers to fixed physical cost that firms must pay whenever they change a price. However, such an approach is often criticized on the grounds that it is hard to identify significant fixed physical costs of changing prices for most products. A viable pricing model that can make provisions for all sorts of customers and providers' mutual benefit is the dynamic pricing model; however such a model is typically applicable in specific market environments.

According to [5], dynamic pricing is a form of business strategy that adjusts the product or service price in a time-dependent fashion in order to allocate the right product or

service to the right customer at the right time. According to [7] the right customer comprises all the customers within the demand curve. Unlike any other industry, pricing in telecommunication has taken on much more importance in the past decades in both developed and developing countries [8]. Telecommunication pricing has been researched even more intensely after the sector was deregulated in the different countries. For example [9], [10] as well as [11] have all done extensive work on the subject.

In their final report of a research on economics of infrastructure sharing access, Corporate and Strategy Management Group [12] conducted five case studies of countries in which regulated or commercial offers were present. The countries included France, Australia, Canada, Portugal and USA. According to the report, shared access to infrastructure will allow network operators to avoid the high upfront cost of duct. The report concluded that prices or charges for using open - reach duct would be considerably less than the cost of new infrastructure; however this was subject to the pricing or charging methods employed.

Australia and the United States provide a pricing method that allows the market to decide by allowing parties to go into commercial negotiations. In such negotiations the charges or prices are purely affected by factors such as time, demand, investment risk and other specific parameters agreed upon by both parties. Portugal though does not call for commercial negotiations to reach a charge or price. However, it considers the location where the infrastructure is requested as a key component in pricing. All the countries have some form of regulators in determining their price. However, Portugal and Canada fully place pricing in the hand of its regulators, providing a specific price tag for the same services. This implies that the choice of a particular pricing model depends on the market situation on the ground for the country or location involved.

It is in this light that the researcher intends to dedicate this research to investigating the applicability of dynamic pricing within Ghana's infrastructure market, so that a viable solution can be offered to the ever increasing infrastructure investment despite infrastructure sharing..

II. LITERATURE REVIEW

A. Pricing Telecom Infrastructure

Developed Country context.

The [12] final report of a research on economics of infrastructure sharing access, profiled five case studies of countries in which regulated or commercial offers were present. These countries include France, Australia, Canada, Portugal and USA. According to the report, shared access to infrastructure will allow Communication Providers (CP) to avoid the high upfront cost of duct. The report concluded that the prices or charges for using open reach duct would be considerably less than the cost of newly built infrastructure. However this is subject to the pricing or charging methods employed.

Australia

Following the regulation of the telecoms sector in 1991, the government of Australia began to create laws to facilitate competition through mandating carrier infrastructure sharing. Players in infrastructure sharing are allowed under the codes to engage in commercial negotiations whiles the government puts in safeguards to resolve any disputes that arise. In disputes over prices of a particular access, the Australian competition and consumer commission (ACCC) authorized by the government as the last arbitrator, determines the price that would occur if the provider of access faces effective competition. In addition, they consider factors like asset age, location, investment risk, available capacity and through benchmarking or efficient-cost models. This means that there is no single price for the same asset since several factors other than the infrastructure itself accounts for the cost.

Canada

The Canadian Radio-television and Telecommunications Commission (CRTC), has the authority to review and approve telecom infrastructure access rates. The Incumbent Local Exchange Carrier (ILEC) or the owner of the infrastructure is mandated to submit tariff proposals to the CRTC, along with hard evidence or materials such as cost studies, in order to get approval for standard rates. They may charge companies seeking to access their infrastructure. The most common guideline or policy on rates of the CRTC is that, tariffs should be sufficient to cover casually attributable costs and provide a contribution towards the common cost. The regulator determines the ceiling for the rates. Additional charges including engineering search fees, repair and maintenance fees, and costs associated with modifications to infrastructure to allow for attachments, are allowed.

France

Shared infrastructure access in France is offered by France Telecom and several municipalities. To obtain access to France Telecom duct work, a communications provider (CP) must submit a planning application. Once the necessary preliminary studies have been completed, France Telecom grants access permits for the facilities on the route. CPs undertakes their own installation work subject to contractual conditions specified by France Telecom. Where a CP installs cable directly into a duct, that duct cannot be shared with other operators. The reference offer specifies further rules with respect to the size of the cables, the percentage that space cables and sub-ducts may occupy, and the order in which available space should be utilized. The pricing is calculated in relation to the amount of duct area that is occupied by the cable. The effective area is calculated by multiplying the cross-sectional area of the cable by 1.62. The draft price for duct access is €1.20 / meter / cm2.

