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Socio-Economic Assessment Of Broadband Development in Egypt

Arab Republic of Egypt
Ministry of Communications and Information Technology

Arab Republic of Egypt
National Telecommunications Regulatory Authority

THE WORLD BANK
Information and Communications Technologies (ICT) Sector Unit

Contents

Executive Summary

THE GOVERNMENT OF EGYPT has recognized broadband as being of strategic importance to the country´s economic and social development and it is developing a new strategy to develop access and use of broadband networks and services. As a specific target of this strategy, the government seeks to increase broadband penetration to 20 connections per 100 inhabitants by 2013. This report is the result of the second part of the existing Reimbursable Technical Assistance on communications by which the World Bank has been providing assistance to the government of Egypt in the development of this broadband strategy.

The objective of this particular assignment is to support the policy making process to develop broadband services and infrastructure throughout Egypt and achieve substantial economic impact in the economy including specific intermediary sectors. This assignment builds of the outcomes of the previously delivered study (Strategic Options for Broadband Development, 2010) and it uses both qualitative and quantitative approaches to provide specific advisory outputs. This present report is structured into four components:

1. Forecasting economic model of broadband diffusion in Egypt to assess the viability of different technology choices for increasing overall broadband penetration in the country.
2. Analysis of macroeconomic impact of broadband and estimates of these impacts for broadband policies in Egypt.
3. Study of broadband impact in three intermediary sectors: (i) education, (ii) broadband job creation and IT-BPO industry, and (ii) banking and financial sector.
4. Analysis of policy options to develop broadband in Egypt and achieve the estimated economic impact in the economy and the intermediary sectors.

These studies have shown that Egypt can achieve substantial economic gains from broadband diffusion. However, as the forecasting model shows, the expansion of broadband penetration in an efficient way is challenging and impacted by many variables. Thus, careful thinking must be devoted to the policies and incentives that will deliver the best outcome for broadband diffusion and its economic impact in Egypt.

Broadband Economic Model: Transformation of the Broadband Sector in Egypt

The economic model shows that reaching the target of broadband penetration envisioned by the Egyptian government will transform significantly the telecommunications sector in the country. In particular, the results from the economic model predict that for the base-case scenario broadband subscribers in Egypt services will surpass 11 million and revenues from broadband services will reach close to US$ 3 billion per year within the 5-year forecast period. This base-case scenario follows the current NTRA broadband policy, by which in 2014 the projected number of broadband subscribers shall reach 4 million for mobile Broadband and 4 million for fixed Broadband (which consists of 3 million lines of DSL supplemented by slightly more than 1 million Fixed-wireless Urban subscribers). In this scenario, both, Rural Broadband and Fiber Access will reach only relatively small levels of penetration: around 200,000 and 300,000 subscriptions respectively.

Investment requirements over the 5 year forecast period are projected to be around US$ 2.2 billion. These investments are split between the different technology/market combinations as follows: US$ 30 million for Rural Broadband, US$ 290 million for Urban Broadband, US$ 330 million for Fiber Access, US$ 510 million for DSL rollout, US$ 730 million for Mobile Broadband, and US$ 300 million for setting-up an independent backhaul network, which is required as uncompetitive high leased line prices by Telecom Egypt make most business cases not viable. Leased Line prices of Telecom Egypt would have to be reduced by 50% to 80% to reach a similar level of financial viability compared to the cases with setting up an independent backhaul provider.

Besides the base-case, the model includes a worst-case and a best-case scenario. Over the 5-year forecast period, subscriber numbers range between 7 million in the worst-case and close to 17.5 million in the best-case scenario, while revenue projections range between US$ 1.8 billion and US$ 4.5 billion respectively. As investment numbers are scaled to the projected number of subscribers, total investment requirements vary between US$ 1.3 billion and US$ 3.6 billion.

Broadband Economic Impact: Appropriating Macroeconomic and Sector's Economic Impact

Developing broadband as predicted by the economic model is expected to result in significant economic benefits for Egypt. Based on multipliers developed by the literature of broadband economic growth, it is estimated an incremental cumulative contribution to GDP for the period 2010-2020 for the base scenario of US$ 5-US$ 42 billion. Using the other scenarios from the model described above, contributions can increase to a range of US$ 17-US$ 67 billion. In terms of jobs created, the estimates for the base scenario are an average of 25-36 thousand jobs created per year. For the other scenarios the range is of 13-50 thousand jobs.

The expansion of broadband diffusion in Egypt will not only result in macroeconomic impact. It is also likely to impact intermediary sectors, prompting transformation in these sectors. This assignment analyzed how broadband has impacted three specific sectors globally and the likely result on Egypt:

- **Education.** The use of broadband to support the education sector is transforming the education sector as it was traditionally conceived. Curriculums, learning techniques and teachers are being adapted to the new possibilities of broadband and digital interactive content to achieve 21st century skills (i.e., skills to think creatively, solve problems, communicate effectively, identify and analyze existing information and create knowledge). Content sharing through crowd sourcing and teachers' collaboration platforms, the wider availability of mobile devices and cloud computing are also transforming the way educational content is created and delivered and promise significant cost reduction opportunities. With the development of broadband, Egypt's education sector can go beyond the connectivity of schools and transform its education system to develop 21st century skills in the coming Egyptian generations.

- **Job creation and IT-BPO sector.** Broadband has been creating new job opportunities globally. Most of job creation is due to innovation that broadband spurs in the economy. For instance, broadband has enabled new job opportunities through telecommuting or facilitation of job search. One of the industries that have been more favored with the expansion of broadband worldwide has been the IT-BPO. Egypt has already developed a globally competitive IT-BPO industry. Indeed, A.T. Kearney ranks Egypt as 4th place in providing IT offshore services globally. ITIDA estimates that Egypt's IT-BPO industry generated more than US$ 1 billion in exports in 2010 alone. Building in this success, new job opportunities, such as rural BPO and microwork can be developed over wide broadband connectivity in the country.
- **Banking and Financial Sector.** Broadband has spurred changing in the banking and financial sector, which has been transformed from the front to the back office. Competition among banks has increase by adding new online services and customers enjoy wider choice and wider access to banking through extended ATM networks, phone and internet services. Productivity and efficiency of the sector has also increased through the use of electronic transaction systems. Egypt bank system is embracing broadband already. A widespread diffusion of this platform will result in similar benefits as seen in other countries. Moreover, the widespread network of Egypt post provides a unique opportunity to leverage broadband-enabled banking services that reach a wide set of the Egyptian population.

Policy Options for Broadband Development

All these highlighted benefits can be achieved in Egypt if broadband is developed successfully. However, for this to happen it is needed the adequate set of policies and incentives that allows for an efficient diffusion of broadband. Egypt faces many challenges in the development of widespread broadband infrastructure. For instance, fixed broadband penetration is limited, international connectivity prices are high when compared to international standards, there is a lack of competitive backbone network infrastructure in the market, and there is a natural resistance from Telecom Egypt to further reforms in the sector. To overcome these challenges and allow for an effective and rapid development of broadband infrastructure, this report proposes the following policy options:

- **Removal of all entry barriers at Networks and Services Level.** Introduction of full competition in the broadband market in countries such as Turkey, Chile, Lithuania or Bahrain, has resulted in lower prices and increased penetration of broadband services. A similar measure in Egypt is likely to produce the same results. Thus, it is recommended that the government of Egypt set a date for full liberalization, similar to what the European Union countries or Turkey did, and introduces uniform licenses. A more gradual approach can be chosen providing uniform licenses to the four existing network operators, which would involve providing Telecom Egypt with a mobile license.

- **Provision of additional spectrum for wireless broadband (4G spectrum).** Mobile broadband market is already the most competitive and efficient market in Egypt. Providing additional spectrum and eliminating restrictions for further market entry will spur wireless broadband market further, expanding broadband access through the population and providing affordable offerings (e.g., by using pre-paid offerings similar to those in the voice mobile market).
- **Proactive Competition in the area of backbone and backhaul, leveraging on fiber investments of electricity and transport utilities.** The removal of entry barriers, and the right given to existing operators to enter each other market, will certainly stimulate competition. However, in the segment of backbone and backhaul service, a more proactive approach to stimulate competition may need to be pursued. Egypt's utilities companies, such as the gas and electricity companies, already have fiber infrastructure installed. The unleashing of such infrastructure not only would provide an additional source of income to these companies, but it will also introduce an alternative backbone network that eliminates this bottleneck from the market.
- **Implementation of an ambitious Ultra-Fast Broadband (UFB) Plan, structural separation between active and passive Infrastructure, and deployment of USO funds to extend broadband to rural areas.** Different models exist for the achievement of an ambitious UFB plan. The development of an UFB plan should, however, recognize that the driver of growth in the industry is the establishment of an effective competitive market. The issue of dominance in the fiber business can be tackled in different ways. One alternative is through structural separation between active and passive infrastructure (with a SPV managing the passive infrastructure with open access and no discrimination). This model is flexible, allowing for a diversified approach based on the following steps: (i) division of the market in commercial areas where facilities-based competition can exist (area α), commercial areas that would be exposed to dominance due to first mover advantage (area β), and non commercially viable rural and low income areas (area χ); (ii) allow competition in area α , (iii) launch the passive infrastructure model for area β and backbone bottlenecks; and (iv) use USO funds to stimulate broadband in area χ.
- **Strengthening of NTRA's attributions in the area of anti-trust monitoring and enforcing in the telecom sector.** Competition entry in the market will need to be safeguarded by NTRA. Therefore, it will be critical that NTRA reinforces its structure to have the human capital and skills required to these tasks. This will require, at a minimum, of a new division in charge of market analysis that is able to perform market definition and analysis of telecommunications segments based on competition and antitrust principles. In addition, NTRA would need to have the power (legally and effectively) to enforce competition models and the authority to conduct market analysis and use its results to inform NTRA's decisions.
- **Stimulate demand through targeted measures for specific user groups, selecting measures with high potential employment generation, and/or high social value.** The supply-side measures should remain the core of Egypt's broadband plan. However, increased recognition should be given to demand-side measures. Among other measures that would target demand

are: (i) accessibility policies (e.g., broadband access centers, digital literacy programs, or inclusion policies); (ii) affordability policies (e.g., lowering cost of terminals or building consumer awareness), and (iii) attractiveness policies (e.g., supporting local content and applications or providing a legal e-framework for e-commerce).

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List of Acronyms & Abbreviations

3G, 4G	3rd Generation, 4th Generation
ADSL	Asymmetric Digital Subscriber Line
ARENTO	Arab Republic of Egypt National Telecommunication Organisation
ARPU	Average Revenue Per User
ATM	Automated Teller Machine
BB	Broadband
BOT	Build-Operate-Transfer
BPO	Business Process Outsourcing
CAPEX	Capital Expenditure
CAPMAS	Central Agency for Public Mobilization And Statistics
CCTV	Closed-Circuit Television
CDMA	Code Division Multiple Access
CGAP	Consultative Group to Assist the Poor
CIT	Cheque Imaging and Truncating (system)
CPE	Client Premises Equipment
DLR	Dynamic Language Runtime
DOE	Department of Education
DSL	Digital Subscriber Line
EBMM	Egypt Broadband Market Model
EDNA	Elevation Derivatives for National Applications
EGP	Egyptian Pound
EMIS	Egton Medical Information Systems
EU	European Union
EUR	Euro
FTTH	Fiber to the Home
FTTN	Fiber to the Node
FTTP	Fiber-To-The-Premises
GDP	Gross Domestic Product
GPT	General Purpose Technology
GSM	Global System for Mobile (communications)
HPS	High-Performance Series

HSPA	High-Speed Pocket Access
ICT	Information and Communication Technologies
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ISTE	International Society for Technology in Education
ITIDA	Information Technology Industry Development Agency
ITU	International Telecommunications Union
ITU	Information Technology
Kbps	kilobit Per Second
LAN	Local Area Network
LTE	Long-Term Evolution
Mbps	Megabit Per Second
MHz	MegaHertZ
MIMO	Multiple-Input and Multiple-Output
MIS	Management Information System
MIT	Massachusetts Institute of Technology
MOE	Ministry of Education
MPLS	Multi-Protocol Label Switching
NASSCOM	National Organization of Software and Service Companies
NET*S-T	ISTE Educational Technology Standard and Performance Indicator for All Teachers
NGO	Non-Governmental Organization
NPV	Net Present Value
NTRA	National Telecommunication Regulatory Authority
OASIS	Organization for the Advancement of Structured Information Standards
OECD	Organization for Economic Cooperation and Development
OFDM	Orthogonal Frequency-Division Multiplexing
OLPC	One Laptop Per Child
OPEX	Operating Cost
PoP	Points of Presence
PSTN	Public Switched Telecommunications Network
QAM	Quadrature Amplitude Modulation
RBPO	Rural Business Process Outsourcing
ROA	Return on Assets
ROE	Return on Equity
RTGS	Real Time Gross Settlement
SDH	Synchronous Digital Hierarchy
SG&A	Sales, General and Administration
SMS	School Management System; Short Message Service
SPV	Special Purpose Vehicle
STM-1	Synchronous Transport Mode
SWIFT	Society for Worldwide Interbank Financial Telecommunication
TCO	Total Cost of Ownership

TE	Telecom Egypt
UAE	United Arab Emirates
UFB	Ultra-Fast Broadband
ULL	Unbundling Local Loop
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States
USDA	United States Department of Agriculture
USO	Universal Search Optimization
VDSL	Very high-speed Digital Subscriber Line
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network
VSAT	Very Small Aperture Terminal
WACC	Weighted Average Cost of Capital
WAN	Wide Area Network
WILL	Wireless Local Loop
WiMAX	Worldwide Interoperability Microwave Access
WTO	World Trade Organization

Chapter 1

EGYPT BROADBAND MARKET MODEL AND HANDBOOK

Executive Summary: Egypt Broadband Model

Background

Since November 2010, the World Bank has engaged with NTRA, the regulatory authority of Egypt in supporting the policy making process towards developing broadband infrastructure and services throughout Egypt. Part of this World Bank support has been the development of a forecasting model with geographic granularity going down to 2nd level of administration (covering 348 districts) to project various market parameters, such as subscriber numbers, potential revenues, required investments, and the financial viability of certain technology/market choices.

