

# PUTTING BROADBAND IN THE PALM OF PEOPLE'S HANDS:

## A MODEL TO DRIVE FASTER ECONOMIC AND SOCIAL GROWTH

### Summary

Today only 59% of the world's population use mobile phones. That means nearly 3 billion people are excluded from the mobile economy. This number is far too large to be a problem; it has to be an opportunity. An opportunity for economic and social growth.

**According to the World Bank, a ten percent increase in mobile penetration leads to a 1 percent increase in low-medium income GDP.** But is this relationship between GDP and mobile growth set, or can we accelerate it?

According to a model developed by Bell Labs and the World Economic Forum, with the right combination of actions and investment, **we can accelerate the impact of mobility by as much as 36%, measured in GDP.**

The model predicts how mobile policies, applications, technology, and economics can impact the future. The team found that **while mobile broadband is a good thing for economic and social growth, when we combine it with the right applications it gets even better.**

Mobility is about a lot more than being able to move around with a phone. It is about giving people access to services, information and markets. To health, to education, to finance. In short its about giving people the ability to do more.

In general, there are three key issues have the most impact on growth:

- 1. Rethinking infrastructure.** With current traffic and technology adoption patterns, our team predicts many urban networks will be soon be overloaded. Conversely, many rural areas are underserved. Mobile access today is not ubiquitous. To achieve ubiquity quickly, we need to look at new business and green technology models that lower costs and accelerate universality.
- 2. Scaling relevant applications** – we need broad deployment for certain applications. One of the most telling aspects of the study is how applications can accelerate economic and social growth. We've seen it in Kenya with mobile payments. These sorts of applications have real social benefits and we need to find ways to scale them more quickly. The issue here is not one of innovation – its about broad deployment.
- 3. Delivering affordable solutions.** This is not new, but if we want to continue to extend the adoption of communications services to all socio-economic levels, the notion of affordability needs to be fully embraced. Sustainable and innovative solutions that meet the price pressures of the poor are essential.

<sup>1</sup>The newly renamed Telecom Industry Global Agenda Council envisions a world in the next five years in which everyone is connected with sufficient access to an Internet-based, open ecosystem of information, devices and applications through incentives for technological, social and business innovation.

<sup>2</sup><http://www.gartner.com/it/page.jsp?id=1278413>

<sup>3</sup>Ovum.

<sup>4</sup>ITU, 2009.

The World Economic Forum assembled a Global Agenda Council on the Telecommunications Industry Communications. Their goal: make sure everyone has Internet access by 2015.<sup>1</sup>

They've done this because mobile broadband can drive economic and social growth. But how fast? Is the relationship between adoption and growth set? Or can we accelerate it?

We asked a team of researchers at Bell Labs, the World Economic Forum-GAC and over fifteen experts in subjects ranging from public policy, economics, social development, technology and business. They did in-depth studies on Kenya, Bangladesh and Venezuela. They found we could increase the mobile impact by 36 percent over current GDP predictions.

We do this in part by opening new markets. This important because developing nations represent 86% of the world's population. They are dramatically underserved. If we make a concerted effort to keep the cost of service and equipment low, and provide compelling applications, this could well be the largest long-term market ever encountered.

## Introduction

There is a strong link between increased telecommunication penetration and faster economic and social development. As a result, the World Economic Forum's Global Agenda Council has set a crucial goal — to provide worldwide access to telecommunication capabilities by 2015.

The Council believes that communications, particularly mobile, open groundbreaking opportunities to transform industries and improve living conditions, particularly in developing countries. They envision a world where people in all walks of life have access to an open ecosystem of information, devices and applications — which can enable new ways to obtain healthcare, make payments, connect with new markets, apply for a loan, learn to read and take other fundamental steps that change lives for the better.

During the past five years, significant progress has been made in providing the benefits of connectivity. In Africa, Asia and Latin America, mobile phones have helped more than two billion people become more productive and efficient. The beneficiaries range from fishermen in India, who use mobile phones to find the best markets for their catch. To village women in Kenya who receive mobile remittances and make mobile payments. To health workers in Brazil who can now collect data more efficiently. The number of mobile devices in use globally has grown to 5 billion, and the number capable of accessing the Internet is expected to reach 1.82 billion by 2013.

But is this rate of progress sufficient to meet the 2015 goal for ubiquitous telecommunications access? If not, what are the challenges hindering this objective? How can they be overcome? How can individual countries and regions quantify the economic and social benefits of extending connectivity to its entire population? Are there ways to accelerate the benefits?

This discussion guide examines the macro-economic and human development-related benefits when networked communications services are made ubiquitously available to every person. It includes estimates of the impact of the investment in new telecommunication infrastructure, particularly mobile infrastructure, as well as the gains resulting from the wide-scale availability of three mobile applications -- mobile financial services, mobile banking and mobile health. This work also examines the inhibitors to adoption. In this case, it identifies the resulting challenges, as well as specific actions that can help accelerate mobile uptake. A diffusion model is used to simulate mobile service adoption within individual population segments.



# WHY IS ACCESS SO IMPORTANT?

With 5 billion mobile devices in use today, mobile networks provide access to people, markets and services. They provide a means to connect more people to the growing digital economy. This is especially important to people in developing countries and rural areas.

Developing countries now comprise 86 percent of the world’s population, and over half the people in those nations are living in rural environments. Mobile access in these areas is still far behind adoption in developed regions.