Portugal

In Portugal, ANACOM, the national telecom regulator, actively monitors PT's offer and settles disputes with accessing operators. PT Communications, by the direction of ANACOM, created the Reference Conduit Access Offer (ORAC). The reference offer sets the terms, costs, and obligations that an accessing operator must comply with before gaining access to PT's ducts. Fees are determined on a cost-oriented basis. The ORAC reference offer specifies charges for occupying ducts and related infrastructure. Prices have to be cost-oriented. Duct access is calculated in terms of distance and cross-sectional area, with a higher charge applied in Lisbon and Porto versus other municipalities.

United States

In the United States, the FCC established maximum rate guidelines to be used for settling rate disputes between infrastructure owners and tenants. The FCC's approach to rate setting allows individual

companies to negotiate terms and conditions on commercial terms, subject to published maximum rate guidelines and formulae. Should the parties be unable to agree terms, the FCC recommends attempting to resolve the dispute through mediation. Failing that, a formal complaint can be lodged with the FCC.

The maximum rates are intended to allow the infrastructure owner to recover no less than its incremental costs of providing space for attachments to poles or ducts, but not more than the fully-allocated cost of owning and maintaining the pole.

Australia and the United States provide a pricing method that allows the market to decide by allowing parties to go into commercial negotiations, where the charges or prices are purely affected by factors such as time, demand, investment risk and other specific parameters agreed upon by both parties. Portugal however does not call for commercial negotiations to reach a charge or price. Yet, it considers the location of which the infrastructure is requested as a key component in pricing. All the countries have some form of regulators in determining their price. However, Portugal and Canada fully place pricing in the hands of its regulators, providing some specific price tag for the same services.

Developing Country Context.

Telecom in India has been one of the biggest success stories in the world [13]. The government of India has identified only the tower companies for granting them infrastructure status. This was after Telecos asked for such status. Telecom tower forms the backbone of the industry. Matured asset or infrastructure is charged differently, since assets are already well depreciated, and the charging is dependent on the useful life classified by each company. A system of charging is dynamic in nature; however, price dynamism is dependent on the age of a particular infrastructure.

[14] outlined Nigerian companies' pricing approach of assets; the company offers an 'asset lite' model as a pricing strategy within the Nigerian infrastructure market. The model also shares the on-going fixed costs (which include the cost of security, engine services, spares and maintenance, as well as regulatory and government levies) among all tenant customers.

The Case of Ghana.

Infrastructure companies (i.e. Tower owners) are allowed full control in determining their prices in the market; the National Communication Authority (NCA) is the regulatory Authority in Ghana. Infrastructure companies employ a fixed cost pricing system on the main infrastructure.

Infrastructure companies, aside their non - negotiable prices offered to customers, require requesting parties to accept a minimum number of spaces in, before agreeing on leasing the infrastructure, though other charges such as security, power, rent, etc. are allowed to be negotiated between the two parties.

Such pricing and the requirement does not appeal and solve the problem of the different customer set and their problems. The Ghanaian telecom infrastructure market is made up of different customers with varied expectations; new entrants and existing ones with low market share who want to enter new geographical areas will expect different negotiation of prices and a certain number of spaces on the tower. However, market share leaders might be willing to break new grounds despite price limitations.

The decline of deployment of infrastructure (i.e. Towers) can be largely attributed to the current pricing system; there is an urgent need for a new approach that can be tailored to the needs of the operators whiles infrastructure owners are still kept in business.

This research intends to investigate the new pricing model "dynamic pricing" whether it can be applicable in the telecom market in Ghana. Thus, the researcher believes it will be the most appropriate model to replace the current pricing model (fixed cost).

B. Dynamic Pricing Theory

When a buyer alternates price between two sellers for price offers over a finite time horizon, the game usually ends when the buyer accepts a price or the selling season is over [15]. [5], dynamic pricing is a form of business strategy that adjusts the product price in timely fashion in order to allocate the right service to the right customer at the right time. [16] Consider a retailer that sells a product with uncertain demand over the finite selling season, by setting up an initial stocking quantity at some predetermined point in the season; retailers optimally mark down the remaining inventory. [17] assert that, retailers are aware that modern consumers are educated, sophisticated, and willing to go to extraordinary lengths to purchase at the lowest possible price. To achieve successive markdown equilibrium, the retailers must recognize the types of consumers they face in the market; strategic and myopic consumers [15]. [16] model added an additional consumer called the bargaining consumer. Myopic consumers are consumers who purchase at the initial full price, so far as it is a little below their expectation. Bargain-hunting consumers only purchase if the discounted price is sufficiently low: Strategic consumers choose which period to make their purchase. They choose between purchases at the full price with the possibility, if the inventory remains, of a later purchase at a markdown. Most often, strategic consumers choose to wait for markdowns, thereby denying retailers full price sakes [18].