The model has a very broad scope, combining five different market/technology combinations, including Rural Broadband, aiming at low-income rural population, which will require some form of service subsidy, Urban Fixed-wireless Broadband focusing on more densely populated areas and as a complement to DSL access, Fiber-to-the-home projected to be rolled-out in high-income areas, DSL access, which currently provides about 50% of all broadband connections (around 1.1 million lines by end of 2010), and Mobile Broadband, currently (end of 2010) providing around 1.2 million connections, and projected to be rolled-out with near nation-wide coverage.

Main Results

On an aggregate nation-wide level, the model projects in the base-case scenario, that subscriber numbers for broadband services will surpass 11 million and that revenues from broadband services in Egypt will reach close to US$ 3 billion per year within the 5 year forecast period. This base-case scenario follows the current NTRA broadband policy, by which in 2014 the projected number of broadband subscribers shall reach 4 million for mobile Broadband and 4 million for fixed Broadband (which consists of 3 million lines of DSL supplemented by slightly more than 1 million Fixed-wireless Urban subscribers). In this scenario, both, Rural Broadband and Fiber Access will reach only relatively small levels of penetration: around 200,000 and 300,000 subscriptions respectively.

Investment requirements over the 5 year forecast period are projected to be around US$ 2.2 billion. These investments are roughly split between the different technology/market combinations as follows: US$ 30 million for Rural Broadband, US$ 290 million for Urban Broadband, US$ 330 million for Fiber Access, US$ 510 million for DSL rollout, US$ 730 million for Mobile Broadband, and US$ 300 million for setting-up an independent backhaul network, which is required as uncompetitively high leased line prices by Telecom Egypt make most business cases not viable. Leased Line prices of Telecom Egypt would have to be reduced by 50% to 80% to reach a similar level of financial viability compared to the cases with setting up an independent backhaul provider.

To better compare the investment requirements for each of the five different technology/ market combinations, the required investments per subscriber are as follows: US$ 218 per rural, US$ 198 per urban, US$ 1,124 per fiber, US$ 238 per DSL, and US$ 199 per mobile broadband subscriber. These numbers decline over time, with increasing subscriber numbers due to economies of scale.

Besides the base-case, the model includes a worst-case and a best-case scenario. Over the 5 year forecast period, subscriber numbers range between 7 million in the worst-case and 17.5 million in the best-case scenario, while revenue projections range between US$ 1.8 billion and US$ 4.5 billion respectively. As investment numbers are scaled to the projected number of subscribers, total investment requirements vary between US$ 1.3 billion and US$ 3.6 billion.

In order to reach the projected subscriber and revenue figures, initial ARPU (average revenue per user) has been set to the following levels: US$ 10 for Rural Broadband, US$ 90 for Fiber-to-the-home, and US$ 20 for the remaining segments (Urban Broadband, DSL and Mobile Broadband).

As the model results show, for Rural Broadband, ARPU would need to reach a level of US$ 17 per month to become commercially viable. As such a relatively high level will most likely not be affordable for most of the rural population, rural broadband access will require some form of subsidization, either in form of a direct subscription subsidy or in form of an investment subsidy. Adding a service subsidy of US$ 7 per month per rural Broadband subscriber, will make the business case for rural Broadband viable. The accumulated cost of this subsidy reaches US$ 34 million over the first 5 years – rising to US$ 282 million over a 10 year period. A better alternative is to subsidize network rollout. In this case, 60% of rural network CAPEX would need to be subsidized. Over a 5 year period this subsidy is projected to accumulate to US$ 20 million, over a 10 year period this figure will reach US$ 64 million. Both these numbers are significantly lower than the direct service subsidy, which make this form of subsidization a preferred option.

Egypt Broadband Market Model and Manual

Introduction and Background

The Government of Egypt is in the process of reviewing its policies towards enhancing the availability, quality and penetration levels of broadband services throughout Egypt. Within this context, NTRA has requested the development of a detailed forecasting model to assess the viability of different technology choices for increasing the overall broadband penetration.

This broadband forecasting model uses input data from various sources, including the local statistics office CAPMAS, current market data from NTRA, as well as benchmarks from comparable regional countries and operators.

The model and this accompanying documentation have been prepared by Dr. Matthias Halfmann, Senior Telecommunications Expert, based on inputs provided by NTRA experts as well as a wider World Bank team. This report provides a summary of the overall methodology, the main model inputs and assumptions, as well as a detailed analysis of projection results including a sensitivity analysis of the main input parameter variations.

The main purpose of the model is to be used as a tool to project the market for broadband access, with geographic granularity going down to 2nd level of administration (district level), while also presenting aggregate outputs at governorate and at national level.

Overall Approach and Methodology

Scenario-Based Broadband Market Model

The main purpose of the broadband market model is to arrive at a realistic forecast of subscriber numbers, required investments in network infrastructure and the evaluation of the financial viability of certain technology choices addressing different market segments in Egypt. The model uses a wide range of technology choices, including fixed line access (DSL and fiber), fixed-wireless access (based on WiMAX), as well as mobile broadband access (assuming a migration towards LTE). The model assesses the main parameters as well as the viability of each technology/market combination, without making an explicit breakdown for individual operators or service providers.

A core element of this broadband model is a geo-module with a breakdown of all 29 governorates of Egypt into 348 districts (Qisms and Markazes), allowing for a high-level of geographic data granularity (see Annex 1 for a map of Egypt and the governorates). Due to the intrinsic difficulty of forecasting a certain market behavior, the model is based on scenarios, to arrive at a range of possible market penetration and service adoption levels and calculating the corresponding ranges of investment requirements and expected levels of sector revenues. The model uses a 10 year timeframe, although the main outputs will focus on a 5 year projection. The model also features a high-level viability assessment based on an NPV (net present value) approach of expected cash-flows from each technology / market combination.

The investment and subscriber forecasts can serve various purposes, such as examining the spill-over effect into other economic sectors, as well as provide an initial guidance on certain sector policy decisions (e.g. on subsidizing access in certain geographic areas).

Service Portfolio and Technology Choices

The relatively broad scope of this forecasting model is reflected in the number of technology choices, each of which addresses a specific market segment. The main market and technology components of the broadband model are:

- Rural broadband access, initially based on CDMA 800 technology and in a later version replaced by WiMAX technology (since CDMA spectrum is not available anymore). This technology option can easily be replaced, e.g. by LTE, which appears to become the main option for future wireless broadband provisioning.
- Urban fixed-wireless broadband access based on WiMAX technology focusing on more densely populated areas. Also here, at this stage of market projection, the technology option can easily be replaced, e.g. by LTE.
- Fiber-to-the-home access in high-income areas as a complementary technology to urban fixed-wireless Broadband provisioning (based on the assumption, that even high-income households cannot be forced to exclusively take-up fiber access).
- DSL access, which currently provides about 50% of all broadband connections (around 1.1 million lines by end of 2010).
- Mobile Broadband, currently (end of 2010) providing around 1.2 million connections.

None of these technologies is exclusive to a certain geographic area. However, based on the choice of input parameters (selection criteria and thresholds), most fixed and fixed-wireless technologies will only be available in certain areas (e.g. “rural Broadband” and “urban Broadband” are mutually exclusive by default), whereas mobile broadband will have (near) full geographic coverage.

CDMA 800

CDMA 800 is a cost-effective, highly flexible, spectrally efficient, commercially available digital wireless technology platform for the 800 MHz frequency band. In the envisaged fixed-wireless application it can provide broadband services across a large geographic area in a cost-efficient way. The main advantage of the 800 MHz range is the coverage, that can be reached by one single base-station: The typical cell radius is close to 30km, which is significantly larger compared to GSM 1800, 3G, or WiMAX installations (typically around 5..10km).

The main advantage of this technology lies in the use for rural areas, with relatively low population densities. However, these advantages could also be exploited by operating other technologies in the 800 MHz frequency band.

During the progress of this project it turned out, that CDMA spectrum is no longer available for rural broadband application. The broadband model has therefore been adjusted to use WiMAX technology in rural areas as well as in urban areas (see following section).

Wireless Local Loop (WLL) and WiMAX

Wireless Local Loop (WLL) is the generic name of point-to-multipoint radio links. It was originally developed for telephony and later adapted for broadband IP access.

In the first generation of WLL it was required to have a line of sight between the base-station and the subscriber antenna. The second generation used OFDM modulation techniques, which, combined with dynamic antenna beam directional techniques, can achieve non-line-of-sight connections to the end user. WLL has been standardized with the development of WiMAX, which has deployed at a large scale in many countries around the globe.

The attractiveness of WiMAX lies in the low cost of its infrastructure. Base-station prices range from US$ 5,000 to US$ 20,000 for wireless ISP applications. The following chart gives an overview of the main characteristics and some indications of prices by Intel.

Figure 1: Basic characteristics and cost parameters for WiMAX systems

Range	< 4 miles	4-6 miles	> 6 miles
Base-station cost ('04 pricing)	$5k - $20k for WISP class $20k+ for carrier	same	same
CPE price	< $300	same	same
Adaptive modulation scheme	64 QAM	16 QAM	½ QPSK up to 16 QAM
Data throughput (20 MHz channel*)	75 Mbit/s	50 Mbit/s	17 Mbit/s to 50 Mbit/s depending on link quality
No. of business users (T1 level) 1	206	138	46 to 138
No. of residential users (512 kbit/s) 2	1,552	1,035	345 to 1,035
Source: Intel Assumes two 10MHz bands in the base station as benchmark for comparison purposes. Over-subscription rate is 5x for business and 12.5x for residential. Also takes into account overhead (efficiency), which for 802.16 is 85% independent of number of users.			

The main advantages of this technology are the fast deployment, the high data speed and the standardized technology with terminal costs rapidly decreasing.

Fiber-to-the-Home

While optical fibers have been used for many years in national and international transmission lines, the cost of deploying this technology to individual buildings and homes has been prohibitively high. However, considering the long-term perspective and the expected higher return for advanced broadband services, fiber-to-the-home is being rolled out in many countries, especially in newly developed residential or business areas.

The broadband model therefore also includes this technology, which will mainly focus on high-income areas allowing for the provision of a wide range of services, such as voice and video telephony, broadband internet, (interactive) TV, and many more.

DSL (Digital Subscriber Lines)

The family of digital subscriber line (DSL) technologies, referred to collectively as xDSL, allows voice and high speed data services over existing copper twisted pair telephone lines. It has proven to be an attractive technology for incumbent telephone companies to offer broadband services in urban and suburban areas.

In a typical application, modems are deployed in pairs, one at the central office or DSLAM location, and the other at the customer premises. The service provided allows voice simultaneous with high speed data to the customer. The data capability is always on. In liberalized markets, independent ISPs get (usually regulated) access to the incumbents copper lines to offer their own services.

The variants of DSL are of two classes: asymmetric and symmetric, depending if the data speed is the same in the upstream and downstream direction (symmetric case) or different (asymmetric case). The most commonly used variants are ADSL and VDSL:

ADSL. Asymmetric DSL with higher data speed in the downstream direction is best suited to typical residential Internet access customers. The typical downstream data speed ranges from 1.5 to 6 Mbps, in typical distances of up to 3 km. The telephone twisted pair line has to be of good quality, without noise, and a good frequency response well over 4 kHz. In a typical case, about 50% of the pairs in a cable can be used with ADSL. The ADSL2 variant is an extension of the ADSL standard allowing for downlink speeds of 8…12 Mbps; the newer ADSL2+ variant allows for downlink speeds of (theoretically) up to 24 Mbps.

VDSL. Very high speed DSL can be symmetrical or asymmetrical. In short distances (up to 1 km) it can achieve 10 Mbps in both directions, or within 300 meter up to 52 Mbps downstream speeds. The VDSL2 variant increases the maximum speed to above 100 Mbps. In order to reach such high data rates, the length of the copper loop has to be below 300 meter, which requires that distribution cabinets at street level are upgraded for fiber access.

With the development of the xDSL technologies reaching their maturity, it is unlikely that there will be further dramatic increases in data rates, especially since fiber-to-the home offers a more flexible technology with (theoretically) almost unlimited bandwidth.

Mobile Broadband

The adoption of mobile services based on the GSM family of standards has been a tremendous worldwide success: By the end of 2010, there were around 5 billion mobile subscribers including more than 1 billion 3G subscribers worldwide1. The number of mobile broadband users adopting the HSPA (High-Speed Access) standard is expected to grow to 1.7 billion by 20142.

HSPA is a set of mobile telephony protocols extending the 3G standards for broadband data services. HSPA allows for peak data rates of up to 14 Mbps in the downlink and 5.8 Mbps in the uplink. HSPA+ (also called HSPA Evolved) extends this standard to support data rates up to 84 Mbps in the downlink and 22 Mbps in the uplink through higher order modulation (64QAM) and the use of a multiple-antenna techniques (MIMO - "multiple-input and multiple-output"). HSPA has been widely adopted by over 200 operators in more than 80 countries, with most operators quickly upgrading to HSPA+. Many operators market their HSPA+ deployment as 4G, although it does not comply with the minimum 100 Mbps data rate requirement.

The next step in mobile broadband standards is LTE (Long Term Evolution), often referred to as 4G, which supports downlink peak rates of at least 100 Mbps and uplink rates of 50 Mbps. This standard includes new features such as peak download rates up to 326.4 Mbps for a 4x4 antennae configuration using 20 MHz of spectrum, or at least 200 active users in every 5 MHz cell.

In the medium to long run, the main advantage of LTE will be the expected low cost of handsets and terminal equipment, which is basically driven by economies of scale: with an adoption of several billion subscribers, the GSM-family of standards achieves unprecedented levels of economies of scale, driving down the cost of chipsets and in turn, handsets and other terminal or networking equipment.

Market Model and Regional Roll-out

The core module of the broadband model is a bottom-up regional market model based on 348 administrative districts (called Qisms and Markazes), which can be aggregated on governorate and on nation-wide level. For each administrative district, various macro-economic parameters such as population number, area, population density, number of buildings, GDP per capita, Household income

[1] Wireless Intelligence for the quarter ending Sep 2010
[2] Wireless Intelligence, Nov 2010

figures, a poverty index, and an "overcrowded ratio" have been made available from national census reports. The "overcrowded ratio" refers to the number of people per building.