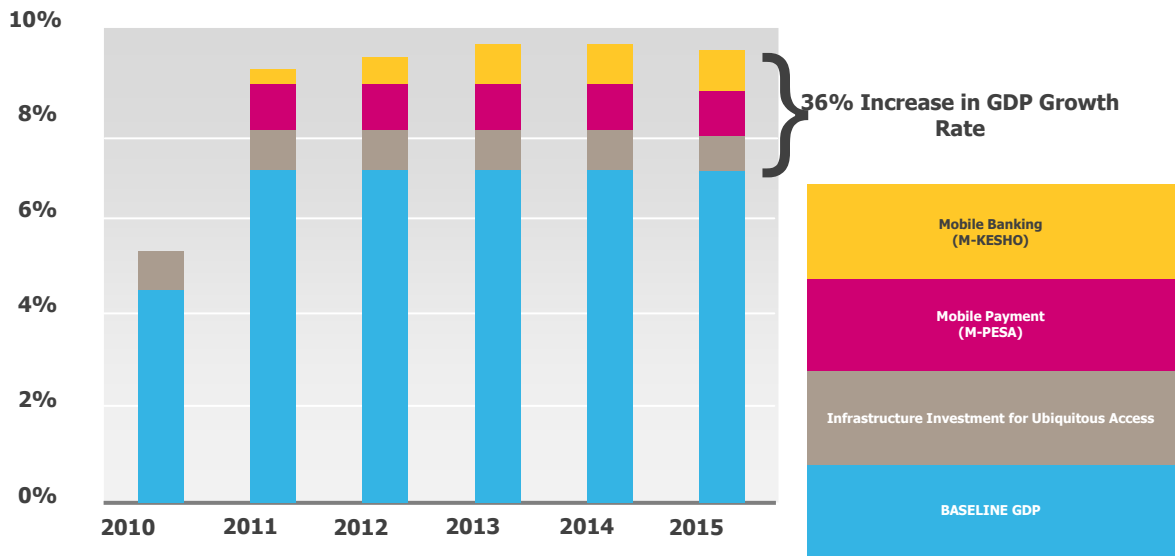
People in emerging markets are only half as likely to have access to mobile communications as the residents of developed countries. And fewer than 10 percent have Internet access, far below the global average of 23 percent.

If more people have access to mobile communications, economies can grow and improve lives. Numerous studies have demonstrated the impact of mobile penetration on GDP growth<sup>1</sup>.

Brought down to an individual level, GDP per capita is an indicator of standard of living. It is used along with data on life expectancy and education to calculate Human Development Index scores. Mobility affects GDP and can be a tool to drive education into underserved areas. As it relates to the model developed for this paper, the right combination of applications and affordable access can lead to a 2.7% GDP increase, and 1% increase in HDI in Kenya. In real terms it means, it appears that Kenyans could educate an **additional 443,000 students and add fifteen months in life expectancy**.

## Bootstrap model applied to Kenya

GDP (PPP) Growth Rate



**Mobile broadband combined with the right applications brings a 36% more GDP growth than broadband alone.**

<sup>1</sup>For example, "Telecommunications Infrastructure and Economic Development: A Simultaneous Approach," H.-L. Roller and L. Waverman, American Economic Review, Vol. 91, No. 4, pp 909-923, September 2001.  
 "Telecommunications Infrastructure and Economic Growth: Evidence from Developing Countries," K.S. Shridhar and V. Shridhar, National Institute of Public Finance and Policy, India, 2005.  
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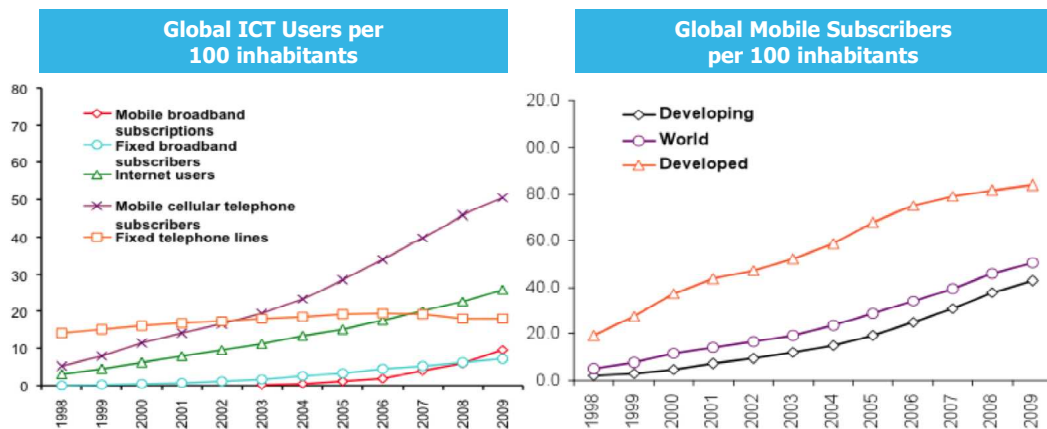
# A CASE FOR BOOTSTRAPPING: CURRENT MOBILE TRENDS SHOW WE'LL FALL SHORT OF OUR 2015 GOAL

To determine what needs to be done to achieve the 2015 goal, current trends in mobile adoption were examined to gauge if ubiquitous access could be achieved at its current course and speed. The Figure below shows 10-year telecommunications trends, ending in 2009 — and breaks out mobile growth by developing and developed countries. If these trends continue at the current pace, the goal of connecting everyone to the networked economy would not be met.