The study of dynamic pricing is to solve the problem of how a firm will adjust its prices temporally in order to maximize profit since most potential buyers may wait strategically for the best offer, or may enter or exit the market at different times, while competitors' prices may change over time. [19]supported the notion that consumers wait strategically for expected markdowns through empirical studies. Recent research on monopolistic dynamic pricing suggests that, retailers could suffer significantly if they overlook strategic waiting [21],[20] Earlier researches have focused much on myopic consumers as a way of maximizing profits.

Firms opt for multi-period pricing models when they are dealing with unknown or heterogeneous valuations.[16]assert that, even though inventories are typically fixed, a firm has the ability to practice price discriminate among its consumers or to discover information about their valuations. [22]'s research on multi-period explains a variety of observed retail pricing phenomena via a fixed-inventory, two-period pricing framework with myopic consumers who purchase if their valuation of the product exceeds the price,[20]address the inclusion of strategic consumers to the dynamic pricing problem. Their model shows an incapacitated, monopolistic retailer selling to a fixed number of heterogeneous,

rational consumers over an arbitrary number of periods. The appearance of strategic consumers leads to lower prices in each period and optimally to myopic consumers. This is because the retailer competes inter-temporally with itself. Thus consumers have the option to wait until a later period to purchase. The model provides no uncertainty; there is no risk of stock-out or leftover inventory.

[23] as well as [24] proposed a differential game model for duopolistic competition, where one more firm is added to the monopolistic setting. [25] differ, when uncertainty is introduced. [26] examined competitive pricing when there is demand uncertainty over time and advance-purchase discount are possible. Recent scholars present a multi-period, finite-horizon, and dynamic pricing model for oligopolistic firms that sell differentiated perishable goods to multiple finite segments of strategic consumers. These include: [27],[28]and [29]

For successful implementation of dynamic pricing, the onus lies with the seller to identify the various behaviors in the market so that appropriate timing of adjusting prices can be established. However, consumer behavior is developed based on their valuations of product or service, and their differences in valuations

The literature shares various views with this research under study, "investigating the applicability of dynamic pricing in Ghana's Telecom infrastructure market. Distinctive contribution shall be made: the researcher shall investigate whether the above features are applicable in the telecommunications infrastructure market in Ghana.

Preconditions for Dynamic Pricing

The bigger a market, the larger the number of customers, and the greater the number of transactions, the greater the opportunity for DP. Bigger markets come with numerous transactions. Further, lots of product and demand play a major role in the kind of pricing approach to be applied [7]

A typical example is the automobile company, especially the highly competitive automobile market in America. These include the three major companies; Ford, General Motors and Daimler Chryslar who have resorted to aggressive price decreases through incentives and rebates in order to maintain their market share. The study shows that Ford applied DP in 2003, and used a detailed market data showing how a model is selling at each region and raised or lowered the price. With its final prices plus the incentives and rebates in response to a near real time demand, Ford has been able to hold average prices across all models steady in certain years due to pricing based on evolving customer demand for different product lines. Whiles the explorer decreased, Ford saw an increase in Taurus, while net vehicle prices at General Motors fell 2% during the first quarter of 2003. An average price gain of 0.2% across all models was recorded, allowing a rise in revenue per vehicles during the same period. Ford employed a variant of demand-based DP that depends on a near-real-time understanding of demand for each model category by geography and price. According to the study, rebate levels were also changed frequently as once a week, based on the daily data from its dealers, whiles General Motors adopted aggressive price decreases through incentives and rebates with a single price across board irrespective of demand for each category of model by geography and price. Ford adopted DP based on a near-real-time understanding of demand for each category of model by geography and price. Even though it makes sense to say that a decrease in prices of goods and services will account for bigger market share, at a certain price level no greater amount of market share can balance total cost. Gathering the right information in real time, and pricing according to the taste and expectations of customers, will provide the solution. High prices will always make up for low prices and therefore will cause slight profit margin and judicious use of computer power to gather real time data in such a huge transaction. This is very vital and it leads to profitable DP according to the study.

The greater the involvement of customers in the process, and the greater the variation in valuation that customers put on the same service, the higher the opportunity for DP to relocate and manage demand effectively. The relationship between customer satisfaction and their loyalty with respect to services is moderated by positive emotions in the case of high involvement service settings. [30], [7].