For each region, the model performs automated decisions if and when that region will be covered by a certain broadband access technology. This decision making process has two stages: first, the selection, if a district is qualified to be covered by a certain technology, and then – if this decision has been positive – the second stage decides, when that district will get coverage. The parameters for this automated decision-making process are adjustable by input thresholds, most of which are accessible through the Dashboard of the valuation model.

The model allows to separately set the decision thresholds, which region will or will not be included for each of the four fixed/fixed-wireless access technologies: Rural Broadband, Urban Broadband, Fiber Access, and DSL. The model assumes that mobile broadband services will be rolled-out independently with almost full nation-wide coverage.

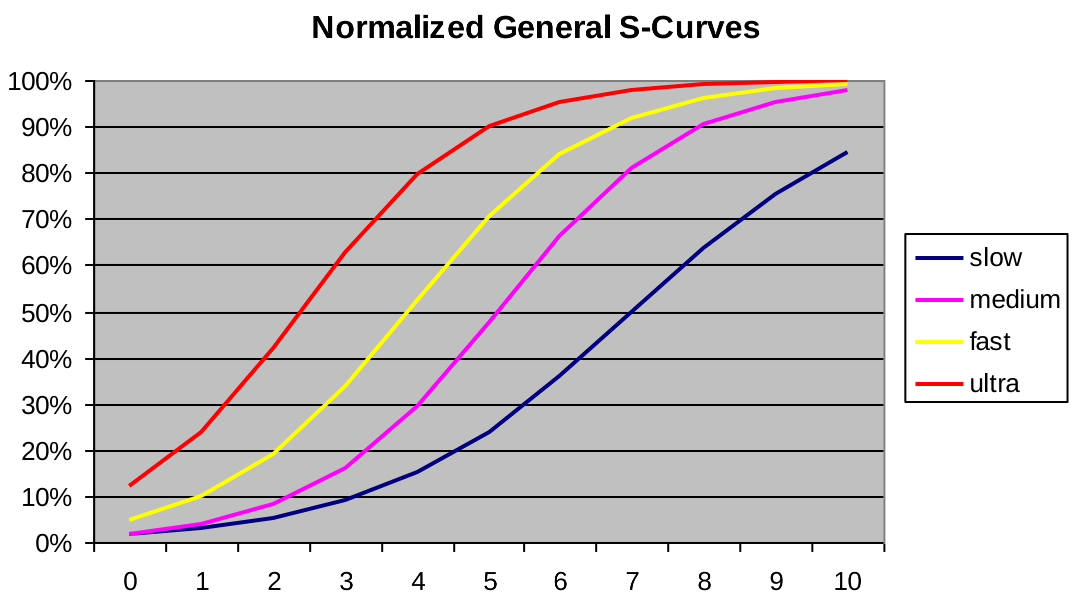
Forecasting based on S-curves

Currently, only limited data on demand forecasting are available for Egypt. We therefore use a scenario-based approach using different parameter sets for the speed of service adoption by customers based on different S-curves3 as explained below. The overall projection timeframe for the broadband model is set to 10 years; however, only the first 5 years will be used as basis for investment and net present value evaluations (with the exception of the Fiber Access module, which performs an NPV calculation on a 10 year basis).

The model makes extensive use of S-curves to project the various roll-out scenarios as well as the pick-up of services by subscribers. Due to the difficulty of forecasting exact market growth and service take-up, the model allows for 4 different market take-up speeds: slow, medium, fast and ultra; the "ultra" case can only be activated manually, as it may give a too optimistic (i.e. unrealistic) projection. The following chart illustrates the normalized S-curves for each of these scenarios.

[3] S-curves are also known as logistic functions and are commonly used in modeling the diffusion of new services or technologies. S-curves are a special case of the Bass Diffusion Model, developed by Frank M. Bass. This concept has also been extensively covered by Everett M. Rogers in "Diffusion of Innovation"

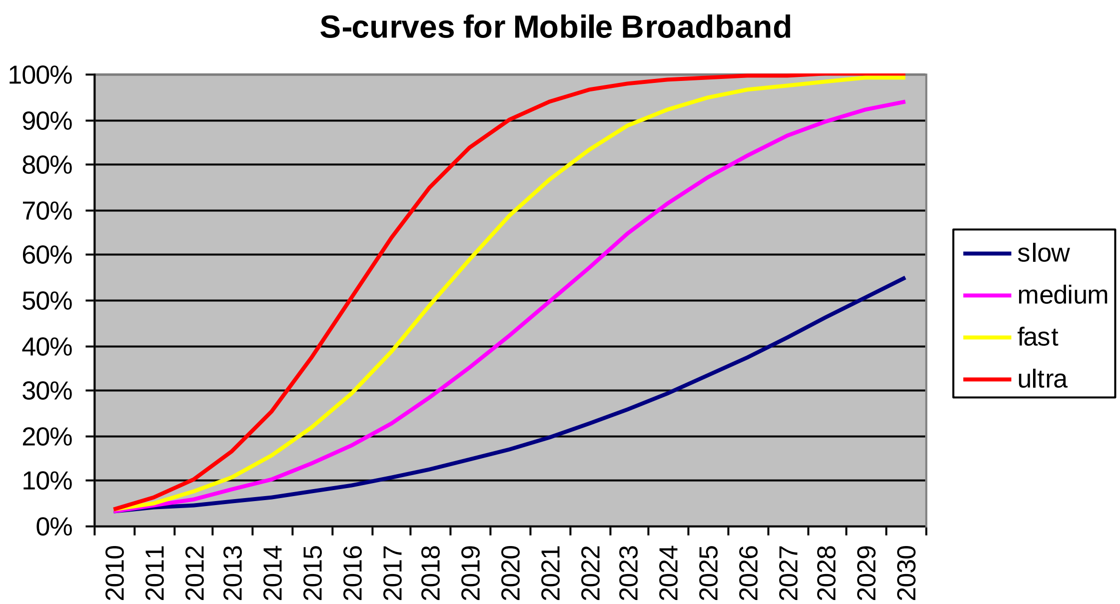
Figure 2: Normalized S-curves used for service roll-out and subscriber take-up



The S-curves in the previous figure are used both, for modeling the roll-out of certain services as well as the subscriber take-up (for urban Broadband, rural Broadband, and Fiber Access services). To achieve realistic scenarios, these S-curves are time-shifted per each geographic area to the point, when a service becomes available in that area and they are also adjusted in their magnitude to reflect a "market ceiling", i.e. a maximum adoption rate during the forecast period. This market ceiling can be set as one of the scenario input parameters for each market/technology combination.

In the case of mobile Broadband and DSL lines, the starting points for the year 2010 are know; therefore these S-curves are fixed at the actual number of subscribers for the first year and then simulate different growth scenarios. The following figure illustrates the normalized S-curves for mobile broadband service adoption. The curves for DSL-line are very similar in shape (in 2010, subscriber number for both service have been slightly above 1 million each).

Figure 3: S-curves used for mobile broadband take-up projections



Main Model Modules

The Broadband Market model consists of different modules for inputs, calculations and outputs. In particular the model consists of the following main worksheets:

- Dashboard (main controlling interface, with key outputs and selected sensitivity inputs)
- Input tables
- Geo-module for forecasting rollout and market developments based on a geographic database (featuring all 348 Qisms/Markazes)
- Separate calculation modules, one for different market/technology combination
- Output summary aggregated at governorate level

The following sections give an overview of the main model modules, the flow of data from inputs trough the geo-module, to the different business case modules and finally to the main dashboard outputs. Main model results are presented and discussed below.

The model is colour-coded, so that the user can easily identify inputs (which are in blue), inputs based on scenario selectors from the Dashboard (magenta), calculations (black), and final outputs (purple). To operate this model the user should only adjust the input cells, i.e. the blue figures. As the model makes heavy use of lookup and other advanced functions, only experienced users should attempt any structural changes.

Model Dashboard

The "dashboard" (see Figure 4 below) is the central interface for operating the broadband model: It shows the main forecast results (expected revenues, investment requirements and subscriber projections), an assessment of the financial viability (in form of NPVs), and it allows for an easy manipulation of core inputs such as the choice of scenario, the change of decision thresholds for various technology options or changing the levels of sensitivity input parameters such as ARPU (average revenue per user) or the size of the market (in terms of subscriber numbers) by adjusting a market ceiling.

Figure 4: Model Dashboard

DASHBOARD — Scenari: medium — Backhaul: LeasedLine

all numbers in $mln		2010	2011	2012	2013	2014	2015	5yr TOTAl
Broadband Revenues		0	**910**	**1,307**	**1,857**	**2,434**	**3,158**	
	Rural BB	0	4	10	22	41	69	
	WiMAX	0	39	83	172	318	514	
	FiberAccess	0	12	28	63	123	208	
	DSL	0	431	611	840	955	1,071	
	Mobile BB	0	424	576	760	997	1,296	
Broadband Investments (excl. lic fees)		0	**280**	**378**	**540**	**578**	**697**	**2,473**
	Rural BB	0	5	9	18	30	43	105
	WiMAX	0	26	30	54	84	112	306
	FiberAccess	0	13	20	43	79	118	273
	DSL	0	144	199	270	189	176	977
	Mobile BB	0	92	120	154	197	248	812
	BACKHAUL	0	0	0	0	0	0	0
RURAL BB	**Subscribers**	0	19,839	59,415	138,860	276,385	488,210	
WiMAX	**Subscribers**	0	125,308	295,009	632,725	1,214,010	2,047,905	
FiberAccess	**Subscribers**	0	15,012	37,471	86,744	176,474	309,449	
DSL	**Subscribers**		1,652,718	2,343,657	3,300,932	3,975,565	4,612,967	
MOBILE BB	**Subscribers**		1,635,957	2,225,917	3,012,828	4,050,250	5,397,475	

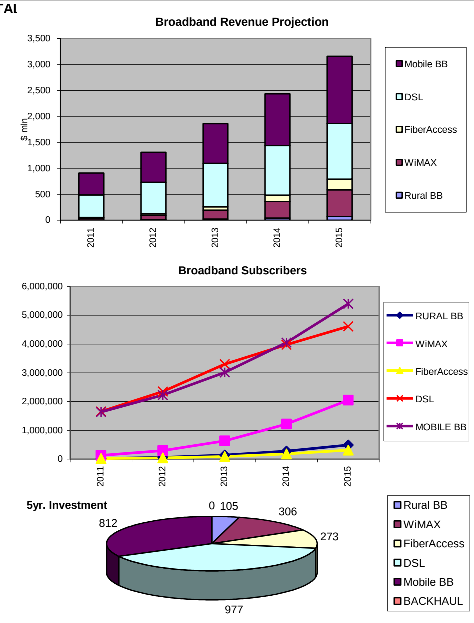
NPV check and SENSITIVITY INPUT PARAMETERS

						qualified areas:
Rural BB NPV	-83	Mobile BB NPV	47	**RURAL BB threshold** (rural) pop):	80%	99
WiMAX NPV	-34			**WiMAX threshold** (urban pop.):	80%	109
FiberAcc. NPV10	-326			**Fiber access** threshold (GDP):	5,000,000	18
DSL NPV:	487	**Line sharing:**		**DSL** max. usable lines	40%	

Monthly ARPU:

10.00	**$, Rural BB**
20.00	**$, WiMAX**
55.00	**$, Fiber**
20.00	**$, DSL**
20.00	**$, MOBILE BB**

Market Ceiling (take-up)		regions:	5yr subs:	10yr subs:
Rural	10%	99	488,210	1,590,523
WiMax	25%	109	2,047,905	5,301,472
Fiber	15%	18	309,449	1,091,815
		DSL:	4,612,967	6,671,575
MobileBB	50%	MOBILE:	5,397,475	18,241,468
		TOTAL:	**12,856,005**	**32,896,853**



As main output graphs, the model dashboard shows the projected revenues from broadband services, projected subscriber numbers by technology, as well as the overall investment requirements over a 5 year period.

Scenario Selectors

The Dashboard features two independent scenario selectors at the top of the sheet: one for roll-out and subscriber adoption rates and one for the setup of backhaul links. The roll-out and subscriber adoption selector contains the three (four) scenarios introduced "Forecasting based on S-curves" section: slow, medium, fast, and ultra – the latter has to be written manually into the field, as this scenario may provide an unrealistically optimistic view of the market development.

The backhaul selector allows for three different options: organizing backhaul based on leased lines from Telecom Egypt, assuming – as starting point – current leased line price levels, and featuring a certain price decline per year (which is contained in the Cost Input sheet). The second option is the development of an independent backhaul network based on fiber-optic rings supplemented with microwave access. The third option is a variation of the own backhaul network development, assuming the use of the already existing fiber optic infrastructure of the electricity company. In case of option two and three, the model calculates cost-based prices for backhaul capacity, which is carried out in detail in sheet "Backhaul."

Decision Thresholds

Another important sensitivity input, are the decision thresholds, which determine the actual number of geographic regions to be preselected for roll-out of a certain broadband technology. These decision thresholds are available for all market/technology combinations, with the exception of mobile: here, the model assumes, that rollout will be country-wide, without the need to exclude certain areas.

Besides mobile, DSL is also a special case in terms of decision thresholds: here the limiting factor for service rollout is the actual availability of copper lines and their suitability for carrying a DSL service. As discussed in the section of "DSL (Digital Subscriber Lines)", only a certain percentage of copper lines can be used for DSL service. This parameter can be set through this Dashboard input.

DSL Line Sharing

A specific feature of the Egyptian broadband market is the sharing of DSL services, which – although illegal – appears to be a common practice. Based on discussions with Telecom Egypt, DSL lines are shared on average with 4 to 5 households. In order to obtain a more realistic view of actual broadband users, the model supports an option to switch between actual DSL lines in service and the number of DSL users by ticking the "line sharing" option. Activating this option leads to two main changes in the model: first, the number of "active subscribers" is replaced by "active users"; secondly, the DSL bandwidth requirement is based on the number of active users rather than actual subscribers.

ARPU Inputs

A key input to the sector revenue projection is the set of different ARPU levels for each technology/market combination. The Dashboard features sliders to easily adjust the ARPU levels, which serve as a starting point of ARPU for the first year of the projection. These ARPU levels will change over time: the corresponding adjustment factor is contained in the General Inputs sheet.