This is where the Bootstrap Model comes in. It enriches our understanding of the mobility adoption curve and its economic and social implications. It cross-references factors such as:

- Service affordability
- Demographics
- Social groups
- Population density
- Technology adoption
- Disposable income
- Application utility

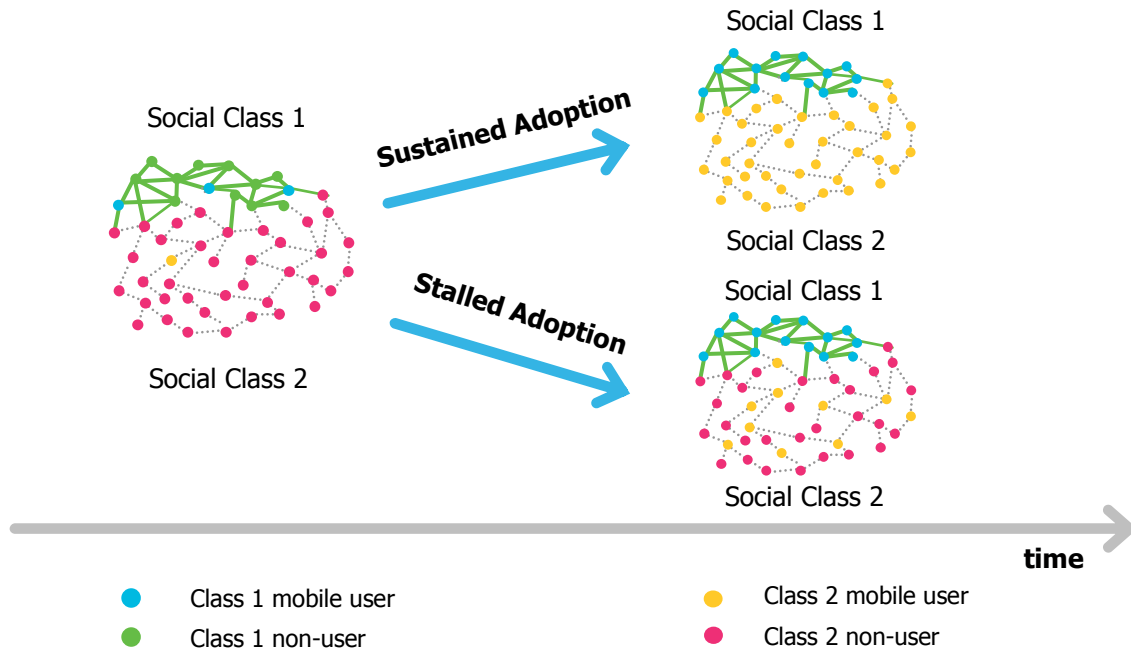
## Recent 10-Year Trends in Telecommunications Growth



\*Source: ITU ICT Indicators Report 2010; Subscriber numbers projected from subscriptions using Pyramid 2010 report

The model predicts how mobile access, application introduction and service pricing impacts mobile uptake. It measure the impact in number of users, economic and social growth. It allows governments and investment agencies to examine the feasibility and benefits of different business models on technology adoption and deployment. It also **helps people understand when mobile growth can plateau and how timely bootstrapping can change it so we drive ubiquitous access.**

# THE BOOTSTRAP MODEL



On the left, we see a largely unconnected market with two classes. These classes represent two distinct population segments such as urban/rural and high-income/low-income. Initially, there are few early adopters of mobile telephony in both classes. Over time, as the number of mobile users within each class grows, they begin to influence those who don't have service within that class. The adoption rate in a class depends upon factors such as service affordability, demographics, population density, technology adoption, disposable income, application utility, in addition to the influence of the users in that class. Over a period of time, the growth in mobile penetration can either be adopted by the entire class as shown in the top right case, or it may stall in any one of the two classes as shown in the bottom right case for class 2. Stalling may occur for a number of reasons such as affordability, lack of applications or lack of infrastructure. The more heterogeneous the population, the higher the number of classes, the greater chances of stalling.

When stalling occurs, an external intervention is required to address its root cause in order to achieve ubiquitous access. **The Bootstrap model simulates the effects of environment changes (prices, policies, applications) resulting from these interventions on early adopters, late adopters, on the strength of their social**

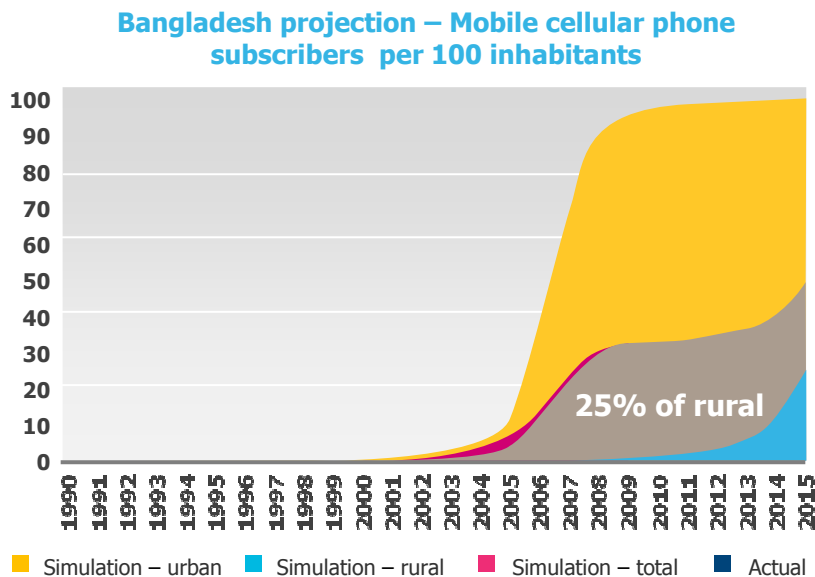
**interactions and on the network effects that drive adoption in order to determine the resulting impact on mobile penetration.** The model not only helps us understand when growth due to network effect can plateau, but also how timely bootstrapping can change it.

As mobile connectivity increases, social networks begin to cross geographical boundaries. Connectivity enables the peer groups to form dynamically. Once people connect to the network, they can join several peer groups, and each peer group can span the entire world.

According to Bright Simons of mPedigree Networks, the provider of innovative mobile healthcare applications in Africa, **"When people across multiple regions are connected, the peer groups that form tend to be widely scattered, and people's buying decisions are influenced not only by others in their neighborhood, but by peers from other regions as well."** This is an important point.