[7] gave an emphatic scenario about a hairdresser in a London suburb; she turned customers away because she never wanted to go beyond the capacity of customers he required a day; however the situation is far different from the weekdays, where her premises have been frequently half full. Her work location is at the very center of England and there were four principal groups of customers; professionals with very tight work schedules, homemakers, pensioners and mothers with children. The group of customers clearly explains why there are always a lot of customers waiting for service on Saturdays; busy professionals will always want to be booked on weekends irrespective of any amount of incentive package available for weekdays, as a result of their work nature; (Unlike pensioners, homemakers and mothers with children who have more flexible hours or days). She considered raising her prices on Saturdays and decreasing them on Tuesdays and Wednesdays as an incentive to propel mothers, pensioners and homemakers to switch to such days. However, the question here again is why not the whole weekdays, studying the number of customers that visit her premises can give her a clue to which specific day records the least or highest customers, and that can be her bases of selection. Moreover, full discussion with, and interviewing of customers can also help to settle on good flexible days for such a group of customers. The hairdresser is able to accommodate professionals on Saturdays if they are willing to pay high prices. This shows that decreasing and increasing prices in some cases does not only help to increase the customer base and profit margin, but is also a way of offering flexible scheduling for certain groups of customers to enable them acquire the good or service. Though her economic idea was sound, her major problem was how the customers will react to such a change. Involving customers in DP, forms the basis for its smooth implementation; most consumers are rational and so far as such change will be in their benefits, will most likely welcome it. Mothers, pensioners and homemakers will benefit from a reduced price and have a flexible schedule that will enable them to meet the midweek appointment. Busy professional will be happy to pay higher prices and not wait for long hours despite appointment on Saturdays.

Products and services that have a clear defined shelf life eventually become obsolescent and are amenable to the use of demand-based DP, even if they are not perishable in the conventional sense, but

nonetheless have a salvage value. [7], [31].

In the telecommunication industry, most infrastructures are made up of components that are perishable in the conventional state. In the case of towers, more advanced or modified versions are made frequently to meet up the increasing demand of users' request, as in the case of the airlines industry; spaces left unoccupied within the tower poles becomes zero, however at a certain period such infrastructure becomes obsolescent and demand can be reallocated by applying DP so that there will not be any zero period.

Similarly, with the electronic and computer industries where technological innovations are changing frequently, computer and electronic component are also perishable in that sense, since at certain periods new and well advanced components will replace them. According to this study, statistical models estimate demand and then track actual demand in different lines, and adjust prices in the case of the airlines. Clothing retailers may obtain more suppliers of fast selling line of clothing and parts unlike the airlines which change the number or type of seats on a scheduled flight. The case is not different from the electronic industries which will also have to keep track of demand and adjust prices accordingly.

The more urgent need for a company to sell excess or reassigned inventory, the greater the potential role for DP. [7]; [31] ; [32].

At a certain point, some assets may no longer be needed; it is a common practice among companies to offer the asset for sale at a much significantly discounted price. In an attempt to recover the investment, the use of DP can raise the recovery price and therefore decrease the loss due to write-downs. Several online sites such as LetsBuyIt, eBay and uBid.com act as an inventory clearinghouse for companies such as Hewlett-Packard Co. and Sun Microsystems among others who have persuaded different customers to pay different prices using various DP mechanisms for new, excess, mature or reassigned inventory; such move has increased both the pool of potential buyers and the price realization for companies.

[31] underlined major fundamental characteristics that aid in the success of DP application. Such techniques are most useful when two product characteristics co-exist; firstly, products with expiry date such as airline flights, generated electricity, or time-dated products calls for an urgent need to sell excess or reassigned inventory. Secondly, capacity is fixed well in advance and can be augmented only at a relatively marginal cost. Hence, in the telecommunication industry, most of the machines have a fixed capacity, especially the case of the tower which has a specified Erlang, such as in the airline industry where the number of seats is fixed, hotel rooms, and generated electricity. The argument here is that unoccupied spaces in the case of telecom towers, hotel rooms, and airline seats will generate zero, and electricity generated without use becomes wasted. Such characteristics create the potential for very large swings in the opportunity cost of sale, because the opportunity cost of sale is a potential foregone subsequent sale.

The combination of perish-ability and capacity- constraint can encourage business orientation in which service providers focus on filling capacity, [32]. In the bid to recover at least the investment cost before the product expires, DP becomes a viable technique; fixed capacity under such situation is likely to face tough challenges. Both made-to-order (MTO) firms and service providers such as airlines face the challenge of effectively utilizing a fixed capacity under uncertain or high demand, in order to maximize profit. Thus, many yield management results are applicable to MTO manufacturing industry, [31].