In combination with the NPV assessment and the scenario input selectors, modifying ARPU levels allows for a quick viability check, to understand, for which level of ARPU a certain market/technology case becomes financially viable.

Market Ceiling

Besides setting different adoption rates through the scenario selector, the model also allows manipulating the "market ceiling" for certain services, with the exception of mobile Broadband and DSL lines: In the case of DSL lines, the ceiling is fixed by the number of actual copper lines suitable for DSL services; in the case of mobile Broadband subscribers, the market ceiling parameter can be found in the General Inputs sheet, where it merely acts as a cap on the maximum number of subscribers.

Section "The use of S-curves in Subscriber Number Projection" below discusses in more detail the calculation and use of S-curves.

Subsidy requirement for rural Broadband

As an additional functionality, the Dashboard calculates an estimate of subsidy requirements to make the business case for rural Broadband financially viable. Subsidies can be set in two ways: through subsidizing monthly subscriptions or through subsidizing CAPEX necessary for the rollout of the network – the model also allows for setting a combination of both subsidy parameters.

Key Output: NPV check

In order to assess the financial viability of certain rollout scenarios in combination with different input assumptions, the Dashboard shows the net present value for each technology/market combination: if the NPV is negative, the value is shown in red, if positive, the color changes to green. This allows for a rapid check, if a combination of certain input assumptions is financially viable or not.

General Inputs

The General Inputs sheet collects input data for population growth, S-curve parameters, expected revenues per subscriber (ARPU per service), as well as basic financial parameters.

The use of S-curves in Subscriber Number Projection

The above section "Forecasting based on S-curves" introduced the concept of S-curves for projecting the market development of different services and subscriber numbers. The model allows for 2 main selections: setting the speed of service adoption (i.e. which of the S-curves in Figure 5 will be selected) and the overall number of subscribers to be reached within the market forecast period of 10 years.

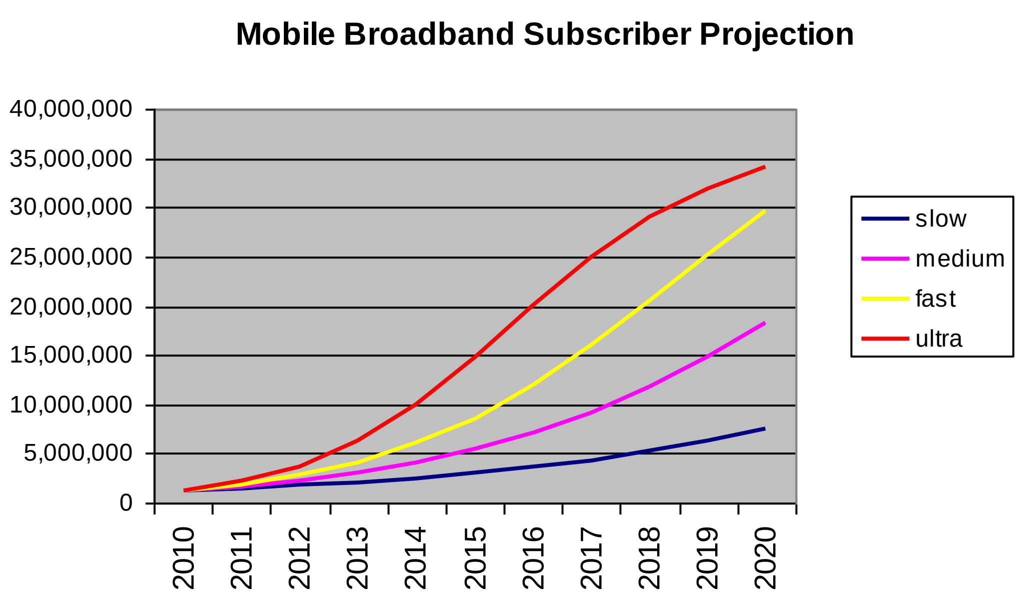
The parameterized S-curves are calculated using the following formula:

$$P(t) = \frac{c}{1 + e^{-(at-b)}}$$

In this formula, parameters a, b, and c are used to stretch (a), shift (b) and scale (c) the appropriate S-curves. The actual values for these parameters are calculated using the Solver functionality of Excel, so that the resulting S-curves match certain data points, such as the know starting value of broadband subscribers in mobile or DSL and to meet a certain future objective, such as a 4 million subscriber target by 2014 (based on the "medium" scenario). The scale parameter (c) in the above equation is equivalent to the market ceiling, defining the upper limit of service adoption during the maximum forecast period of the model.

The following Figure shows the projection for mobile Broadband subscribers, which reaches slightly above 4 million broadband subscribers by 2014 and which also shows the scenario variations for slower or faster adoption rates.

Figure 5: Projection of mobile broadband subscriber numbers



Revenue and ARPU Data

The projection of revenues requires either detailed pricing inputs or – since these have not been available – aggregated monthly ARPU (average revenue per user) by subscriber. The broadband model supports two types of pricing inputs: one-off charges for installation and line activation and (monthly) recurring charges based on subscription and service usage, the latter which is set through the ARPU inputs in the model Dashboard.

ARPU levels are adjusted year-on-year with a certain discount factor, which is set in the General Inputs sheet.

One-off charges for service activation have been set based on current charges by Telecom Egypt for line activation (not: line installation). These one-off charges help compensate for some of the costs of CPEs (client premises equipment), which need to be installed for most broadband access technologies.

Financial Parameters and Assumptions

The main financial parameters and assumptions used in the model are summarized in the following table:

Table 1: Main financial parameters

Expected Return Rate	**20.0%**
Corporate Tax Rate	20%
Import Duties	5%
Sales Tax	10%
Cumulative (import + sales)	15.5%

While the weighted average cost of capital (WACC) calculated by Telecom Egypt is 14.8%, we expect that a commercially oriented international operator would require a significantly higher rate of return. As an adequate figure, we assume a return rate of 20%. This value is used in the calculation of the NPVs of each technology/market business case.

Cost Inputs

The following sections discuss the structure and purpose of the main cost inputs used in the model. Actual input values can be found in the model input sheets.

License and Spectrum Fees

The broadband model supports a variety of license fees such as spectrum fees or the various administration and revenue-based fees including the universal service contribution fee. Fees are divided into one-off upfront fees and ongoing annual licence fees for each broadband access technology. As mentioned in the section of "Scenario-Based Broadband Market Model," the model does not take into account individual operators or service providers; therefore all licence fees are calculated on an aggregate level for each technology/market combination.

In the case of mobile broadband, the model assumes – just for the purpose of fee calculations – a number of 3 mobile operators. With a focus on broadband services, the model apportions some of the licence fees to voice services.

Administration, Marketing and Retail Costs

The administration, marketing and retail costs are based on international benchmarks and assumptions, which have been cross-checked with NTRA for consistency. The following table shows these parameters:

Table 2: Administration, Marketing and Retail Cost parameters

SG&A percentage	15%	of revenues
Marketing percentage	10%	of revenues
Retail Cost (e.g. commission %)	5%	of revenues
Bad Debt (%)	1.5%	of revenues

System Cost Parameters

For each access technology, the model has a separate cost input section. Each cost component has a current cost either in local currency or in US Dollars, a price trend and an asset life time as main input variables.

In terms of actual cost elements, each technology uses more or less the following structure:

- Cost of base-stations or access nodes, split into equipment costs and site acquisition and preparation costs.
- Capacity parameters, such as maximum number of subscribers per base-station or access node.
- Cost for different backhaul options
- Cost for CPEs (customer premises equipment) or end-user terminals
- Bandwidth assumption per subscriber
- OPEX (operating cost) parameters, mostly as function of CAPEX.

Actual figures for each access technology are shown in model cost input sheet.

Network Dimensioning: Bandwidth and Contention Ratios

A central cost driver is the bandwith reserved per subscriber. A typical approach by service providers is offering a certain bandwidth per user and then applying a contention ratio (sometimes called an “overbooking factor”), which defines how many users simultaneously share this bandwidth. While ITU still defines a broadband service as having a minimum bandwidth of 256 Kbps per user, such a low data rate may not be adequate anymore for many services such as video calling or other video and gaming applications.

The model therefore sets a broadband bandwidth at 2 Mbps per user and applies a 1:40 contention ratio, i.e. the full 2 Mbps speed is available if one in 40 users is active at any given time. If more users are active (e.g. during certain peak hours), the available bandwidth per user will drop proportionate to the number of additional users. The applied value for contention is in line with international benchmarks;

e.g. BT uses contention ratios of 1:30 to 1:50 for residential customers and a range of 1:10 to 1:20 for business customers4.

Regarding international Internet uplink capacity a further contention ratio of approximately 1:2 is applied, assuming that around 50% of traffic is local (and based on a local benchmark of 5000 subscribers sharing on international STM-1 link).

Backhaul Costs

As discussed above, the model supports three different scenarios for backhaul transmission infrastructure: the use of (Telecom Egypt) leased lines, the use of independent backhaul infrastructure (green field) or use of independent backhaul infrastructure by partnering with the electricity company, which already has extensive fiber infrastructure in place. The latter case applies certain discounts based on the assumption, that this utility company will be able to negotiate larger discounts and be able to reduce costs by (parallel) provision of other infrastructure.

In addition, microwave systems are used in parts of the backhaul network, e.g. to provide connectivity to base-stations and access nodes.

In case that the core transmission network will be built exclusively on leased lines (unlikely scenario), current leased line price of Telecom Egypt are applied, while still factoring in an annual price decline.

Geographic Roll-out Selection and Prioritization

Selection Criteria

The geographic roll-out and market projection module is the core component of the broadband model. This module collects many regional parameters like population, surface area, population density, GDP per capita, Household Income or building numbers. Any combination of these parameters could be used for the selection and prioritization of a service roll-out in a districts as well as the choice of the most appropriate technology to address these markets. The choice of parameters should ideally be based on the underlying rationale for driving either a commercial (business) decision or a policy decision to provide a specific service in a certain geographic area.

The following list shows the main driver for each technology/market combination and the appropriate selection criteria:

- *Urban Broadband (WiMAX)*, with focus on low to medium income urban areas: selection criterion is mainly commercially driven, based on service affordability; Household Income (above a certain threshold) would be an adequate selection parameter
- *Rural Broadband*, with focus on very low income rural areas: main selection is driven by a policy decision to provide broadband services in these areas; Household Inocme or GDP per capita (below a certain threshold) would be adequate measures for selection
- *Fiber Access*, with focus on affluent urban areas: selection is mainly driven by a business decision with focus on certain income levels; again, Household Income (above a certain threshold) is the adequate selection parameter
- *DSL Service*, this is driven by actual availability of copper lines plus affordability of service in the roll-out area; here, again GDP per capita could be used a proxy for regional selection

[4] See for example: http://business.bt.com/broadband-and-internet/internet-access/sdsl/ or: http://www.griffin.com/about/editorials/view/128/expert_witness__broadband_end_user_experience/

- *Mobile Broadband*, is driven by a business decision based on service affordability

As this list shows, Household Income and/or GDP per capita are the main criteria for selecting a certain access technology for each geographic region. When developing this model further, e.g. to support specific regional policies, other indices, such as the poverty index or an "overcrowded ratio" (i.e. persons per building) could be used for further refinement of the decision making process.

Regions with a predominantly low income levels will be covered by rural broadband technology, a decision which needs to be driven by a sector policy, as this case (as the model output show) is financially not viable without some form of subsidization.

Rollout Prioritization

Once a district has been selected – as discussed in the previous section – the model performs a prioritization, when the access technology will be rolled-out in each of the selected districts. Based on a prioritization criterion for a particular technology, the model performs a ranking of all selected districts. As a next step, the model scales the service roll-out S-curve to the maximum number of districts to be covered. For each roll-out year, the model then assesses which districts will be selected to meet the total number of districts on the roll-out S-curve.

As an illustration, the following figure shows the rollout schedule for the Al-Daqahliyya governorate for rural broadband.

Figure 6: Rollout schedule for rural broadband service in the Al-Daqahliyya governorate. This schedule is shown as an illustrative example only. The actual roll-out schedule depends on the chosen scenario as well as the choice of selection and prioritization parameters.

	RURAL BB						
	ROLLOUT SCHEDULE						
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Qism al-Mansûra 1	-	-	-	-	-	-	-
Qism al-Mansûra 2	-	-	-	-	-	-	-
Qism Gamasah	-	-	-	-	-	-	1
Qism Mît Ghamr	-	-	-	-	-	-	-
al-Gamâliyya	-	-	-	1	1	1	1
Markaz al-Sinbillawîn	1	1	1	1	1	1	1
Markaz al-Matariyya	-	-	-	-	-	-	-
Markaz al-Manzala	-	-	1	1	1	1	1
Markaz al-Mansûrâ	-	-	-	-	-	-	-
Markaz Agâ	1	1	1	1	1	1	1
Markaz Bilqâs	1	1	1	1	1	1	1
Markaz bnii aabad	-	-	1	1	1	1	1
Tamy al-Amdîd	-	-	1	1	1	1	1
Markaz Dikirnis	-	-	1	1	1	1	1
Shirbîn	-	1	1	1	1	1	1
Markaz Talkhâ	-	-	-	-	-	-	-
Markaz Mahalit damnah	-	-	-	1	1	1	1
Minyat al-Nasr	-	-	1	1	1	1	1
Mît Salsîl	-	-	-	1	1	1	1
Markaz Mît Ghamr	-	-	-	-	-	-	-
Markaz Nabrawah	-	-	1	1	1	1	1

The criterion used for prioritization should follow the rational for driving the rollout of a service in a certain district: if based on a commercial (business) decision, this criterion will most often be service affordability, which can be linked to Household Income data, or – as a proxy - to GDP per capita figures.