## Bangladesh – A test case for boot strapping mobile growth

To validate the accuracy and applicability of the model, the team selected a test case: Bangladesh. It offers all the challenges the model addresses: a large, under-served population, health and education challenges, a motivated workforce, and a growing urban population with reasonable connectivity. **With no stimulus, the urban population may come close to ubiquitous access by 2015, but the rural majority will not.**



## Why won't Bangladesh reach ubiquitous access?

- 1. Lack of sustainable infrastructure:** Providing affordable mobile services to everyone is challenging especially in regions that are far-flung and sparsely-populated. Many of these regions need to be served by expensive fuel-generated energy as they are not on the traditional energy grid. To be viable, the current mobile telecommunication architecture requires a large number of subscribers that is significantly higher than the population densities in many regions. On the other hand, the exploding rate of mobile data usage, and the growing number of high bandwidth-consuming devices make it difficult for service providers to operate profitably in urban regions.
- 2. Lack of affordability:** Monthly service charges and handset prices are leading barriers to mobile phone ownership. Even at the lowest currently prevailing (average) usage charges in many developing countries, the mobile phone is out of reach for most of the poor. Likewise, even with the availability of refurbished, pre-owned versions, handset prices are too high for many individuals. Cost, both in perception and in actual terms, is a critical factor in the successful deployment of many mobile health applications.
- 3. Lack of scalable applications:** A major impediment to the adoption of mobile services is a lack of applications. There are many instances of niche applications that address the needs of specific user groups among underserved populations. But there are very few examples of multiple applications being offered as a suite that would enhance their value to the consumer.

# THREE CALLS TO ACTION...

## 1. Rethinking infrastructure developing sustainable business models

Bangladesh and many other countries face the same challenge: the urban/rural divide. As the chart below shows, urban challenges will be capacity driven. Rural challenges will be coverage driven.

Urban areas need to meet the growing traffic demands. Urban smart phone users will grow from 400 per km<sup>2</sup> today to 12,800 in 2015. The growing number of users will generate a 30 fold increase in traffic. Networks will stagger beneath the load. So we also need to scale urban networks to ensure they can support the growth.

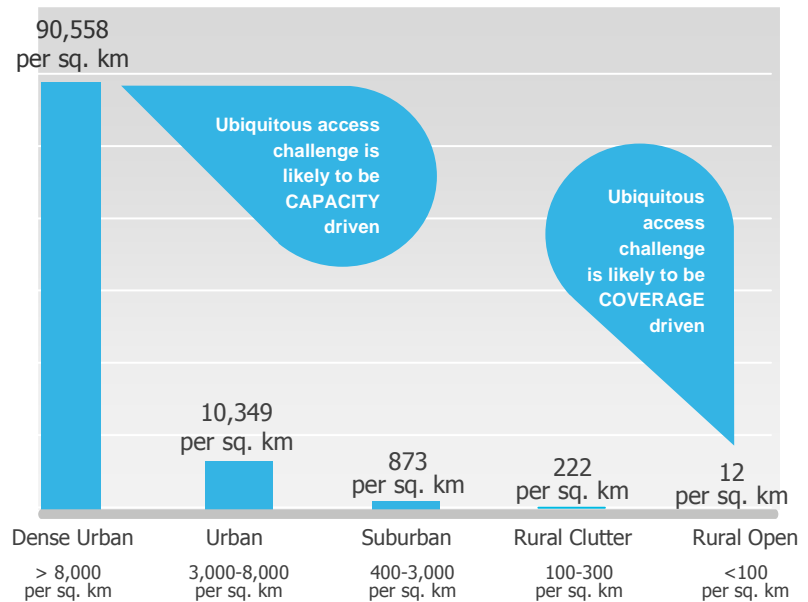
Rural regions lack the population densities needed to amortize infrastructure investments across a large population. As Ben Verwaayen, CEO Alcatel-Lucent says, **"We need a combination of energy-efficient and affordable networks to drive rural deployment. Green is good for the pocket, for the environment and it's necessary to go rural."**

Relying on traditional power generation sources will create a huge emission load with ubiquitous access. Some solutions to this challenge are technological; others, however, are legislative.

Several technological innovations offer great promise in terms of curbing emissions and reducing the environmental impact of technology, while simultaneously addressing cost factors. Among them are smart network management systems, the incorporation of improved energy management algorithms, low-cost wireless services that rely on a hierarchy of cells, energy efficient hybrid wireless networks that incorporate green products, renewable energy solutions, and the smart grid concept.

**Long Term Evolution (LTE) offers a revolutionary radio design that not only provides greater reach than other radio technologies, but is so spectrum and energy-efficient that it slashes the power requirements and operating expenses (OPEX) for operators significantly.**