A. Dynamic Pricing in the Telecom Infrastructure Sector

Unlike any other firm, pricing in telecommunication has taken on much more importance in the past decades and has become an intense area of research since its deregulation. It is an issue which is widely discussed by [9]; [10] as well as [11].The rapid growth of the internet and the pervasive diffusion of the TCP/IP paradigm for the transport of both data and real-time traffic have led to developing and testing pricing methodologies, capable of achieving globally optimal utility and fairness. Recent pricing models have been considered and analyzed in the context of QoS guaranteed networks, mainly with respect to the asynchronous transfer mode or an (ATM) world.[9];[11];[33];[8].[8]proposed a dynamic adaptive priority scheme based on the periodic adjustment of prices per unit of bandwidth associated with each virtual path (VP) performed by the network management; the users decide the bandwidth to be utilized on the corresponding VP and pay accordingly up to the next reallocation.

The vast majority of literature on pricing of networks supposes that the pricing is based upon shadow prices and marginal costs; that is to say that, the marginal cost of adding a new request, or user, to the network defines the price that should be charged to the user. [34]; [35] and [36].

Central features of today's telecommunication environment are the presence of uncertainty and usually the absence of equilibria, making many established approaches inapplicable.[37].This supports the fact that few research has been made on the usage of dynamic pricing in the telecommunication market.

Applicability to the Ghanaian Case.

Vodafone Ghana has introduced a "Pay As You Go" tariff structure, [38]. The rationale for introducing dynamic pricing model is the varied browsing habit amongst its customers. This means that customers will pay less, the longer they browse using Vodafone's internet service. The successful implementation of this model is not only based on the varied consumer habit but also on the rise of internet penetration in Ghana, reported at about approximately 8.4% as of December 2011. The company intends to provide tariff that will suit every pocket and behavior.

The telecom industry has become so exciting and new strategic marketing plans are emerging. The telecom companies are meeting the two major demands of their customers which are the reduction of tariff and provision of quality of service (QoS). To maintain their market share despite the high cost of infrastructure investment, MTN, Tigo, Vodafone, Airtel and Glo have resorted to dynamic pricing as a strategy for their business to client models. This includes forms of periodic promotions such as the famous MTN zones and other discount and promotional strategies which are all geared towards rewarding different forms of customers within specific periods of time.

According to [2] recent valuations of network operators' market shares show a rise in

MTN and Vodafone's market share. They have taken the first two spots respectively, among the rest of network operators. It is no coincidence that MTN and Vodafone have taken the forefront of promoting the new innovative strategy "dynamic pricing" in the telecom market. Intuitively, there should be a corresponding increase in their revenues as well; however, that is not the case due to the marginal cost increase in telecom infrastructure.

Infrastructure - sharing has been embraced as the viable solution to reducing the high fixed cost of telecom infrastructure. However, it faces huge setback as a result of the pricing strategy used by the owing companies. Infrastructure owners in Ghana apply the fixed cost pricing model with minimum amount of space in the case of tower companies that a requesting operator will have to purchase or rent, especially in the case of the tower. This approach of prices has caused a massive decline of operators deploying towers to increase their coverage. The reasons are simple, and operators with different market shares will always have varied valuations on price. Therefore fixed pricing might not be the best option under such circumstances.

This research intends to investigate the applicability of dynamic pricing in Ghana's infrastructure market.

III. METHODOLOGY

The primary objective of this research was to identify the challenges the sector players face with current pricing strategy for infrastructure sharing in Ghana's telecom market and to investigate the applicability of dynamic pricing to the Ghanaian Telecom Sector. In particular the study tries to verify whether the preconditions for the successful application of dynamic pricing have been met the Ghanaian Telecom Infrastructure Market.

For this study the author adopted the descriptive method of research. This choice was to give a vivid picture of the phenomena being investigated by the researcher before the data collection procedure is carried out. The primary respondents in this research were subscribers (i.e. Clients) and employees of some players in the telecom infrastructure sharing market in Ghana, namely the vendors (Ericson, nokia-Siemens and Huawei), the telecom tower sharing companies (American Tower Company-ATC, Helios, African Towers, and Easton Towers), and network operators (MTN, Vodafone, and Airtel).

In addition to the respondents an employee of National Communications Authority (NCA) also provided relevant information. Within the broader scope, certain department and units were specifically identified and interviewed due to their direct involvement or knowledge in pricing within the entire infrastructure market (i.e. Finance and marketing department).

For the researcher to obtain a general representation of some employees (i.e. Customer service personnel) and subscribers (i.e. Clients) on the survey topic, cluster sampling techniques were employed. Cluster sampling is a sampling technique used when "natural" but relatively homogeneous groupings are evident in a statistical population. Cluster sampling allowed the telecom market to be divided into clusters of ten (10) regions. The researcher then applied simple random sampling to select three (3) clusters from the sample frame. The population focused on the Upper West Region which represents the Northern part of Ghana and the Ashanti and Greater Accra Regions which represent the middle and southern parts of Ghana respectively.

