

VoIP in Developing Countries: The Next Disruptive Technology?

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"... telecommunications policies affect not only telecommunications..., but also the economic development... and social, cultural and political growth."

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INTRODUCTION/OVERVIEW

Voice over internet protocol (VoIP) has not proven itself as a disruptive technology in the developed world, but it may prove to be disruptive to un-served and under-served customer segments in developing countries (DC). These firms (for simplicity we will term these companies DC-VoIP providers or Providers) are providing inexpensive international telephone calls to this market segment. Several firms have targeted these segments that are overcharged, if served at all, by their traditional telecommunication provider.¹ This segment of the communications market has been ignored or under-served by the traditional carriers, although the demand for communications is larger than many of the incumbents have anticipated. Indeed, now that incumbents have become aware of these new VoIP services entering the market, they are taking steps to limit or constrain the competitive VoIP entrants.

The Grameen mobile phone is a well known disruptive (communications) technology, but it was welcomed into Bangladesh. It has contributed jobs and added hundreds of millions of dollars to the gross domestic product in Bangladesh.² It has changed the face of communications in the country due to its innovations in financing and distribution methods.³

The DC-VoIP providers are aimed at emerging market small businesses and at enabling social entrepreneurship in developing countries by connecting communities with affordable communications services via internet based technology platforms. These entrepreneurs are analogous to the Bangladeshi phone ladies. The Providers are using the internet to out-flank the incumbent telephone companies, providing more access to telephone service in addition to low cost for the service. The unique feature of some of the Providers' offer is no need for credit cards or checking accounts. Literally billions of people do not own credit cards, checking accounts or Pay Pal accounts. Moreover, banking services are difficult to access and expensive or completely unavailable for these customer segments. (Service such as Skype or Jajah requires a credit card to use.)

¹ Including iWorldServices, MediaRing, Delta 3, Go2Call, IDT (Net2Phone), MyWebCalls, Interlink – Global, Varphonex, Hatif, and Talk Free.

² http://mobileactive.org/grameen_phone [27 October 2007].

³ The concept is being replicated in Rwanda and Uganda by the Grameen Foundation.

A secondary result of the analysis is that, in many countries, the incumbent has thwarted the provision of these competitive alternatives by blocking the various VoIP protocols. Nevertheless, our analysis indicates that DC-VoIP providers will prove to be a disruptive technology. If DC-VoIP prevails, it will be as socially beneficial as the Grameen mobile phone. By estimating the demand for the DC-VoIP providers' service, the impact on the economy can be determined. While we cannot estimate the demand in the conventional manner, because of the lack of relevant household data, we use a proxy. Thus, the demand for DC-VoIP providers' service is estimated based on the growth in demand in selected countries. This cross-country data is normalized by country parameters to determine the effect these service will have on specific countries. These estimates are, by analogy with the Grameen's impact, used to calculate the macro consequences of this disruptive technology. Preliminary estimates suggest that the Providers may add an additional one-third of one percent to the economy, a significant amount for the size of the investment.

The difficulty in assessing the full impact of VoIP's disruptive impact on communications comes from the fact that it must be integrated with the technology it is attempting to disrupt in order for the complete (or even major) impact to be felt. Since the incumbent carriers have no or little incentive in most cases to adopt or even facilitate the VoIP technology, the adoption will be drawn out over a fairly long period. When regulatory barriers are used to thwart introduction of VoIP, the difficulties are compounded.^{4, 5}

This paper is organized as follows: the next section reviews the impact of information and communications technology (ICT) on economic development, the third section examines the demand for voice service; it discusses the methodology, the data and results. The final section concludes and makes recommendations for further research.

COMMUNICATIONS IN DEVELOPING COUNTRIES

VoIP⁶

VoIP is a common term that refers to the different protocols that are used to transport real-time voice and the necessary signaling by means of Internet Protocol (IP). VoIP allows the user to place a call over IP networks. The basic architectural difference between traditional telephony and IP telephony is that an IP network such as the Internet is inserted between the telephony end-points, typically central offices. IP networks are packet-switched, as opposed to circuit-switched traditional telephony. Unlike circuit-switched networks, packet networks do not set up a fixed circuit before the call begins. Instead, the individual voice packets are sent through the IP network to the destination. Each packet may traverse an entirely different path through the network; however, the conversation is reassembled in the correct order before being passed on to the VoIP

⁴ Thanks to Dan Jensen for this observation.

⁵ For example, see Rendón *et al* (2007) or Trope (2005) for a review of the regulatory structure in Latin America.