Average Population Density by Morphology

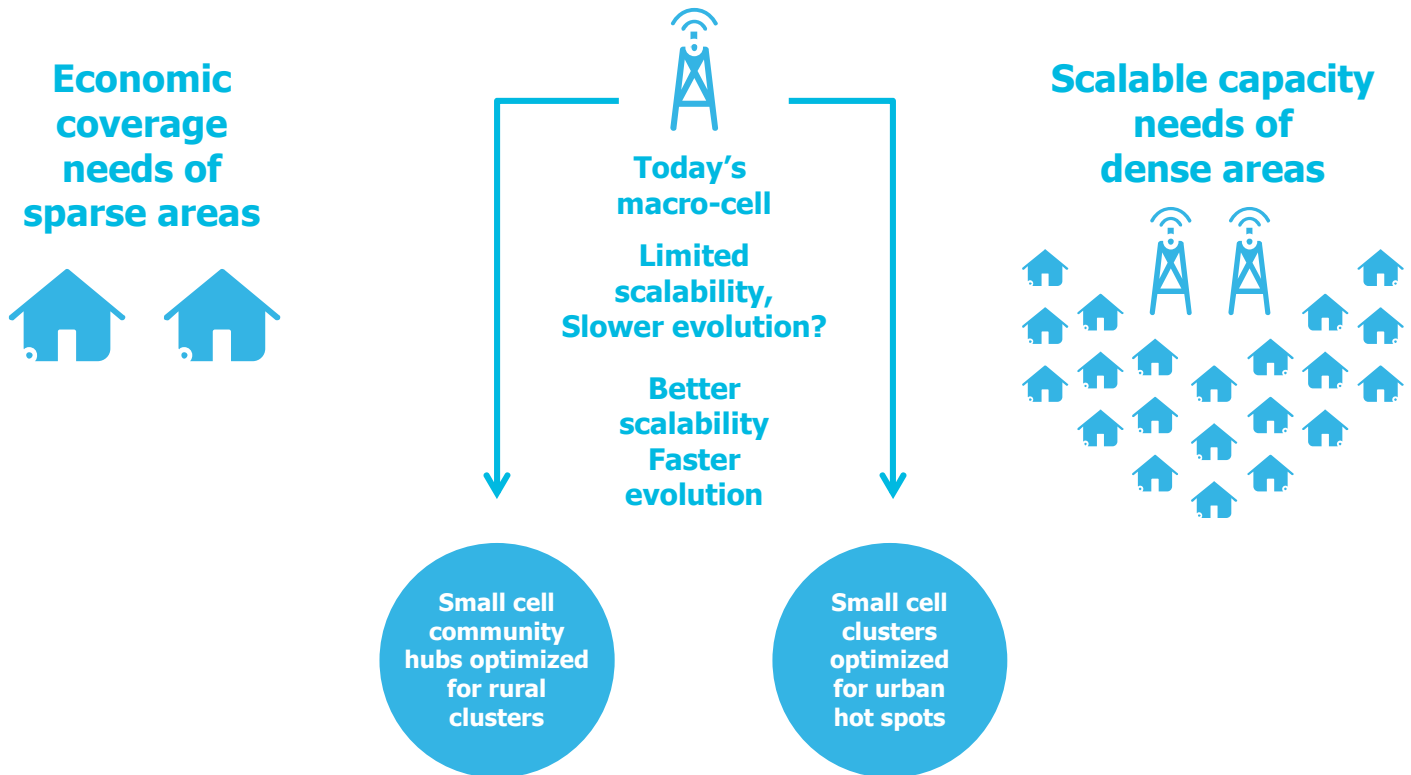


## THE CHALLENGES FOR ADOPTION

The areas where adoption of network applications is most urgently needed are also those that are the hardest to access. For instance, in many of the poorest rural areas, diesel-powered motors are needed to generate the sort of electricity required for the adoption of rich device technology.

Over-capacity in urban areas is another significant challenge to adoption; due to the explosion of the number of devices in cities, there will be severe capacity bottlenecks in the future.

# BOILS DOWN TO A FEW THINGS



**Network performance modeling shows that the evolution from a traditional base station model to a self-organizing smaller cell model can reduce the cost of transmitting data through a network significantly.**

And there is yet another benefit. Self-organizing small cell models also supports third-party application-programming interfaces (APIs) which allow application developers to plug into the network and deliver their applications to customers on the same network, thus bringing innovation and low-cost capability to the rural population. This model also helps with application scalability, by providing broader reach for application developers.

Some rural settings do not have access to electricity but we no longer need to choose between delivering electricity or communications infrastructure. With new technologies and innovative business models specifically aimed at the rural market, electricity and mobile can now arrive hand in hand.

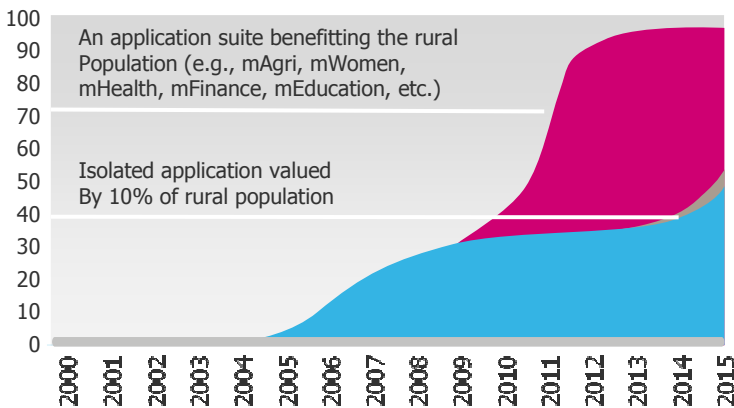
## 2. Scaling relevant applications

One of the key observations that emerged from this effort is that when mobile applications appeal to a large portion of the rural base, the adoption rate of the technology increases more quickly.

The reason for this is fairly straight-forward: **As long as the applications are relevant to the population that they serve, resistance to their introduction will be low, and indeed, the rate of adoption will accelerate as the number of people using them increases** — again, the network effect.

**A suite of applications** was modeled for rural Bangladesh. These mobile applications included mAgriculture, mWomen, mHealth, mFinance and mEducation, and were designed to offer tangible benefits to the rural population at which they were targeted. **In fact, they directly served 80 percent of the rural population—and radically accelerated mobile adoption.** On the other hand, the introduction of a single application had much less impact, as shown below.

**Mobile cellular phone subscribers per 100 inhabitants**



**When mobile applications target a larger critical mass of the rural base, technology adoption percolates much faster**

### Bridging the Gender Gap

One of the most glaring discrepancies in the developing world is the gender gap that exists with regard to mobile phone usage. According to an extensive study by the GSMA and Cherie Blair Foundation, 300 million fewer women than men subscribe to mobile phones, implying that two-thirds of all future subscribers may very well be women. As a consequence of this burgeoning reality, it is crucial that operators take steps to develop a clear understanding of applications that are most relevant to women, and invest a respectable percentage of their research and development budgets on women-specific applications.