The survey instrument (questionnaire) was distributed among employees in the telecommunication industry and the subscribers (i.e. Clients of age 18 and over) with knowledge of the market, pricing of infrastructure and pricing of product and services within the industry. In addition, the researcher granted interviews to top management level officials from the selected players of the telecom industry and the Telecom regulatory body in Ghana (NCA) to solicit views on the research topic.

In order to measure opinions, gauge customer and employees' perception of satisfaction on the subject matter, and study a wide range of social, economic, geographic and cultural issues from the response given by the respondents, the researcher utilized a range of statistical methods to analyze survey data. The researcher used graphical and descriptive analysis with the help of some computer software programs such as SPSS and Microsoft Excel were used in the analysis of the data gathered.

IV. RESULTS AND ANALYSIS

Objective 1: Challenges associated with the Current Pricing Strategy (FP) in Ghana's Telecom Infrastructure market

Figure 1 below shows the major challenges facing Fixed Pricing strategy currently employed by the Telecommunication Infrastructure market. According to the ranking; surplus inventory; does not meet the demands of varied customers; unable to achieve expected revenue; does not attract new entrants/customers and insecurity (fear of overpricing of infrastructure)

Figure 1: Ranking of the Challenges of FP Strategy, Researchers' field data (2013)

Objective 2: To determine whether the telecom market in Ghana can support DP

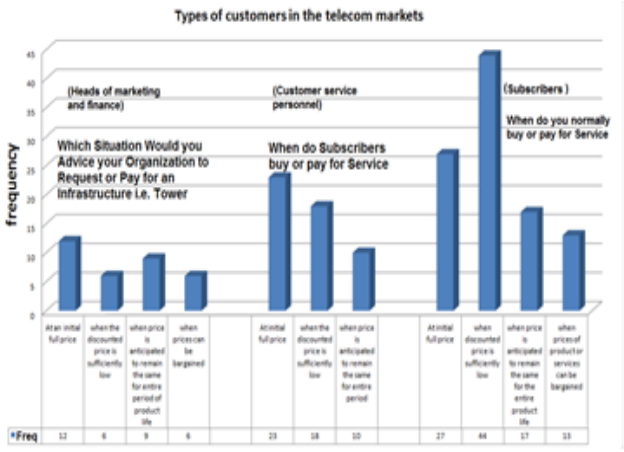

Figure 2: Types of customers in Ghana's Telecom market.

Source: Researchers' field data (2013)

Figure 2 displays the variety of customers within the telecommunications infrastructure market in Ghana. It shows that there are four major kinds of customers: (i) ones that will buy or pay for infrastructure, at its initial full price (ii) those that preferred to buy the infrastructure when its discounted price was sufficiently

low (iii) those that preferred to buy the infrastructure when price is anticipated to remain the same for the entire period and finally and (iv) those that preferred to buy the infrastructure when prices can be bargained

Objective 3: To investigate if DP can help boost revenues

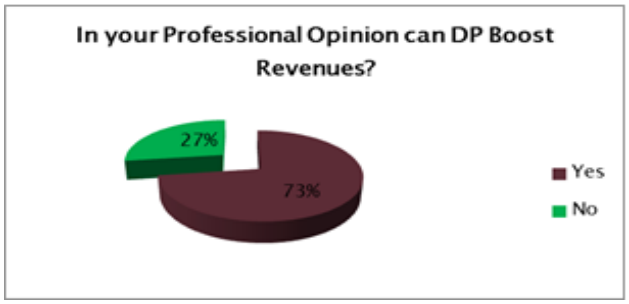

Figure 3: Professional Opinion by Finance and Marketing Managers on DP

Source: Researchers' field data (2013)

Figure 3, shows that out of the total respondents less that 30% opposed the submission. It thus appears that, DP can boost revenues at least from the point of view of the respondents.

A. Objective Non-Qualitative Evidence

Evidence 1: DP can help Boast Revenues

Revenue generation chart of MTN Ghana before and after introducing MTN Zones: A comparison of their fixed pricing approach and Price Discrimination or Dynamic approach.