The following table summarizes the main rationale, primary driver and actually chosen driver per technology/market combination:

Table 3: Selection and Prioritization criteria

Technology / Market Combination	Focus and rationale	Primary selection criteria	Selection criterion used in model	Primary prioritization criterion
Urban Broadband	Urban and suburban population, commercially driven	Affordability, or Household Income	Household Income above threshold	Aggregate Household Income
Rural Broadband	Rural, low income population; driven by sector policy	Affordability, or Household Income below threshold	Household income below threshold	Aggregate Household Income
Fiber Access	Urban affluent population; commercially driven	High Affordability, or Household Income	Aggregate Household income per district above threshold	Aggregate Household Income
DSL Service	Country-wide focus, where copper lines are available	Availability of copper lines	Availability of copper lines	Aggregate Household Income
Mobile Broadband	Country-wide focus, commercially driven	Availability of mobile service, Household Income	Availability of mobile service	Aggregate Household Income

Subscriber Projections

As soon as a service becomes available in a geographic region, subscriber pick-up will begin following the S-curves of the selected scenario. To calculate this subscriber pick-up the appropriate S-curve needs to be time-shifted to the point, when a service becomes available in a district.

The following figure illustrates this process, by showing the projected subscriber numbers for the Al-Daqahliyya governorate for rural broadband (corresponding to the rollout schedule shown in **Error! Reference source not found.** above).

Figure 7: Projected Subscriber pick-up for rural broadband service in the Al-Daqahliyya governorate. This subscriber projection is shown as an illustrative example only. The actual subscriber projections depend on the chosen scenario as well as the choice of selection and prioritization parameters.

	RURAL BB						
	Subscriber Pickup						
	2011	2012	2013	2014	2015	2016	2017
Qism al-Mansûra 1	0	0	0	0	0	0	0
Qism al-Mansûra 2	0	0	0	0	0	0	0
Qism Gamasah	0	0	0	0	0	0	7
Qism Mît Ghamr	0	0	0	0	0	0	0
al-Gamâliyya	0	0	0	275	583	1,183	2,208
Markaz al-Sinbillawîn	1,407	2,987	6,055	11,303	18,628	26,477	32,929
Markaz al-Matariyya	0	0	0	0	0	0	0
Markaz al-Manzala	0	0	844	1,791	3,631	6,779	11,172
Markaz al-Mansûrâ	0	0	0	0	0	0	0
Markaz Agâ	1,256	2,667	5,406	10,091	16,632	23,639	29,400
Markaz Bilqâs	1,326	2,815	5,706	10,652	17,556	24,952	31,033
Markaz bnii aabad	0	0	330	701	1,420	2,651	4,369
Tamy al-Amdîd	0	0	458	973	1,972	3,680	6,066
Markaz Dikirnis	0	0	905	1,921	3,893	7,268	11,978
Shirbîn	0	1,070	2,271	4,603	8,593	14,162	20,130
Markaz Talkhâ	0	0	0	0	0	0	0
Markaz Mahalit damnah	0	0	0	152	322	653	1,219
Minyat al-Nasr	0	0	746	1,582	3,208	5,988	9,869
Mît Salsîl	0	0	0	185	392	795	1,483
Markaz Mît Ghamr	0	0	0	0	0	0	0
Markaz Nabrawah	0	0	709	1,504	3,049	5,691	9,380

The subscriber projection for DSL service and for mobile broadband follows a slightly different algorithm. As the number of copper lines has only been available on governorate level, the projection of DSL subscribers uses the current number of DSL lines per governorate as a starting point and extrapolates these by the use of S-curves. The model applies a ceiling at the number of copper lines, which can be used for DSL services.

The mobile broadband projection has been prepared on Qism/Markaz level using the number of base-stations in each of these geographic regions as a proxy for actual customer subscriber numbers. As this approach may not be completely accurate (people may use their phone at a different location from where they live), this approach should still provide a viable estimate on aggregate governorate level for the actual distribution of mobile subscribers.

In this approach, the number of (nation-wide) mobile subscribers is distributed across the different geographic regions based on the number of 2G and 3G base-stations. The resulting subscriber base is then extrapolated based on the S-curves as discussed above. In 2010, population penetration for mobile services already surpassed 95%. Therefore, mobile service is already ubiquitously available throughout most of Egypt. The extrapolation for mobile broadband subscriptions is therefore largely based on an incremental case for adding additional (broadband) capacity and functionality to existing sites.

Business Cases per Technology / Market Combination

The broadband model features five separate business cases, one for each technology/market combination. In addition, there is a separate Backhaul module, which follows the same logic as the other business cases with a few modifications, such as the inclusion of a service pricing module to calculate the cost of backhaul services for an independent backhaul network roll-out.

Business Case Structure

All business cases follow the same basic structure, starting with a collection of business case drivers. These drivers are mainly derived from the geo-module described in the previous sections and include:

- projected subscriber numbers
- projected number of base stations or access nodes
- projected bandwidth requirements

The following business case sections then calculate the actual investment requirements (CAPEX) using the cost inputs for equipment. Depending on the life time of different assets, the model also calculates the need for reinvestments after the end of the useful asset life. The depreciation module projects depreciation charges applying a straight-line depreciation. Operating costs (OPEX) are based on percentage benchmarks, derived from the cost input section. Finally, revenues are projected applying the appropriate ARPU inputs including ARPU trends to the projected subscriber numbers.

Cost calculations for backhaul are based on three different options (which can be selected through the Dashboard): using leased lines (based on Telecom Egypt leased line prices), using backhaul service from an independent backhaul provider (which would need to be established) or using backhauls service from such an independent backhaul provider, assuming this provider can use some of the electricity company infrastructure.

As a main output each module produces an investment (CAPEX) summary, a revenue summary and a high-level Cash Flow projecting (excluding tax in interest charges) to assess the financial viability of each case through an NPV calculation.

Backhaul Module and Backhaul Price Setting

As described in the previous section, all business cases for the five technology/market combinations include a cost section for backhaul cost. The Backhaul module calculates a business case for such a (still hypothetical) independent backhaul operator based on two different assumptions: one, that the operator builds a backhaul network as a green-field operation, two, that this operator builds the backhaul network using already existing infrastructure of the electricity company.

In either case, the main cost outputs are used to calculate cost-based prices for backhaul bandwidth. These cost-based prices are based on a fully-allocated cost methodology and could be calculated using the following formula:

SERVICE COST = OPEX + DEPRECIATION + RETURN ON NET BOOK VALUE

While operating costs can be determined relatively straight-forward, return on capital and depreciation charges can be based on different approaches, depending on the form of depreciation method. Most commonly used approaches are straight-line depreciation (used in most accounting systems) and annuities (typically used for regulatory price setting).

Straight-line depreciation has the advantage, that it can be easily based on operator accounts. However, the main disadvantage is that the return on capital changes significantly over time: As return on capital is based on the net book value of an asset, this net book value decreases over the life time of an asset to zero, leading to a very high charge at the beginning of the asset life time and a zero charge at the end.

A more adequate approach for service price setting are annuities, as they keep the combination of depreciation and return on capital constant over the life-time of an asset.

Service costs are then calculated applying the following formula:

SERVICE COST = OPEX + ANNUALIZATION FACTOR * CAPEX

The formula for calculating the annualization factor of annuities is:

Cost of capital/{1-[1/(1+cost of capital)]^asset life}

By applying a cost-based price using the backhaul capacity projected by the other business case modules, the NPV of the Backhaul business case will always turn positive. This is achieved by calculating the cash flow through a numeric iteration of revenues based on the cost of the backhaul service. This can be easily realized in Excel by allowing for circular references to solve these numerical iterations.

Model Outputs and Main Sensitivities

Parameters of "Base Case" Scenario

As discussed in the introductory sections "Introduction and Background" and "Overall Approach and Methodology" in this chapter, the main focus of the broadband model is projecting subscriber numbers and investment requirements based on different parameter sets.

The main input parameters have been discussed in detail in section "Main Model Modules." Due to the inherent difficulty of reliable forecasting of certain parameters, a sub-set of such parameters has been included as sensitivity variables in the Dashboard of the broadband model.

Two parameter sets are selectable through drop-down boxes:

- *Speed of service adoption:* The model allows for 4 scenarios "slow", "medium", "fast" and "ultra" adoption using different S-curves. The base case uses the "medium" scenario which is coupled to the policy objectives of achieving 4 million mobile and 4 million fixed broadband subscribers by 2014
- *Backhaul infrastructure:* The base case assumes that private operators will setup an independent backhaul operator making use of the electricity company's infrastructure to provide cost-efficient backhaul services across Egypt. The other two options are building this fiber-backbone network as a green-field operation, and buying backhaul connectivity through leased lines from Telecom Egypt.

The sensitivity input fields are set to the following values for calculating the base case scenarios presented in the following sections:

- Selection parameters for rural regions: Household Income below: LE 12,500
- Selection parameters for urban regions: Household Income above: LE 12,500
- Selection parameters for Fiber Access: aggregate HH income: LE250 million, HH income: LE 25,000
- Maximum copper lines usable for DSL: 30%

Monthly ARPU values are set to the following values:

- Rural Broadband ARPU: US$ 10 (assuming, this is the maximum affordable level for rural population)

- Urban BB ARPU: US$ 20
- DSL ARPU: US$ 20
- Fiber Access ARPU: US$ 75
- Mobile Broadband ARPU: US$ 20

Market ceilings for Rural, WiMAX and Fiber Access are set as follows:

- Rural Broadband: 20%
- WiMAX: 20%
- Fiber Access: 20%

Base Case Scenario Results

Subscriber, Revenue and Investment Projections

The following two figures show, that subscriber numbers for broadband services will surpass 11 million and that revenues from broadband services in Egypt are projected to reach US$ 3 billion per year within the 5 year forecast period.

Figure 8: Broadband Revenue Projection

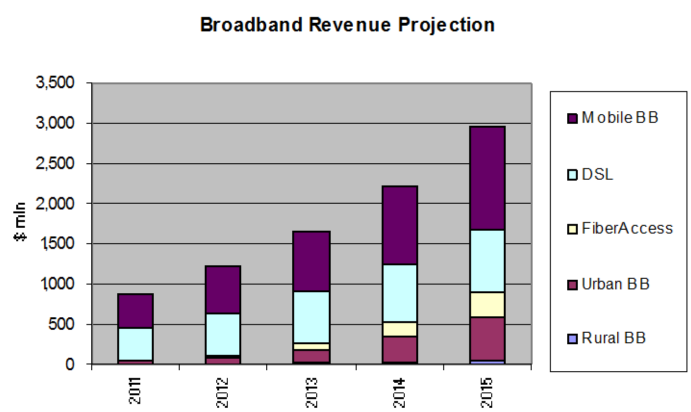
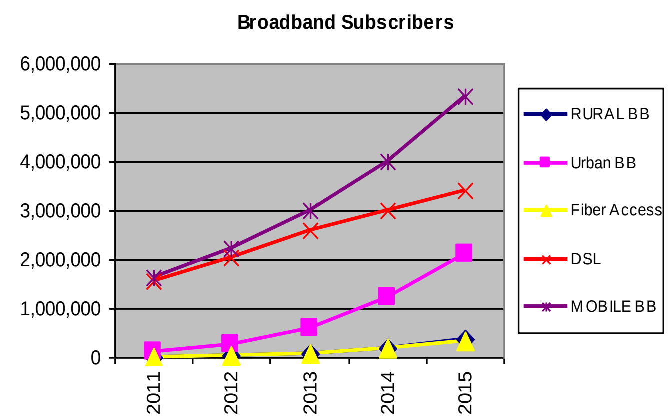


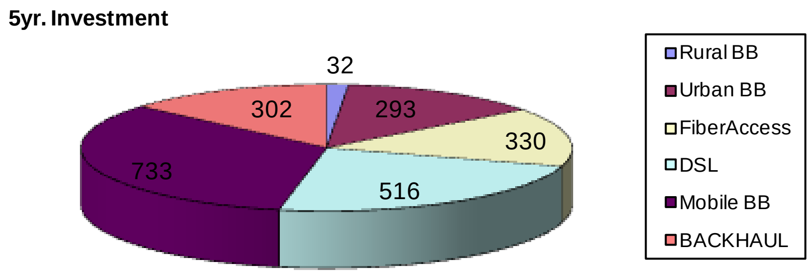
Figure 9: Subscriber Projection



Following the NTRA broadband policy, by 2014 the projected number of broadband subscribers will reach 4 million for mobile Broadband and 3 million for DSL supplemented by slightly more than 1 million WiMAX subscribers. Both, rural broadband as well as Fiber Access will reach only relatively small levels of penetration: around 200,000 and 300,000 subscriptions respectively.

Investment requirements over the 5 year forecast period are projected to reach US$ 2.2 billion. The following chart shows, how these investments will be split between the different technology/market combinations, including the setup of an independent backhaul provider.

Figure 10: Projected Investment requirements (in US$ million)



Selected Cost and Investment Indicators

To understand the actual cost levels and cost elements in more detail, the model supports various key indicators such as CAPEX per subscriber, total service cost or pure network costs per subscriber.

The following table shows the CAPEX figures per subscriber and technology, projected for the 5 year period:

Table 4: Total CAPEX per new Subscriber projection (in USD)

	2011	2012	2013	2014	2015
RURAL BB	218	196	172	155	140
URBAN BB	198	167	149	132	118
Fiber Access	1124	1105	1088	1074	1063
DSL	238	233	230	229	228
MOBILE BB	199	191	182	173	166

The following table shows the monthly total cost per subscriber and technology, applying a 5 year depreciation on CAPEX and including the full set of operating costs:

Table 5: Total cost per Subscriber per month (USD/month)

	2011	2012	2013	2014	2015
RURAL BB	31	17	12	9	8
URBAN BB	23	16	14	12	11
Fiber Access	91	79	73	69	67
DSL	14	14	14	13	13
MOBILE BB	16	15	14	12	12

To get a more direct comparison of the cost of the different access technologies, the following table shows the pure network cost per subscriber per month (excluding all other cost elements, such as CPEs, terminals, licence fees, or marketing and other overhead costs):

Table 6: Pure Network Technology cost per Subscriber per month (USD/month)

	2011	2012	2013	2014	2015
RURAL BB	5.50	5.02	4.49	4.10	3.77
URBAN BB	5.18	4.60	4.28	3.98	3.73
Fiber Access	48.87	46.40	44.29	42.49	40.89
DSL	8.50	8.40	8.31	8.26	8.21
MOBILE BB	5.90	5.56	5.23	4.94	4.69

NPVs and Viability of Different Technology/Market Combinations

As one of the key outputs, the broadband model assesses the financial viability of the different technology/market combinations, by performing a net present value (NPV) analysis. All NPVs are calculated based on a 5 year projection, with the exception of Fiber Access, which uses a 10 year timeframe. The following table shows these NPV results:

Table 7: NPVs of different Technology/Market Combinations

Technolgy:	NPV (US$ million):
Rural BroadBand	-10
URBAN BB	83
Fiber Access *(10 year)*	-111
DSL	435
Mobile BroadBand	-10

As this Table shows, Rural Broadband and Fiber Access are not viable under the conditions chosen in the base scenario. One "easy" fix in terms of changing model parameters is an increase of ARPU levels. Once the ARPU for fiber access surpasses US$ 87 per month, the corresponding NPV turns positive.