The GSMA mWomen Programme, announced in 2010 the launch of the mWomen Base of the Pyramid (BOP) App Challenge. This competition is designed to address the significant demand for innovative application designs targeted at the specific needs of women in developing countries.

Mamakiba, for example, is a mobile-based budgeting application that helps low-income pregnant women save and prepay their prenatal care and the costs of childbirth.

Under the banner of education, literacy has been determined to be a high-demand item. Handsets that come pre-loaded with applications will help; in Bangladesh, more than 300,000 people have taken advantage of a new program that teaches English very effectively via cell phone.

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<sup>2</sup><http://www.gartner.com/it/page.jsp?id=1278413>

<sup>3</sup>Ovum.

<sup>4</sup>ITU, 2009.

# mPAYMENT: THE POWER OF A LIGHTHOUSE APPLICATION

The adoption of mobile services can be increased with a richer understanding of innovative lighthouse applications. M-PESA, a mobile payment service in Kenya, and mPedigree, an Africa-based service to fight counterfeit medication, are two examples.

According to Nik Nesbitt, CEO of Kenya-based contact center KenCall, multiple mobile applications need to be deployed in order to fully convey the value of mobile phones to the rural population.

For example, in Kenya Equity Bank and telecom partner Safaricom have collaborated to offer M-KESHO, a mobile banking application that allows M-PESA subscribers to engage in routine banking transactions via their mobile phones. The service has become popular; the venture is opening somewhere between 5,000 and 10,000 accounts daily.



### 3. Ensuring Affordability

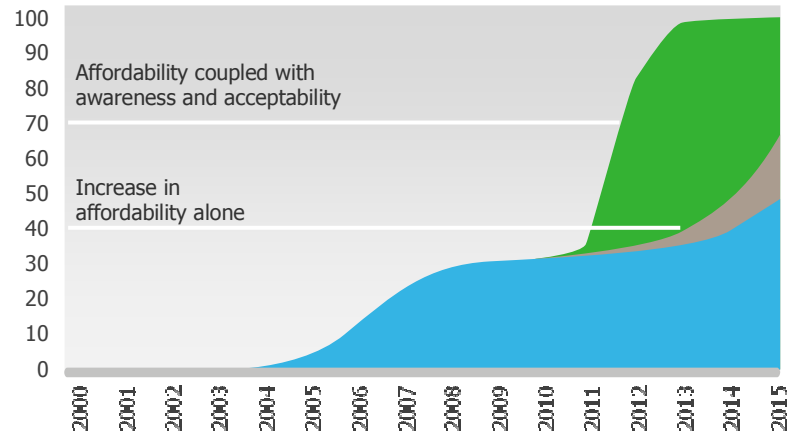
#### Mobile service cost below 5% of household expenses

The combination of handset cost and monthly service charges represent a significant cost barrier for those at lower socio-economic levels. What is a good measure of affordability? **A GSMA Development Fund study<sup>2</sup> found that for women in low- and middle-income countries when the price of mobile phone service fell below five percent of household expenses, it became a realistic number.**

#### So what can be done to make this happen?

The answer requires the combined efforts of device manufacturers, content providers, operators, and government agencies. Technology providers, for example, should invest in developing radically different alternatives to traditional macro-cellular architecture, optimized to serve low density regions and requiring very low capital and operating expenses. Device manufacturers and content providers can develop extremely low-cost, simple-interface devices and populate them with lighthouse applications to catalyze usage. Network operators can work in partnership with public and private sector organizations to develop low-cost services designed specifically for low-income households. **And government agencies can offer reduced taxes on mobile devices and put into place policies based on the notion of inclusive and sustainable economic growth.**

Mobile cellular phone subscribers per 100 inhabitants



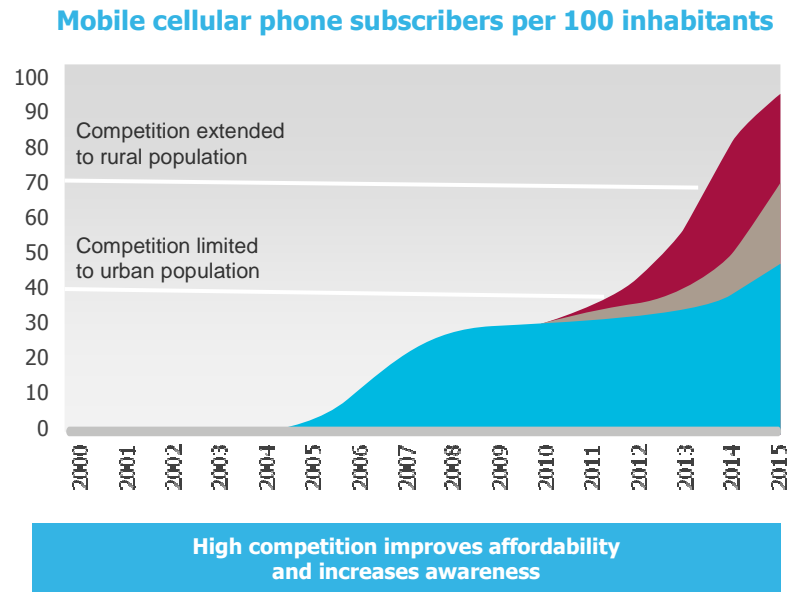
Improved affordability together with greater awareness of benefits and acceptability can achieve the goal

The above graph shows the impact of economics combined with an aggressive awareness campaign to influence the market to buy. The result: A self-validating market that is its own best catalyst for adoption and growth.

## The Importance of Competition

Another factor for improved penetration is the impact of competition. **When competition is introduced into a rural market, service affordability improves, awareness of available services grows, and the market finds itself energized by the battle for the customer's wallet between the competing parties.** The diagram on the right illustrates this nicely.