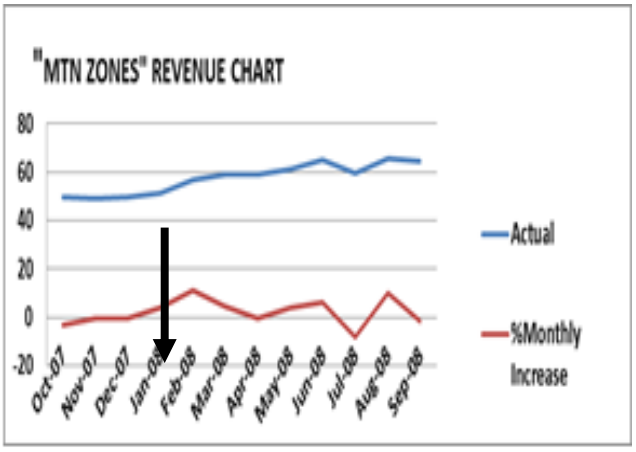

Figure 4: "Mtn Zones" Revenue Chart

Source: MTN GHANA, Fixed price or Single price ended in December, 2007: Dynamic or Price Discrimination started from January, 2008.

Evidence 2: The market size of countries already using a dynamic pricing approach in pricing their Telecom Infrastructure (A major precondition for DP application)

Table 1: Market size for Developed countries

Country	No. of subscribers (in millions)	Country's Population	%of subscribers to the country's population	No. of Telecom operators.	FD/DP?	Ownership
United States	102	316.3Million	70%	18	DP	Majority Private
Australia	19.2	21.8Million	119.5%	3	DP	Majority Private
Canada	26.4	35 Million	74%	3	FD	Majority Government
Portugal	15.9	10.56 Million	150.6%	3	DP/FD	Majority Government

Source: Fcc, Crtc, Accc, Anacom (2013)

Table 2: Marketing size: Developing countries

Country	No.of subscribers (in millions)	Country's Population	%of subscribers to the country's population	No. of Telecom operators.	FD/ DP?	Ownership
India	926.53	1.27 billion	73%	14	DP	Majority Private
Indonesia	220	237.6 Million	92%	10	DP	Majority Private
Ghana	26.921	24.652 Million	109.2%	6	FD	Majority Private

Source: nca, trai (2013)

Dynamic Pricing as the Most Likely Recommended Strategy. Price discrimination and dynamic pricing often work best in the presence of market power which is likely to pertain in Ghana's oligopolistic telecom infrastructure market. The benefits of dynamic pricing will be more pronounced when the demand is non-homogeneous (different types of customers), [39] or when the demand function or distribution is not known in advance, [40]; [41]

According to [42] Offering multiple prices can at best capture only second-order increases in revenue due to the statistical variability in demand", [42] notes however that these second-order increases in revenue may be significant in practice an indication there may be significant advantages of dynamic pricing over the fixed pricing strategy.

Sales revenue without and with price discrimination

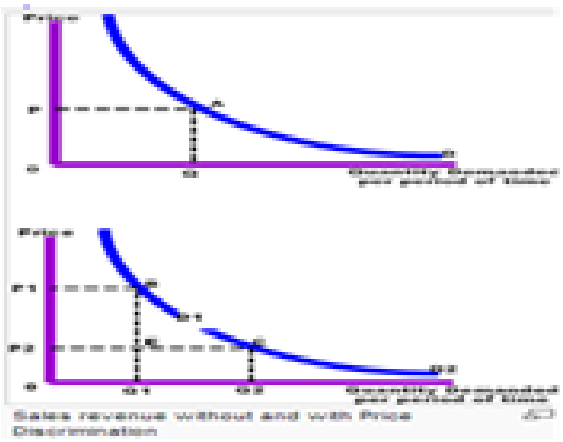

Figure 5: Demand Elasticity Graphs Source: [42]

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[3] assert that it can be proven mathematically that a firm facing a downward sloping demand curve that is convex to the origin will always obtain higher revenues under price discrimination or dynamic pricing than under a single price strategy or fixed price strategy especially in a capacity constrained and a clearly defined life span product or services. This can also be shown diagrammatically.

In the top diagram, a single price (P) is available to all customers. The amount of revenue is represented by area P, A, Q, O. The consumer surplus is the area above line segment P, A but below the demand curve (D).

With price discrimination or dynamic pricing, (the bottom diagram), the demand curve is divided into two segments (D1 and D2). A higher price (P1) is charged to the low elasticity segment, and a lower price (P2) is charged to the high elasticity segment. The total revenue for the first segment is equal to the area P1, B, Q1, O. The total revenue for the second segment is equal to the area E, C, Q2, Q1.