For Rural Broadband, the ARPU would need to reach a level of US$ 17 per month to become commercially viable. As such a high ARPU level will most likely not be affordable for rural population, rural broadband access will require some form of subsidization, either in form of a direct subscription subsidy or in form of an investment subsidy. Both of these subsidy forms can be calculated by the model: giving a service subsidy US$ 7 per month per rural Broadband subscriber, will make the business case for rural Broadband viable. The accumulated cost of this subsidy is US$ 34 million over the first 5 years – rising to US$ 282 million over a 10 year period.

A better alternative is to subsidize network rollout. In this case, 60% of CAPEX would need to be subsidized. Over a 5 year period this subsidy is projected to accumulate to US$ 19 million, over a 10 year period this figure will reach US$ 64 million. Both these numbers are significantly lower than the direct service subsidy, which make this form of subsidization a preferred option.

Sensitivity Analysis

While the model allows for a very high degree of flexibility in sensitivity testing, this report focuses on two main areas for this analysis:

- Change of Market Scenario
- Impact of different Backhaul Options

Results from Different Market Scenarios

The following charts show the main model results in terms of subscriber and revenue forecasts for the "slow" and "fast" scenarios.

Figure 11: Subscriber Projection "slow"

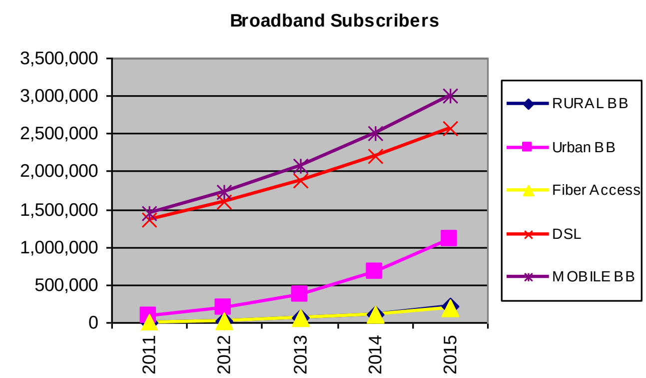


Figure 12: Subscriber Projection "fast"

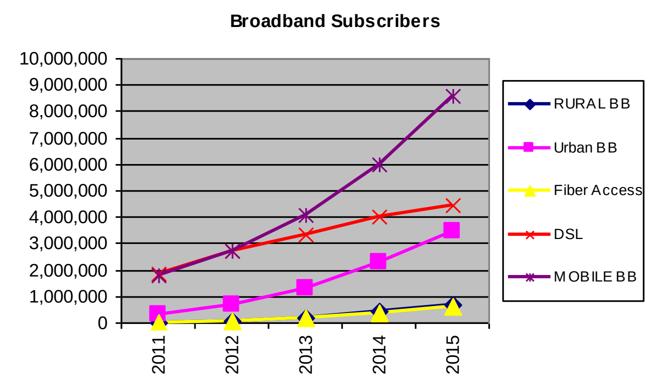


Figure 13: Revenue Projection "slow"

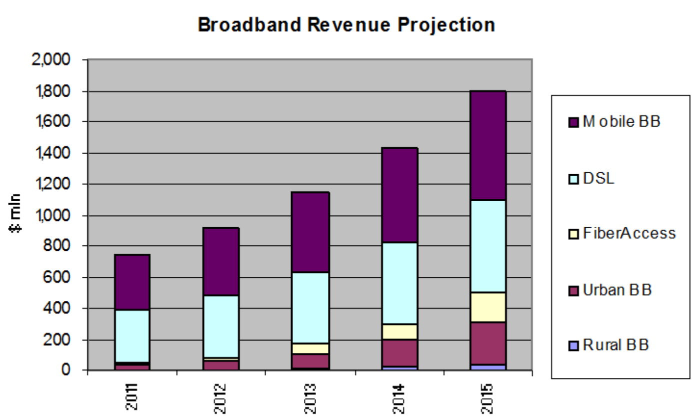
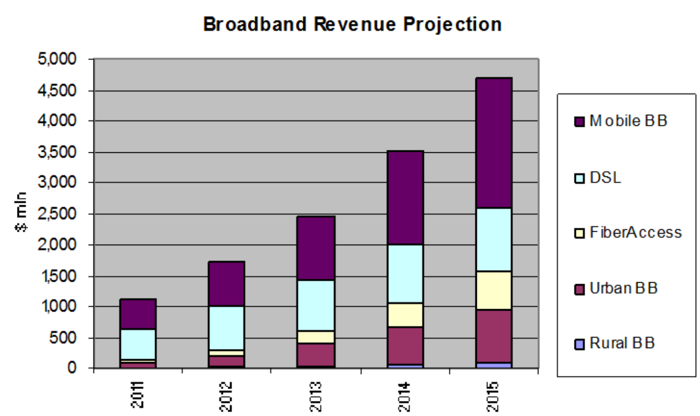


Figure 14: Revenue Projection "fast"



Over the 5 year forecast period, subscriber numbers range between 7 and 17.5 million, revenue projections range between US$ 1.8 and US$ 4.5 billion. As investment numbers are scaled to the projected number of subscribers, total investment requirements will vary between US$ 1.2 billion in the slow and US$ 3.6 billion in the fast scenario.

Impact of Different Backhaul Options

Setting up an independent backhaul operator is projected to require around US$ 300 million investment of the first 5 years in the base case or "medium" growth scenario. In the fast growth scenario this number will increase to US$ 392 million. In case of not co-operating with the electricity company (green-field backhaul), investment requirements will increase between US$ 40 million and US$ 50 million respectively.

Testing the base case scenario with using Leased Lines, shows that the financial viability will be considerably lower compared to building an independent fiber backbone network. Leased Line prices would have to be reduced by 50% to 80% to reach a similar level of financial viability.

The main impact of different backhaul options can be seen in the viability of the different broadband access combinations. As an example WiMAX requires a minimum ARPU of US$ 18.50 if backhaul is setup by using leased lines. In case of an independent backhaul operator, this minimum ARPU requirement can sink to US$ 15, in case of a utility-based backhaul provider this can sink slightly further to US$ 14.80.

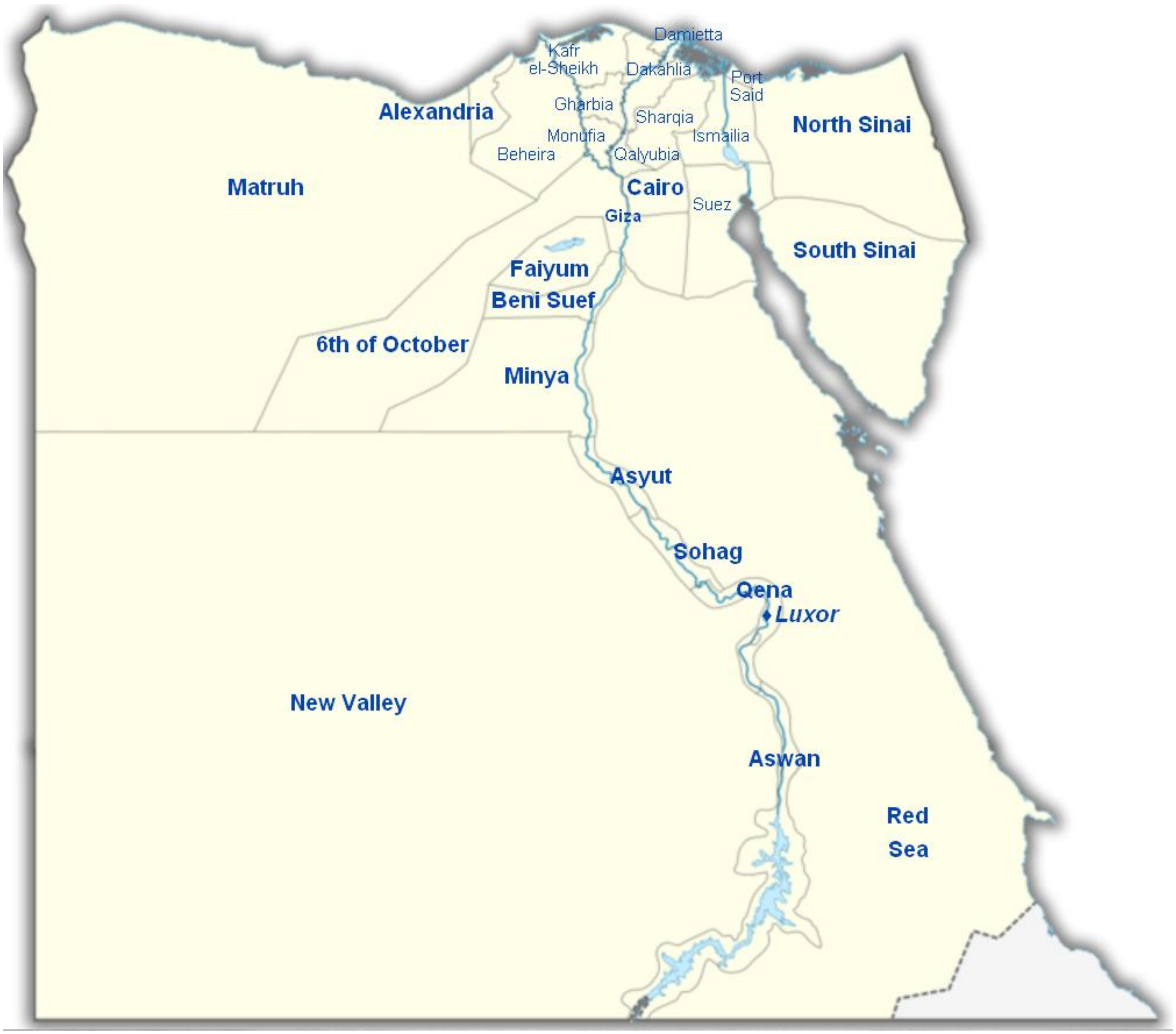
For mobile Broadband, the different backhaul options have a similar impact: In the case of leased lines, the minimum ARPU requirement is US$ 16.40. In case of an independent backhaul operator, this minimum ARPU requirement will sink to US$ 12.70, in case of a utility-based backhaul provider this will sink slightly further to US$ 12.40.

These examples show that the backhaul cost has a big impact on overall ARPU level and – as direct consequence – the price levels of broadband services. This impact can also be observed in the network cost per subscriber per month: when switching from leased line based backhaul to independent backhaul, the resulting cost reduction is around US$ 2 per user per month for WiMAX or mobile Broadband users.

Caveat

We express caution on the results of this (and any) model that tries to simulate and project business and market behavior. There are multiple variables that a model cannot incorporate but that nonetheless will have an impact on the decisions of policy makers, operators, potential investors, and other market parties. Despite the technical quality and intrinsic value of the model, and the sound use of variables and parameters to the best knowledge available, the results may eventually prove to be inconsistent with the actual performance of the market and the resulting actual financial results.

ANNEX 1: Map of Egypt and the 29 Governorates



Chapter 2.

MACROECONOMIC IMPACTS OF BROADBAND IN EGYPT

Executive Summary

This report presents estimates of the macroeconomic impacts of alternate broadband policies in Egypt. These estimates are provided in terms of the number of jobs and the contribution to GDP that may be associated with implementing alternate broadband development scenarios.

These estimates were prepared to be used in conjunction with the *Egypt Broadband Market Model* (EBMM), developed as part of this project under contract to the World Bank. This model provides two principal basis for estimating macroeconomic impacts: (1) forecasts of total broadband subscriber lines from 2010-2020; and (2) forecasts of total broadband investment from 2010-2020.

In the attached report, the literature on broadband economic impacts is reviewed. Collectively, this literature provides strong support for concluding that increasing broadband availability and adoption contributes to economic growth. This literature also provides a range of estimates of multipliers that may be used in conjunction with the elements above to provide estimates of the macroeconomic impacts of broadband.

The results of applying those multipliers to the EBMM are summarized in Table 8 of this report. The first approach, based on GDP-Broadband penetration multipliers, results in an estimate of an incremental cumulative contribution to GDP for the period from 2010-2020 of US$ 5 -US$ 42 billion. These results are for the base case scenario. Using more extreme scenarios from the EBMM model suggests a range of US$ 3 - US$ 57 billion.

The second approach, based on Broadband investment multipliers, results in an estimate of an incremental cumulative contribution to GDP for the period from 2010-2020 of US$ 35 - US$ 48 billion. Once again, these results are for the base case scenario. Using more extreme scenarios from the EBMM model suggests a range of US$ 17 - US$ 67 billion.

The second approach also yields estimates of the number of jobs created. The base case scenario projects an average of 25-36 thousand jobs will be created per year. The more extreme cases suggest a range of 13-50 thousand jobs.

The report also offers a number of caveats of relevance when considering how to use and interpret these estimates.

Description of Task

In September 2010, the World Bank was engaged by the Egyptian government under the terms of a Reimbursable Technical Assistance service agreement relative to the Communication Sector to develop a confidential and proprietary tool for evaluating broadband policy options under consideration by the Egyptian government.

A core component of this project was the preparation of a spreadsheet model to estimate the deployment trajectory, revenue and investment cost implications of expanding broadband availability and adoption in Egypt through 2020. This model was developed by Matthias Halfman under contract to the World Bank, and was delivered in final form in July 2011 as the *Egypt Broadband Market Model*, hereafter referred to as the EBMM. Key input assumptions and much of the detailed data used to populate the EBMM was collected in consultation with Egyptian policymakers involved in formulating the Egyptian broadband strategic plans.