⁶ This section is based on the Rappoport, *et al.* (2004) paper on willingness to pay for VoIP.

application. The "glue" that ties together the PSTN (Public Switched Telephone Network) with the IP network is known as an IP gateway. IP gateways perform many of the traditional telephone functions such as terminate (answer) a call, determine where the call is to be directed, and perform various administrative services such as user verification and billing before passing the call on to a receiving IP gateway. The receiving IP gateway, which may also be interconnected with the PSTN, dials the destination and completes the call.⁷

Before turning to technical details, it is useful to note just what it is that VoIP represents. Unlike some services that have emerged out of the electronic revolution, VoIP does not involve a new good *per se*, but rather a new way of providing an existing good at possibly lower cost and in a possibly more convenient manner.⁸ The good in question, of course, is real-time voice communication at a distance.

The word *possibly* is to be emphasized, for voice communication is a mature good in a mature market, with characteristics that for all practical purposes are now those of a commodity (Rappoport, *et al.* 2004). However, in the developing world, the ultimate potential market for VoIP is more than simply the size of the current voice market plus normal growth, because the incumbent carriers have neglected to serve the lower strata of the population. Incorrectly, they assumed that this was not a strong market. We disagree with this perception, and moreover, this paper will show that the market is robust, and underserved. Indeed, the incumbents are now beginning to recognize this; however, instead of welcoming the filling of this market gap, the companies are thwarting the efforts of new entrants to provide services to this lowest stratum. The incumbents have blocked the various protocols which provide VoIP service.⁹

Impact on Growth

An ITU study of telecommunications and development, *The Missing Link*, concluded that, now nearly a quarter of a century ago, "telecommunications can increase the efficiency of economic, commercial, and administrative activities, improve the effectiveness of social and emergency services and distribute the social, cultural and economic benefits of the process of development more equitably throughout the country." Although it is recognized as an essential catalyst for growth, however, improved telecommunications generally has not been a central investment focus for developing countries.

A wide range of studies indicate that expanded communications investment is essential, not only for growth, but also to remain competitive within the increasingly information-oriented global economy. Failure to develop ICT systems will only increase the development gap between the developing and the

⁷ http://www.cse.ohio-state.edu/~jain/cis788-99/ftp/voip_products/

⁸ Cellular telephone provides an apt contrast with VoIP, for, while cellular, too, represents an alternative way of providing real-time voice communication, it also allows for such to take place at times not available to traditional fixed-line telephony, hence in this sense is a genuine new good.

⁹ Five protocols can be used for VoIP. At least one company has used all five and had each blocked by a country's incumbent telephone company.

industrialized countries. Nevertheless, with some exceptions, the necessary investments have not been made. A mobile telephone service has offered a countervailing power in some instances. Now, VoIP is becoming yet another counter weight to the high-priced, inadequate investments, and poor quality of service offered by the incumbents.

Extensive studies from the 1960s to the present have documented a strong correlation between GDP per capita and telephone density indicators. The data for all countries generally fall within a small band along a straight line on a logarithmic chart. Recent statistical tests for the direction of causality by Hardy (1980), DRI/McGraw-Hill (1991) and Norton (1992) show that the growth of telecommunications investment or penetration is a statistically significant predictor of economic growth, and *vice-versa*: indicators of economic growth are significant predictors of telecommunications investment. Communications is thus considered to be both a cause and a consequence of economic growth. According to Norton (1992), "The data in this study...are consistent with the proposition that telephones provide substantial growth- and investment-enhancing activity and thus facilitate economic growth."

Input-output studies of the economic impact of telecommunications also show that it makes substantial contributions to the efficiency of the economy. A quantitative study of the U.S. during the years 1963-1982 estimated efficiency gains of nearly US\$ 80 billion for the 1982 economy.

Thus, while it is clear that information and communications technology contributes to economic growth and development, the magnitude of its contribution, much less the individual contributions of wireline voice, cellular (wireless) and, now, VoIP is not clear. We hope to shed some light on this issue.

Literature Review¹⁰

Governments and public agencies in most countries, both developed and less developed, spend large sums of money on infrastructure. The purpose of infrastructure investment is to positively influence economic activity in terms of employment, value added, productivity, capital formation and income. Infrastructure investments also help with the social and political integration of a region. While this study is focused on VoIP, which has to be supported by an internet and, sometimes in combination with the traditional voice telephone service, it is useful to examine the role of the communications infrastructure and investment impacts on development. It helps to understand the role of VoIP which rides on top of this infrastructure¹¹.

Investments in physical infrastructure generally fall into four broad categories: utilities; communications; transportation and land development. Most of these investments have certain characteristics in common. They tend to have some attributes of public goods in that they require a high initial investment with a relatively low marginal cost once the investment is in place. The provision of

¹⁰ This section is adapted and updated from Alleman, *et al.* (1992).

¹¹ Including cellular and other wireless technologies.

service from these industries also provides benefits to a large percentage of businesses and households of a region and typically has some form of external economies.