The sum of these areas will always be greater than the area without discrimination assuming the demand curve resembles a rectangular hyperbola with unitary elasticity. The more prices that are introduced, the greater the sum of the revenue areas, and the more of the consumer surplus is captured by the producer. The combination of perish-ability and capacity- constraints can encourage business orientation in which service providers focus on filling capacity Diseraju and Shugan (1999), and assert that the optimal pricing strategy is price discrimination or Dynamic Pricing(DP). In the Telecommunication infrastructure market where tower spaces left unoccupied goes wasted each and every passing, it is therefore most appropriate to recommend dynamic pricing approach over fixed pricing approach

V. CONCLUSION

The Telecom sector players face numerous challenges with the current fixed pricing strategy. Such challenges include: surplus inventory, inability to meet the demands of varied or variety of customers in the market, inability to achieve the expected revenues, inability to attract new entrants or customers and fear of over pricing (insecurity).The entire Telecom Infrastructure market is made of a variety of different types of customers which makes it suitable for DP application. They comprise: customers who will buy a product or pay for service at an initial full price, ones who will buy or pay for service when the discounted price is very low, others will buy or pay for service when they anticipate prices will remain the same for the entire period of product life and customers who will buy or pay for service when prices can be bargained. Results from the analysis from the previous chapter allowed the researcher to conclude that DP can help alleviate the challenges of FP and also boost Revenues. The researcher concluded that based on the analysis from preceding chapter DP is the highly recommended most likely effective strategy for the Telecom Infrastructure market.

VI. RECOMMENDATION

Ghana's Telecom infrastructure market should adopt dynamic pricing as the most likely effective alternative pricing strategy. This will encourage new entrants whiles it will also encourage existing network operators to expand their coverage into remote areas.

The regulators (NCA) should monitor prices so as to set floors and ceilings when necessary within the application of dynamic pricing in order to avoid some sort of anti-competitive prices that may result.

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Alexander Osei-Owusu (BSc, MSc) is a Telecommunications management expert heavily involved in telecommunications research. Alex’s interests are mainly in the areas of telecommunication’s policy formulation and research. He is currently the Research Coordinator at the Graduate School at Ghana Technology University College (GTUC) where he also serves as a supervisor of graduate master’s thesis. Alex is an exceptional scholar. He was adjudged the overall best student and was also presented with the best thesis award during his MSc studies at GTUC where he successfully completed with distinction. Alex has conducted extensive research work in the area of Information and Communications Technology (ICT). Some of his research work has been accepted at international conferences such as the Global Development Network (GDN) conference in Accra, Ghana; the 7th International Research Conference organized by Koforidua Polytechnic in Koforidua, Ghana and the African Finance and Economics Association (AFEA) conference in Boston in March 2014. Alex Osei-Owusu is currently pursuing a PhD in ICT, and is highly motivated to contribute his quota to the world and his country through cutting edge research.

Stephen E. Armah (BSc, MA, PhD) is an economist specializing in econometrics, agricultural economics, industrial organization, and economic development. Although a young scholar, his academic career is backed by 14 years of teaching experience at the college level. Dr. Armah taught classes at Emory University in Atlanta, GA and the University of Illinois at Urbana-Champaign, Illinois before taking up his current job at Ashesi University in Ghana as an Assistant professor in economics. Before his current job, Stephen worked in corporate America as a research economist in residence for Moody’s Regional Economic Consultants in West Chester, PA. Stephen holds a BA degree from Swarthmore College, an MA degree from Emory University and a PhD from the University of Illinois at Urbana-Champaign. Stephen is very active in research, having won several awards in the United States for excellence in academic research. For example, he won the “best paper” awards at the South-Western Economics Conference in 2007 and at the Illinois Economics Association Conference in 2008. Furthermore, in March 2011, Stephen’s paper, “Media Freedom and Political Stability in SSA,” was selected as one of the very best at Oxford University’s CSAE Conference. Stephen has a reputation for being a stickler for “good research.” He focuses primarily on empirical research and has several publications to his credit. In 2014 alone, apart from this article Stephen has published two journal articles: [1. *Osiakwan, R and S. E. Armah (2014) “Clearing the Muddy Waters: An attempt to decompose the impacts of inflation on the welfare of Ghanaian citizens in light of recent political rhetoric on inflation” Journal of Economic Development, Management, IT, Finance and Marketing, 5(2), 32-65 Sept 2013 & 2. Osiakwan, R and S. E. Armah (2014) The Fashionable Inflation and "Food Inflation" Rhetoric in Ghana: Is there any substance behind all the hype? International Journal of Agriculture and Economic Development, 1(1), 1-36, Dec. 2013 1]* and also expects to publish two book chapters by June of 2014. Stephen is the associate editor for many US-based economics journals apart from being the chief editor of the Ashesi Economics Lecture Series Journal. At Ashesi, Dr. Armah is involved in Student-Mentoring Programs, serves on the Ashesi Strategic Planning Committee and Ashesi Judicial Council (AJC). He pioneered the Ashesi Economics Lecture Series, which he still directs.