The purpose of this document is to supplement the EBMM with estimates of the macroeconomic impacts on employment and GDP associated with the trajectory for broadband adoption forecasted by the EBMM. To appropriately contextualize these estimates, this report provides a review of the research literature that informs the macroeconomic impact estimates and an assessment of its applicability to the present task at hand. These estimates and the methods used to integrate them with the EBMM may be refined on the basis of future discussions.

This report is provided in confidence to the World Bank and Egyptian government as part of the project referenced above. Confidential Egyptian data and the EBMM were used in preparing this report.

Introduction

The importance of basic telecommunications services for economic growth and development has long been recognized in the international community. Telephone penetration (traditionally measured in terms of fixed voice line equivalents per 100 population) is a standard metric for evaluating the quality of basic infrastructure, and the positive correlation between telephone penetration and economic activity (usually measured as GDP per capita) is well known, and generalizes to more complex measures of ICT development (see Figure 1).

Today, access to telephony services, while remaining essential, is no longer enough. Internet access -- and increasingly that means broadband Internet access -- is now generally regarded as essential basic infrastructure for society and the economy. From email to the WorldWide Web, from electronic commerce to blogs, from Web 2.0 supply-chain management to social networking, a growing number of citizens depend on the Internet and access to mass-market data communications services as part of their social and economic lives. A BBC Poll released in March 2010 found strong international support for the view that Internet access should be a basic fundamental right.[1] In 2010, worldwide Internet subscribership passed the 2 Billion mark (see Figure 2). The Internet has emerged as *the* global successor to the Public Switched Telecommunications Network (PSTN).

While broadband Internet access is now widely recognized to be essential basic infrastructure,[2] access is not universal in even the most developed economies, and deployment lags significantly in less developed markets. As Figure 3 illustrates, although significant progress in expanding Internet access has occurred, Digital Divides persist. In recognition of the need to expand options for access, policymakers in many countries are implementing plans and allocating public funds to promote investment in broadband infrastructure and to promote the adoption and use of Internet services across the economy and society.[3]

Policymakers in Egypt likewise have embraced plans to promote a significant expansion in broadband service availability and adoption. Although current broadband adoption is low -- only about 3% in 2010[4] and substantially below the levels that have been attained in more developed OECD countries[5] – Egypt is planning to significantly increase the level of broadband adoption in coming years. The Egyptian plan is to expand broadband access by approximately 8 million subscriber lines (split between mobile and fixed services), which will increase Egyptian penetration to over 10% by 2014, and reach 37% by 2020 (see Table 1).[6]

Table 1: EBMM Broadband Deployment Forecast[7]			
	2010	2014	2020
Subscriber Lines (Millions)			
Fixed	1.16	4.51	15.61
Mobile	1.19	4.00	17.83
Total	2.36	8.51	33.44
Population (Millions)	77.78	82.84	91.06
Penetration	3%	10%	37%

The EBMM forecasts that US$ 7.2 billion in cumulative infrastructure investments will be required to realize this adoption scenario.

The balance of this report explains why it is reasonable to expect that promoting broadband availability and adoption will produce significant macroeconomic benefits for Egypt in terms of increased employment and higher GDP based on a review of the academic research on ICT impacts; describes a methodology for estimating these macroeconomic impacts that is compatible with the EBMM; and offers estimates of those impacts for use in evaluating broadband policy goals.

Broadband Economic Impacts

Information and Computing Technologies (ICTs) have transformed society and economies around the globe. ICTs have changed the way we communicate, work, and socialize. Computing and telecommunications resources, rendered more usable and accessible via the Internet, pervade all aspects of our economic and social lives. ICTs have substantially altered the way firms operate and markets are organized – impacting the work of employees in businesses of all sizes, across every industry sector, and across all business functions from the shop floor to the executive suite, from human resources to customer relationship management.

While the economic and social importance of ICT and its benefits are widely accepted, reliably quantifying those benefits is challenging. In a 1987 quip that has subsequently become famous, Robert Solow, a Nobel laureate economist, commented, "we can see the computer age everywhere but in the productivity statistics."[8] Early scholarly work supported Professor Solow's paradoxical observation.[9] For those who worked with computers and advanced telecommunication services, it was clear that ICTs were contributing to productivity improvements, but it took time and significantly better data in order to observe the increased returns that investments in ICT promised.

With 20/20 hindsight, it is not surprising that it was difficult to observe the economic impacts of ICTs in aggregate data. First, although investment in ICT represented a significant share of total fixed business investment in the United States (where most of the early research focused), it still represented only a small share of the total capital stock and, ICT-producing sectors, a small share of total GDP.[10] The early studies were based on noisy aggregate industry or economy-wide data that obscured the effects of ICTs on economic output.

Second, measuring ICT inputs is notoriously difficult, in part, because of the very rapid pace of innovation and continuously declining prices, described popularly as *Moore's Law*. This makes it difficult to measure both the quantity and value of ICT inputs (and outputs) in appropriate quality-adjusted terms. A computer purchased in 2010 is a much more capable device than one purchased in 2000.

Additionally, ICT is used most intensively in the service sectors of the economy (and in service-sector-like business operations of non-service sector firms[11]), for which it is notoriously difficult to measure output appropriately. Failure to measure ICT inputs or ICT-derived outputs correctly contributes to the measurement problems, making it difficult to observe measurable ICT impacts.

Third, and perhaps, most important, ICT is a *general purpose technology*[12] that is used by businesses in many ways to produce many different types of intermediate and final goods and services. ICT changes the way firms produce goods and services (e.g., just-in-time manufacturing, supply-chain management, and electronic commerce), enhancing the quality of other factor inputs such as labor and non-ICT capital. Furthermore, it takes time for such seismic changes to reveal themselves and so the benefits from ICT investment are likely to be observable only with a lag of perhaps several years. The fact that

ICT may be expected to change firm production functions in so many ways means that measuring ICT's impacts is inherently complex.

Evidence of the significant contribution of ICTs to economic growth began to accumulate in the late 1990s. First, firm-level studies with better data demonstrated the superior returns offered by ICT investments.[13] Next, with time and better data, the significant benefits of ICT were apparent even in aggregate industry-level data and economy-wide metrics. For example, Jorgenson (2001) estimated that ICT added 1.18% to GDP growth and accounted for 2/3rds of total factor productivity growth from 1995 through 2000, thereby helping to explain the resurgence in economic growth in the United States in the last half of the 1990s.[14] Jorgenson, Ho, and Stiroh (2007) estimated that ICT contributed 59% of the growth in labor productivity from 1995 through 2000 and 33% from 2000 to 2005.[15] It is worth noting that although the growth impact appears to have slowed during the latter period, ICTs were still contributing sizable excess returns. Fuss and Waverman (2006) attributed 60% of the slower productivity growth experienced by Canada (relative to the US) in 2003 to Canada's less intensive use of ICT.[16]

Although the evidence that ICTs do contribute to economic growth and productivity enhancements is now substantial, the evidence of a positive contribution from broadband Internet access is less clear. There are many reasons for why it is difficult to measure the economic impact of broadband.

First, it is important to remember that broadband is a component of ICT use. Broadband is not useful by itself, but only when used in conjunction with other ICTs. All of the same problems that confounded early attempts to measure positive impacts from ICT bedevil efforts to demonstrate the economic contribution from a component of ICT such as advanced communication services, or even more narrowly, broadband.

Broadband services are not desirable in themselves, but for what they enable. Because broadband is an input in the production and consumption of many other goods and services, rather than a final output, we do not observe the value created by broadband directly. This adds to the measurement difficulties.

Furthermore, we are still in the early stages of realizing the benefits of broadband (more akin to the status of efforts to measure the impacts of ICTs in the 1980s). Broadband services only began to be widely deployed in the most advanced markets after 2000, and significant adoption lags significantly in developing markets. It will take time for the necessary evidence and data to accumulate to be able to document the economic impacts of broadband.

Finally, as with other types of ICTs, it is possible to view broadband as a GPT with the potential to change how firms operate and industries are organized. For example, broadband may make it possible to outsource customer service or back-office administrative functions, moving the activity out of the manufacturing sector into the service sector (or even, potentially, offshore). Broadband and the ICTs like computers and telecommunications devices and the applications broadband is used with has the potential to simultaneously complement and substitute for labor, depending on the context. On the one hand, ICT-enabled decision-making (rendered more usable via broadband) might be viewed as capital substituting for labor (e.g., when manual data management is automated); while on the other it may be viewed as labor-enhancing (e.g., when access to on-line education facilitates learning, thereby improving labor quality). New ICT-enabled processes (e.g., software applications like ERP, just-in-time manufacturing, Customer Relationship Management systems, business productivity group ware, RFID-enhanced supply chain management, factory automation, etc.) may fundamentally change the mix of inputs, and thereby relative prices, resulting in complex interaction effects. Realizing the full benefits of broadband-induced transformation to production functions, and resultant, transformations in industry value chains and market structures (e.g., eCommerce's impact on bricks-and-mortar retail trade or supply chains) takes time.

In spite of the inherent data and methodological challenges associated with measuring the economic impact of broadband and other components of ICT, evidence is accumulating demonstrating the economic contribution that broadband may make to economic growth and productivity. The first wave of studies in this vein lacked sufficient statistical data to estimate econometrically the benefits of broadband. Broadband was too new and data on its usage was too limited for analysis of historical data. Instead, researchers developed forecasts of the potential benefits from broadband adoption by building up sector-specific estimates of how wider broadband adoption might contribute to economic growth. For example, Crandall and Jackson (2001) estimated that faster deployment of ubiquitous broadband in the United States would contribute US$ 500 billion to GDP in 2006 by changing consumer shopping, commuting, home entertainment, and health care habits.[17] Another forward-looking US-based study by Pociask (2002) predicted that construction of a national broadband network might add 1.2 million jobs.[18] In a study that sought to project the potential benefits from broadband-enabled growth in telemedicine and telecommuting, Litan (2005) estimated that cumulative benefits from accelerated broadband deployment could exceed US$ 927 billion from 2005-2030, exceeding "what the United States currently spends annually for healthcare for all its citizens."[19]

As the number of broadband-enabled communities expanded after 2000 and evidence began to accumulate, a number of community-specific studies became available that sought to quantify the benefits from broadband deployments.[20]

More recently, large sample econometric studies have become available that document the economic benefits of broadband. For example, Lehr *et al.* (2005) looked at zip-code level data on broadband deployment in the U.S. during the period from 1999 through 2002 and found evidence that zip codes that had broadband as of 1999 experienced faster job growth (1 to 1.4%) from 1998 to 2002, had higher rental rates in 2000 (by 6%), experienced faster growth in business establishments (0.5 to 1.2%), and a favorable shift in the mix of business toward higher-value-added ICT-intensive sectors (0.3 to 0.6%).[21] Crandall *et al.* (2007) looked at state-level data to estimate that a 1% increase in broadband penetration could be expected to add 0.2-0.3% higher job growth, or an additional 300 thousand jobs nationally.[22]

Interest in estimating the economic benefits from broadband has increased, and now includes studies from other markets. These studies are based on the econometric analysis of country-level (and in some cases, more geographically granular) historical data (in most cases, from 1998 through 2008). These studies look at the relationship between economic productivity (measured in terms of GDP or GDP per capita) and the level of broadband penetration (measured in lines per 100), while controlling for a variety of other factors that can be expected to partially explain the level of economic output. The studies differ in terms of the data sets (time frame, countries included), the econometric specification, and the variables included (the selection of dependent and independent variables and how they are measured). For the most part the studies focused on the United States or OECD countries, so there is much less evidence available for developing countries like Egypt. These studies, covering different time periods and samples, all conclude that there is a positive correlation between broadband penetration and GDP growth, estimating GDP-Broadband elasticities of between 0.018% and 0.150%.

A selection of these results is summarized below (see Table 2):

- Czernich et al. (2011)[23] used panel data for OECD countries from 1996-2007, and found that a one percent increase in broadband penetration raised GDP per capita growth by 0.09 to 0.15%.
- Franklin, Stam & Clayton (2009)[24] looked at a panel of 13 European countries on firm-level productivity from 2001-2005 and found that broadband enhanced employee productivity, but that this impact varied with the level of adoption, suggesting that critical mass is required to realize significant benefits.
- Katz and Avila (2010)[25] analyzed data for 24 Latin American and Carribean countries from 2004-2008 and found that a 1% increase in broadband penetration resulted in a 0.0178% increase in GDP. They also estimated that the same increase in broadband penetration would increase employment by 0.18%.
- Koutroimpis (2009)[26] examined a panel for 15 European countries from 2003-2006 and concluded that a one percent increase in broadband resulted in a 0.038% higher GDP growth.
- OECD (2011)[27] looked at a panel of OECD countries and found that 1% higher broadband penetration resulted in 0.109% faster GDP growth. This study also looked at the relationship between IPv4 address growth and GDP and found a similar positive impact. This is interesting because it provides additional support for the view that broadband causes (rather than follows) economic growth.
- Quiang et al. (2009)[28] used data for 120 countries from 1980-2006 and found that a one percent increase in broadband penetration added 0.121% to the GDP growth of medium to high income countries; and 0.138% to the GDP growth of developing countries. This last result is interesting because it differs from the findings of higher growth impacts in countries with more advanced broadband markets.
- Waverman (2009)[29] used data for the United States and 14 European countries from 1998-2007 to conclude that one percent higher broadband penetration raised productivity by 0.0013% in markets with medium to high levels of broadband penetration, but resulted in no significant measured impact for countries with low broadband penetration (providing further support for the notion that critical mass is important in order to realize significant benefits from broadband).

An alternate approach to estimating economy-wide impacts is based on a bottom-up forecast of the impact of investing in broadband infrastructure and expanding broadband service adoption. These studies often make use of multipliers derived from input-output tables to capture the direct, indirect, and induced stimulus effects of investment in broadband infrastructure. The direct employment effects are associated with the investment in the infrastructure by the network operators undertaking such investment. This results in the direct creation (or sustainment)[30] of employment in the sector. This direct employment effect indirectly stimulates employment in upstream sectors that supply the telecom service providers investing in the broadband infrastructure. Next, the investment and increased final output it produces raises national income that results in still further stimulus effects as the additional income fuels demand in other downstream sectors, stimulating employment in those sectors as well.