Most infrastructure investment can positively affect the economy in three ways. First, it can reduce the cost of production. Second, it can increase revenues. Third, it can increase employment through both direct and indirect effects.

Most analysts show a positive correlation between infrastructure investment and economic development.⁸ Three different methods ordinarily are used to estimate the effect of infrastructure investment on economic development: production functions; factor movements; and trade flows.

The idea that infrastructure investment is correlated with economic development is appealing and intuitive. To imagine an economically developed country without a substantial infrastructure is difficult. However, to state a precise relationship between the two is difficult. For example, Balabkins (1990) points out that investment in infrastructure must occur before what economists call final demand. Others, such as Hirshman state that development may cause the investment in infrastructure. Another example is provided in a study by Ford and Poret. They examined the relationship of decreases in total factor productivity to changes in the level of infrastructure investment for eleven countries. They found that in half the countries investment in infrastructure increased and in half it decreased while total factor productivity decreased in all countries. Although these, and other studies, are seemingly contradictory, they indicate that the relationship between infrastructure investment and economic development is complex.

A number of researchers point out that infrastructure by itself is not a sufficient condition for economic growth. It is a necessary condition but it will not by itself ensure economic growth. Other factors must be in place. It must have a favorable existing potential for new development. Infrastructure is essential for economic development. A country or region cannot develop without it but the degree to which it will spur growth is uncertain.

Two other factors may complicate the relationship between infrastructure and growth. First, there may be decreasing returns to infrastructure investment. The contribution of infrastructure to growth may depend more upon the uniqueness of the investment than an increase in the ubiquity of the investment. For example, the addition of a traffic lane to the roads of a country with a highly developed highway system will have less of an effect than building roads in a region that does not have any. Second, the ability of infrastructure to exert a strong influence on economic development requires that the infrastructure investment be maintained once it is in place. A road that deteriorates to the point where it is difficult to traverse does not exert as much economic stimulus as one in good repair that can be traveled easily and does not cause excessive maintenance on cars and trucks.

Telephone service is a category of infrastructure investment. The previous discussion of the relationship between infrastructure investment and economic development generally applies to telephone service as a category of infrastructure investment. Some developing countries invest as much as 0.61 percent of their gross domestic product (GDP) in telecommunications. In the 1970s the average was 0.25 percent (developed countries average 0.8 percent of GDP during the same period). At least one group studying the issue suggested that developing countries invest not less than 0.5 percent of GDP in telecommunications infrastructure (see Alleman, Rappoport, & Madden (2008) for the latest estimates).

Investment in ICT presents its own set of conditions. Because of the nature of ICT services and the benefits derived from them, measuring the benefits or placing economic values on the benefits may be more difficult with ICT investments than other infrastructure investments. ICT investments affect economic development in the same general way as other infrastructure investment. It can reduce the cost of production. It can increase revenues. Finally, it can increase employment through both direct and indirect effects.

ICT, however, will affect revenues and costs in more indirect ways than many other types of infrastructure investment. The reason is that much of the benefits of increased telephone service are derived from increases in information and knowledge. For example, industrial development requires cooperation and coordination of a series of operations. Increases in information and knowledge result in more efficient cooperation and coordination. Commerce is essentially an information processing activity. Effective buying, selling and brokerage rely on access to current information on the availability and price of goods and services. ICT increases the available information, and thereby increases the efficiency of commercial activity. In the lowest strata of the population, the need for communications is underestimated and under-served. This is where the Grameen phone enters and now VoIP.

DEMAND FOR DC-VOIP

Pent-up demand

While there is very little data desired to produce more precise estimates of VoIP demand and its contribution to economic growth, data is available on the growth in demand for one company.¹²

The analysis indicates that the demand for communications is much more than heretofore estimated even among the lowest strata of the populations. The Grameen phones were the first example, and the data indicated that the VoIP services are the second. Two measures of the nature of the pent-up demand:

¹² The authors are grateful for data provided by Paul Falchi and Dan Jensen of iWorldServices used in the estimations as well for their insights.

The first is the rate of growth of one Provider. This is shown in Figure 1. This represents an average annual compound rate of growth of over 3,500 percent.¹³