**Affordability, coupled with government policies promoting competition can do a great deal to catalyze the growth of mobile services in the developing world.**



The results of the modeling demonstrates that creative, cooperative actions can eliminate the affordability barrier. The above Figure shows that, when radical innovations in technology, business models and government policies are combined, they can deliver affordable services.

<sup>2</sup> "Women & Mobile: A Global Opportunity A study on the mobile phone gender gap in low and middle-income countries," GSMA Development Fund and Cherie Blair Foundation for Woman, February 2010.

# FINAL THOUGHTS

## Mobility Matters

Three criteria must be met if the impact of mobility in the developing world is to be achieved:

- We must create solutions to the coming capacity bottlenecks that will plague cities and combine green investment and new sustainability business models in rural infrastructure.
- We must encourage the development of scalable applications that support basic human needs.
- And finally, we must deliver communications services in an affordable and sustainable manner.

The focus of this analysis shows the power of widely deployed communications technology in a rural, low-income environment – or, equally important, the staggering impact of not deploying it. The industry, governments, and operators must collaborate to create and offer relevant applications, on a wide scale basis. This is crucial for widespread acceptance and use of mobile services. Operators must work closely with manufacturers to come up with an infrastructure model that will:

- Catalyze the deployment of service in the rural marketplace
- Meet the burgeoning traffic requirements of cities

**Equally important to this particular effort, is a focus on sustainable and cost-effective power technologies.**

Green initiatives are already underway in some regions in the form of biomass-fueled power stations, solar-charged handsets and other innovations that will help the BOP sector overcome the challenge of a non-existent or undependable power grid. Finally, efforts must be made to encourage **the development and deployment of scalable applications** that will meet the critical needs of the developing world’s population in terms of relevant use of the mobile device.

**The time to act is now. A global effort to bring together investment, interoperability, innovation, and education can accelerate the promise of this opportunity for connecting the world.**



# INTERVIEW NOTES

While conducting research for this paper, we interviewed a number of GAC members and World Economic Forum participants who are experts on the topic. Here are insights and ideas on the topic of ubiquitous mobile access which we would like to highlight.

## **Muhammad Ibrahim, Centre for Mass Education in Science, Bangladesh:**

Owning a mobile handset and having access to mobile services is not a luxury: it should be considered a basic human right.

Bangladesh teledensity has increased dramatically—reaching an unbelievable level, especially the way it has reached the lower income people in the rural areas. The cost now seems to be affordable even to poor families.

The next challenge is how to use this technology for poverty alleviation and improving the quality of life, through value addition in mobile phone. Its impact on education, health, good governance, livelihood options etc. can bring a much larger revolution.

## **Dawn Haig-Thomas, GSMA:**

There are 300 million fewer female phone subscribers than male. This implies that two-thirds of future subscribers are likely to be women. Operators need to understand what applications will be relevant to women, and invest R&D on women-oriented applications.

Women find agriculture, health, finance and education relevant.

Safety and security is also an area of concern to women. This includes protection against domestic violence. Phone ownership (as opposed to sharing) will make a major difference.

Literacy is a major challenge for women, especially those at the BOP. Handsets that come pre-loaded with applications will help address this problem.

## **Bright Simons, mPedigree Networks:**

We must explore ways to reduce mobile phone costs. One approach? The government distributes free handsets which carry a SIM card with their national ID so that subscribers can access mGovernment applications.

With increasing global connectivity, social networks start cutting across geographical boundaries. When people across multiple regions are connected, peer groups form that have members in several locations, and people's buying decisions are influenced not only by others in their neighborhood, but by peers from other regions as well.

The adoption of mobile service can be increased by providing "lighthouse" applications. While these applications may have limited intrinsic value of their own, they act as catalysts for attracting end users to adopt other mobile applications, and enable rapid scaling. In many cases, they also enable other applications. M-PESA and uSwitch are examples of lighthouse applications. mPedigree has turned out to be a lighthouse application in Nigeria.

It is important to understand that putting a phone in the hands of the lower income people has the potential to completely change their behavior. There will be new paradigms of usage involving a significant re-ordering of their priorities.

Distribution channels can play an important role in improving affordability by matching end users with the right kind of device appropriate for their needs. This is especially true for the BOP market. These channels can provide micro-credits for phone purchase. They can also facilitate micro-transactions.

A critical driver of the affordability gap is the income variability that afflicts the BOP. While their average earnings are very low, what is especially crippling for them is that they don't have a steady source of income. There are days when they don't earn anything at all. It is therefore important to provide the BOP with need-based credit triggered at short notice.

## **Jack Sim, World Toilet Organization:**

A BOP hub is created by bringing several companies together that can collectively address a number of BOP problems simultaneously. It serves two important purposes: it fosters innovative ideas, and bridges the last mile to the BOP that may not be possible for the individual companies to cover individually.

For the poor, product purchases are triggered emotionally; they are not necessarily based on rational decisions. For example, owning a mobile device conveys the impression of moving up socially.

### Professor Lourdes Casanova, INSEAD:

In CALA, many poor people don't use phones because of literacy multiple language issues. We need to train people to use mobile phones and mobile applications. This could be done by the government, network operators, other businesses, or other agencies.

In Brazil, politicians are using the phone as a medium for individual citizens to reach them. Every candidate in an election has a number that he/she can be reached at.

Lower income people are mainly interested in using the phone for voice calls now. But, they are also very interested in applications that will increase their productivity, and organize their daily activities.

### Nik Nesbitt, KenCall EPZ:

People in emerging countries are increasingly adept in their use of mobile phones. Many new applications are emerging that improve productivity including applications that monitor increases in dairy production, and money exchange applications.

According to the President of Equity Bank, people at the bottom of the pyramid want banking services. The major issue is one of high transaction costs. Traditionally, banking growth in Kenya has been proportional to the growth in the number of branches.

M-KESHO, the mobile banking service offered by Safaricom in partnership with Equity Bank, is adding 5,000-10,000 new customers every day.