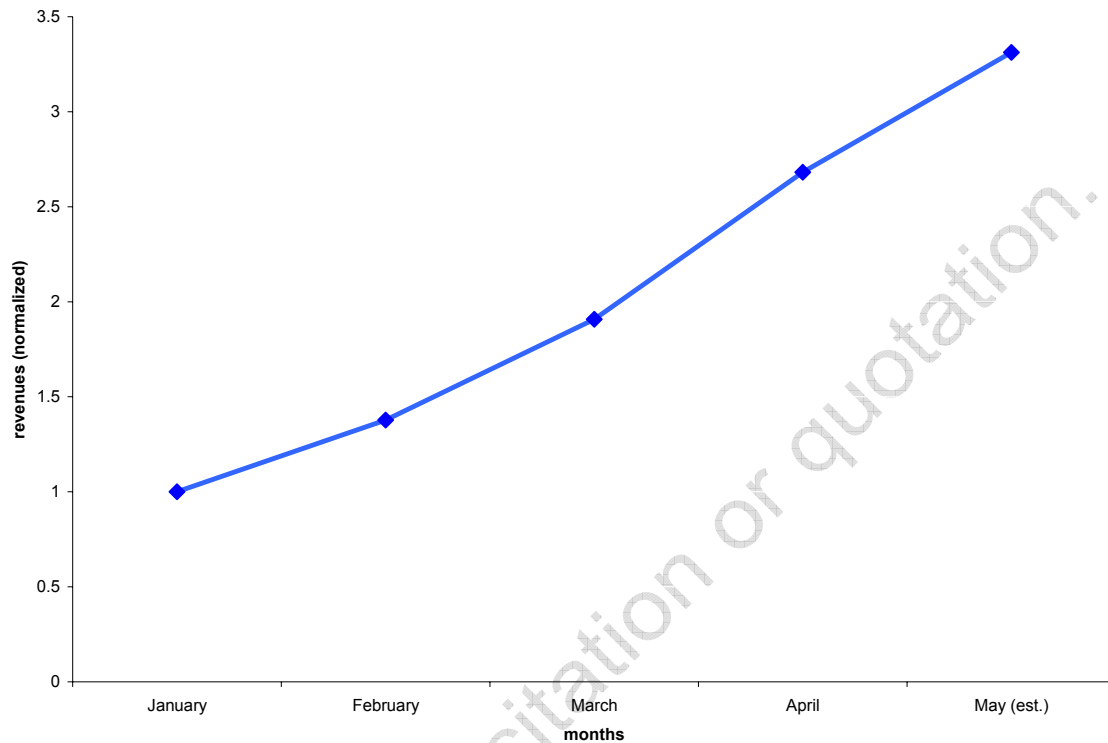


Figure 1. Revenue growth

The second indication is the traffic generated in the countries in such a short period of time. One Caribbean country for one VoIP Provider had nearly one-half of one percent of the outgoing international calls, and a North African country nearly one and a half percent of all outgoing call based on current growth rates. These countries had a growth rate in international calls of 12.5 and 2.3 percent, respectively, for last five years of reported data.¹⁴

Data Deficiencies

The results generated by economic models and analyses are only as valid as the initial data. An effective economic model requires a valid, reproducible and accurate statistical time series over a significant period of time. Because of the limited provision of VoIP, these statistical series are not available for many countries. The countries at the lower range of the development spectrum.

The authors used a variety of data sources in developing the profile of the countries under study. The authors have worked extensively with the published

¹³ This growth rate is for the last four months of operation (approximately six months after initiation of service). It is true that a new company starts from zero and will have a higher growth rate than an established company. Nevertheless, this growth rate is pronominal.

¹⁴ Authors' calculations, iWorldServices and Euromonitor International (2008).

and electronic version of the data available on the selected countries. Several data deficiencies have been found. As noted above, the authors found several areas where the data series did not agree with one another. Data deficiencies could not be entirely overcome within the context of this study

Results

By estimating the demand for the DC-VoIP providers' service, the impact on the economy can be determined. The demand for DC-VoIP providers' service is estimated based on the growth in demand in selected countries. This cross-country data is normalized by country parameters to determine the effect this service will have on specific countries. These estimates are, by analogy with the Grameen's impact, used to calculate the macro consequences of this disruptive technology. Preliminary estimates suggest that the Providers may add an additional one-third of one percent to the economy, a significant amount for the size of the investment.¹⁵

The thesis of this paper is that the DC-VoIP providers will prove to be as disruptive and socially beneficial as the Grameen mobile phone, a secondary result indicates that, in many cases, the incumbent telecommunications provider or its agents have attempted to thwart DC-VoIP.

CONCLUSIONS/FUTURE RESEARCH

We have suggested a methodology for relating communications and economic development in the context of VoIP within developing countries. It is recommended that more detailed studies be developed for each country to confirm these assessments. Preliminary estimates suggest that the Providers may add an additional one-third of one percent to the economy, a significant amount for the size of the investment. Of course, the question of the cause-and-effect relationship between economic growth and development and communications is always present.

The thesis of this paper has shown empirically that the DC-VoIP Providers appear to be a disruptive technology. It has the potential to be as socially beneficial as the Grameen mobile phone. A secondary but important finding is that, in many cases, the incumbent telecommunications provider or its agents have attempted to thwart DC-VoIP.

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¹⁵ Authors' calculation, http://mobileactive.org/grameen_phone and <https://www.cia.gov/library/publications/the-world-factbook/geos/bg.html>.

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