In another example, KenCall EPZ is promoting handsets and POS devices that can serve as a mini-ATM machine; user authentication is done through phone or card.

### Prof. Leonard Waverman, Univ of Calgary:

While the impact of network build-out can be significant, the major benefits realized from ubiquitous access comes from applications being carried over this network.

In addition to their impact on consumers, telecommunications applications provide significant benefits to both large and small businesses as well.

Through changes in taxation rules and related policies, governments can significantly impact the benefits of mobile and broadband applications.

### World Bank:

The call for action should be linked to the market environment in line with the kind of intervention required to address adoption obstacles as they arise.

**On September 15th during the World Economic Forum's "Summer Davos" at Tianjin, China, Rajeev Singh-Molares of Alcatel-Lucent presided over a private session with World Economic Forum participants on the topic of Ubiquitous Access. Below is a summary of the feedback received on the study and ideas to address the challenges of end-user affordability, the economics of adoption and applications.**

### The Social and Economic Impact of Ubiquitous Wireless Access

Recent World Bank studies suggest that affordable access to mobile broadband and applications can drive significant economic and social progress in GDP, healthcare, education and finance. However, the policies, infrastructure and applications needed to drive this impact are still emerging and somewhat uncertain. These uncertainties are clustered along the following lines: affordability, access and capacity, and applications.

### End-user Affordability

Overall, the total cost of the mobile communication should be less than 5% of household budgets, as otherwise it will not be adopted, especially in some of the poorest areas, such as India and rural China. Although it is difficult to get devices down to a low cost, the ICT sector can draw inspiration from innovations in the PC industry, such as the US\$ 100 laptop. In coming up with this highly ambitious target, Nicholas Negroponte created an aspirational goal that helped change people's mindset. Developers started to look for ways to come close to this possibility. Based on this analogy, such a target for mobile devices could be US\$1 per handset.

The consumer life cycle for handsets in the developed world is approximately two years. Could there be a business model that recycles handsets and distributes them among the 2 billion people that need them? There should be a mandate from governments for everyone to have a handset. Promoting handsets as a quasi-human right would reinforce the notion of ubiquity.

## The Economics of Adoption

The areas where adoption of network applications is most urgently needed are also those that are the hardest to access. For instance, in many of the poorest rural areas, diesel-powered motors are needed to generate the sort of electricity required for the adoption of rich device technology.

It may be useful to challenge the notion of ubiquity and instead think about minimal requirements. It seems better to avoid the big game changers, which are unrealistic goals for some of the poorest areas, and instead focus on small, incremental steps. Simple solutions (e.g. cell phones instead of iPhones) have a better chance of proliferation, while taking into account the material and geographic conditions of the poorest areas.

Business models from the microfinance industry could be a useful guide to drive mobile technology adoption, as they prescribe innovative ways to tap into the potential of the human resources at the village level. For instance, through “civil” applications such as SMS questionnaires, villagers can help evaluate whether distributed drugs are counterfeit or bona fide.

Over-capacity in urban areas is another significant challenge to adoption; due to the explosion of the number of devices in cities, there will be severe capacity bottlenecks in the future.

## Acknowledgements

This study has benefited from discussions with several subject matter experts from the industry, academia and public organizations. In particular, we wish to acknowledge the support of Seth Ayers (InfoDev), Jennifer Blanke (World Economic Forum), Prof. Lourdes Casanova (INSEAD), Valerie D’Costa (InfoDev), Kevin Donovan (InfoDev), Maria Farrell (InfoDev), Dawn Haig-Thomas (GSMA), William Hoffman (World Economic Forum), Prof. Raul Katz (CITI, Columbia University), Tim Kelly (CITPO), Arturo Kunigami (CITPO), Prof. Patty Mechael (Earth Institute, Columbia University), Mariana Medvedtchi-Dahan (CITPO), Irene Mia (World Economic Forum), Nicholas Nesbitt (KenCall EPZ, Kenya), Prof. Eli Noam (CITI, Columbia University), Kim Perdikou (Juniper Networks), Juan Carlos Parra Osorio (World Bank), Bright Simons (mPedigree Networks), Chris Volinsky (AT&T), Prof. Leonard Waverman (University of Calgary), and Quentin Wodon (World Bank). Alcatel-Lucent contributor: Rajeev Singh-Molares, Vice Chair, World Economic Forum Telecom Industry Global Agenda Council.

The 2010-2011 World Economic Forum Telecom Industry Global Agenda Council members : Jose Maria Alvarez Pallete (Telefonica), Seth Ayers (World Bank), John Clippinger (Harvard), William Hague (AT&T), Dawn Haig-Thomas (GSMA Development Fund), Peter Gabriel (Artist/Musician), Paul Jacobs (Qualcomm), Michele Luzi (Bain and Company), Nicholas Nesbitt (Kencall EPZ Ltd), Eli Noam (Columbia University), Sandy Pentland (MIT), Bright Simons (mPedigree Network), Rajeev Singh-Molares (Alcatel-Lucent), Hamadoun Touré (ITU), Hequan Wu (Chinese Academy of Engineering).

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## Applications

There are many encouraging stories of adoption of network applications, but the fundamental problem is that many of these cases do not scale up.

It may be helpful to look at existing infrastructure in villages when thinking about scalability and how it could be used as an amplifier for the usage of phone technology. For example, companies could add a phone near public toilets in a village, which would serve to amplify adoption.

A common misconception – that the only thing needed in some of the poorest areas is technology – needs to be addressed. In Bangladesh, the penetration rate of mobile devices is almost 100%, while there is a severe lack of some of the most elementary goods such as water and sanitation.

It is worrying that, among governments, the idea of charity seems to be disappearing. For instance, the last G20 agenda did not include foreign aid. Poverty, therefore, is more and more a challenge for business to solve.