Finally, the productivity enhancements delivered by broadband are expected to result in additional "externality" or spillover benefits. These result from the enhancements in labor and capital productivity, innovation, and more efficient business operations made possible through the use of broadband enabled technology. Examples of such improvements include being able to economically address larger geographic markets (because of the way the Internet reduces the effects of distance), engage in more flexible and responsive supply-chain management, or enhance service quality (e.g., through better consumer service). These latter effects are typically estimated to be of similar or even larger magnitude than the direct (plus indirect and induced) effects identified above. While the direct (plus indirect and induced) effects may be realized relatively rapidly,[31] the externality benefits may take longer to be realized.

Once again, the studies provide a range of estimates, and the applicability of these estimates across countries is more suspect since the analysis is grounded in the specifics of the particular economies under study. Nevertheless, the studies provide employment multiplier estimates (per US$ million of broadband investment) in the range of from 35 to 50 (of which from 16 to 27 is due to externality effects)[32]; and GDP multipliers in the range of 4.8 – 6.7 (per US$ of broadband investment), of which 3.8 is due to externality effects.[33]

A selection of these bottom-up/forecast based estimates of broadband impacts include (see Table 3):

- Atkinson et al. (2009)[34] sought to estimate the economic impact of the broadband stimulus investments in the United States, and using a muliplier-based model, concluded that a US$ 10 billion investment in broadband had the potential to create 498,000 jobs. This implies a total employment multiplier effect of 7.82 (per US$ million of investment), of which 4.22 is due to network effects. This implies a cost of US$ 20,082 per job created.
- BCG (2009)[35] completed a bottom-up cost-benefit case study analysis of Bangladesh, Serbia, and Thailand's broadband plans in 2009. They concluded that expanded Internet use would contribute between 2.6% to 5.2% to GDP by 2020, due mostly to productivity enhancements.
- Crandall & Singer (2010)[36] updated an earlier analysis by Crandall, Jackson, and Singer (2003)[37] that had sought to forecast broadband investments and the resulting economic impacts. They concluded that based on actual performance between 2003-2006 that their earlier study had significantly under-estimated the likely impacts, and while acknowledging the serious difficulties associated with providing precise estimates, they offered revised estimates of expected broadband investment and its economic impacts from 2010-2015. They conclude that cumulative investments of US$ 182.5 billion (averaging US$ 30.4 billion per year) over the period will result in an average of 509,546 jobs being sustained (implied multiplier of 16.8 or cost of per job created of US$ 59.7 thousand) and cumulative increment to GDP of US$ 542.1 billion (implied GDP multiplier of 2.97).
- Eisenach, Singer et al. (2009)[38] examined the likely impact of tax incentives for more rapid broadband investment in the United States. Their analysis anticipated an employment multiplier effect of 14.7 to 19.7, depending on the type of broadband infrastructure to be deployed; and, a GDP multiplier of between 2.9 to 3.1.
- Fornefeld et al. (2008)[39] looked at European plans for broadband deployment and sought to estimate the economic impacts over the period from 2006-2015. They used a bottom-up approach combined with input/output analysis to identify a number of ways in which broadband may contribute to economic growth. They found that increased broadband would add 0.71% to GDP growth and a net increase in jobs of 105,000 per year in 2006. They also

sought to account for displacement effects (the impact of investing in broadband instead of something else), which results in net job creation that is significantly smaller than the gross estimate of jobs that would be created (which is 1.3 million).

- Katz and Sutter (2009)[40] also sought to estimate the impact of broadband stimulus funding and relied on a multiplier model. Their estimate implied an employment multiplier of 7.07, with 3.65 due to network effects. Their analysis implied a cost per job created of US$ 24,261.
- Katz, Vaterlaus et al. (2009)[41] used a variety of methods, including a multiplier-based approach to forecast the benefits in terms of GDP impacts and employment creation from the German broadband stimulus plan. Their analysis forecasted that from 2010-2020, the German's plan to spend EUR 35.9 billion (US$ 47.7 billion) would create 968,000 jobs and result in incremental benefits to GDP of EUR 170.9 billion (US$ 226.9 billion). Their analysis implies a jobs multiplier of 20.29 (per US$ million invested), of which 8.95 is attributed to externality effects. They estimated a GDP multiplier of 4.76, of which 3.83 is attributed to externality effects. They also included a regression analysis for Germany using data for 2003-2006 and found that a 1 percent increase in BB penetration would result in a 0.025% increase in per capita GDP.

In summary, therefore, the research literature provides compelling evidence that broadband does contribute significantly to economic growth and productivity improvements.

Estimating the Macroeconomic impacts of Broadband in Egypt

The literature reviewed above suggests two approaches for providing estimates of the macroeconomic impacts of broadband that may be linked to the EBMM. The first approach relies on the results from the cross-country econometric analyses of the relationship between GDP and broadband penetration, and uses the EBMM forecasts of broadband penetration. The second approach uses broadband investment multipliers to project employment and GDP growth effects, using the EBMM forecasts of broadband investment.

Both of the methods are demonstrated by applying them to the base case EBMM scenario for "Medium Growth/Own Infrastructure" which is detailed in the July 2011 EBMM model. The relevant data from the model are reproduced in Table 4.

Method 1: GDP and BB Penetration

The basic methodology is to use the EBMM estimates of broadband penetration increase on an aggregate level and use those estimates to derive augmented GDP growth forecasts, based on multipliers derived from the academic literature described above. Application of this approach is demonstrated in Table 5 and is explained further below.

- The earlier analysis concluded that annual GDP increased by between 0.018% to 0.150% per 1% increase in broadband penetration.
- The EBMM scenario detailed in Table 4 forecasts penetration growing from 3.0% in 2010 to 36.7% by 2020
- The EBMM reports GDP in the base year (2009) as US$ 605.73 billion and a growth rate of 4.6% per year. This is used to construct a base case scenario for GDP growth in the absence of the planned broadband investments. If a better forecast of GDP is available, it may be substituted here.

- The increases in penetration by year are applied to the multipliers (both low and high) to obtain revised forecasts for GDP. Because GDP is growing the benefits of broadband are compounded. These revised estimates of GDP with the broadband plan are compared with the base GDP scenario to compute the incremental contributions to GDP by year.

Using this method, the cumulative contribution from 2010-2020 to GDP is US$ 5 to US$ 42 billion. Relative to the initial year GDP (2010), broadband increases GDP by 0.8-6.6%.

Several significant caveats apply to this estimate:

- The econometric analyses on which these estimates are based are derived principally from studies of more developed OECD countries that have much higher levels of broadband penetration. There is some evidence (Waverman, 2009) that there are increasing returns to broadband adoption and that some minimum level of penetration must be achieved for broadband to have a significant impact on output. This is plausible since broadband must be used in conjunction with other ICTs, and thus, one might expect that the magnitude of macroeconomic impacts might be related to the level of eReadiness.[42]
- The estimates from the econometric analyses are marginal estimates and it is a big jump to assume that GDP-broadband elasticities would remain constant over the large changes in penetration assumed in this analysis (a 34% increase).

Method 2: Broadband Investment and Multipliers

The second approach for estimating macroeconomic impacts in the EBMM is to use the EBMM forecast of broadband investment and estimates of the employment and GDP multipliers derived from the research literature to estimate the macroeconomic impacts associated with the broadband plan. Application of this approach is demonstrated in Table 6 and is explained further below.

- The earlier analysis concluded that employment multipliers were in the range of 35-50 (jobs per year for each US$ 1 million in infrastructure investment); and GDP multipliers were in the range of 4.8 to 6.7 (US$ additional GDP per US$ of infrastructure investment).
- The baseline scenario projects total investment of US$ 7.184 billion from 2010-2020.
- The multipliers may be applied to the annual investment to derive forecasts of the jobs and GDP impacts. The GDP is reported as cumulative, but the jobs are reported as averages.

Application of this approach suggests that the broadband plan will result in between 25 to 36 thousand jobs being sustained, and will add between US$ 35 to US$ 48 billion to GDP over the period from 2010-2020.

There are several important caveats that apply to these forecasts:

- As with the first method, the research studies on which the multipliers are based are derived from the study of OECD countries that are more developed and have higher penetration rates than Egypt, which may impact the applicability of those results.
- The relationship between investment in broadband infrastructure and job creation and GDP growth in Egypt may not be appropriately estimated using multipliers derived from analysis of OECD countries because of systematic differences in relative prices (e.g., wages). It might be appropriate to adjust the job impacts upward to reflect a purchasing power parity adjustment. On the other hand, a greater share of the costs of broadband investment may be associated with imports of foreign capital, which may tend to reduce the multipliers.

Sensitivity Analysis

The macroeconomic impact estimates provided herein are intended to be used in conjunction with the EBMM. The EBMM allows users to vary a number of input assumptions. One important set of assumptions relate to the scenarios. The EBMM allows the user to select between low, medium, and high broadband subscriber growth trajectories (with the medium trajectory selected as the base case). And, for each subscriber growth trajectory, the model allows the user to choose among three infrastructure investment models: “Own infrastructure” (which is taken as the base case and is the most investment intensive of the three); “Leased lines” (which is the least expensive option); and, “Public Utility.” Table 7 summarizes the six possible scenarios in terms of the data relevant for estimating macroeconomic impacts (subscriber penetration targets and investment trajectories).

The base case (medium growth, own infrastructure) is bracketed by the results of the (low growth, leased lines) and (fast growth, own infrastructure) scenarios. Table 8 summarizes the macroeconomic impacts using the subscriber penetration and investment trajectories of these extreme scenarios.

From this table, the first method produces estimates of cumulative GDP impacts that range from a low of US$ 3 billion (Slow, Leased Lines) to a high of US$ 57 billion (High, Own Infra), which bracket the results reported above of US$ 5 - US$ 42 billion (Med, Own Infra).

Similarly, the second approach projects an incremental contribution to GDP from broadband that ranges from US$ 17 - US$ 67 billion, compared with the base case result of US$ 35 - US$ 48 billion. The second method produces estimates of average jobs created that range from a low of 13 thousand to a high of 50 thousand, which bracket the results reported above of 25-36 thousand.

Applying the Results and Further Thoughts

As should be clear by now, the estimates of macroeconomic impacts associated with different broadband deployment scenarios are inherently uncertain. In addition to the caveats already discussed regarding the extant academic literature and its applicability to the case of Egypt, there are a number of additional considerations that are worth noting.

Forecasts most useful for comparison accounting

The goal of these estimates is less to provide reliable forecasts than to provide a rough tool for evaluating high-level aggregate broadband policies. The broadband policies were offered at a high level of aggregation and without much specificity as to precisely how broadband would be priced or what complementary programs may accompany broadband deployment (e.g., industry-sector-specific ICT plans). Local context matters a lot. How broadband is used (by whom, for what purpose) and with what complementary resources (quality of labor-force, availability of computers and application software) may be expected to have a big impact on the benefits that are realized. Of special importance, the EBMM does not distinguish between subscriber lines that will be used by business and by consumers. It is reasonable to anticipate that the greatest near-term economic impacts of increasing the quality of advanced telecommunications infrastructure, including broadband, may be associated with providing services to businesses. In the developed OECD markets, businesses are generally assumed to be well-provided with access to broadband. The studies that underlie the analysis presented here have focused on the expansion of mass-market broadband which is especially relevant to consumers and small to medium businesses. However, all businesses may benefit when broadband enables new modes of connecting with customers (e.g., eCommerce, customer relationship management) and of organizing work (e.g., telecommuting).

Forecasts do not account for productivity differences by technology

While the EBMM forecasts deployment trajectories for different broadband technologies, including both mobile and fixed infrastructure, there is no reasonable basis in the literature for allowing the mix of technologies to impact the macroeconomic forecasts at this time (other than via how modifying pricing or technology mix assumptions may impact investment). It is reasonable to hypothesize that mobile and fixed broadband may have different economic impacts. For example, Crandall & Singer (2010) estimate larger job impacts associated with FTTH than for mobile BB because they assume that FTTH will require more investment in labor-intensive construction. Alternately, one might suppose that fixed and mobile broadband services may differ with respect to quality – but which is better may depend on ones usage model. Typically, fixed services may offer higher data rates, while mobile broadband offers the advantage of "mobility." Accounting for how the different value propositions offered by fixed and mobile services are likely to impact their adoption, usage, and ultimately, their impact on economic growth and productivity are important research questions, but ones to which there are no solid empirical answers yet.

Forecasts do not account for line sharing behavior

Moreover, and related to the preceding point, mobile services tend to be personalized (a single user uses a mobile broadband line), whereas fixed services tend to be shared among multiple users in a household. In Egypt, line sharing is especially prevalent as many lines are shared among multiple households. This sort of line sharing has multiple impacts. On the one hand, it reduces broadband provider revenues (US$ per subscriber) and increases provisioning costs for backhaul (or reduces quality if additional capacity is not put in place to handle the traffic of the larger number of users per subscriber line). On the other hand, line sharing may expand the user-base for broadband. Beyond the direct and indirect stimulus effects of investment in broadband infrastructure, broadband produces important spillover benefits when it is used.

Forecasts do not account for broadband incremental value

Fourth, the analysis presented here does not differentiate between the value added by Internet access and the incremental value added by broadband (assuming lower quality Internet access is already available). Greenstein and McDevitt (2009)[43] attempted to estimate the incremental benefits of broadband in the United States. While they still attributed a sizable portion of growth to broadband, their estimates were significantly smaller than those produced by other researchers, including many of those cited herein. In the United States, where basic Internet access was well-established before significant investments were started to enable broadband access, their analysis was relevant. Although even in the U.S., there are good reasons Greenstein and McDevitt's estimates are excessively conservative. The methodology they employ does not adequately account for the ways in which broadband may significantly alter the landscape of Internet markets and usage. In Egypt, where Internet adoption remains low and the quality of broadband is not likely to be very high at least initially, attempting to distinguish between the value of Internet access and the additional value of broadband is neither desirable nor feasible with the available data at this time.

Forecasts do differentiate impacts based on rural/urban or SIC mix

While the EBMM provides significant detail on broadband deployment plans in terms of the geographic distribution of broadband, the macroeconomic impacts are provided only on an aggregate basis. As with the discussion of technology, it is reasonable to suspect that broadband may have different economic impacts in rural versus urban communities, and for communities with different mixes of industry. There is evidence that broadband has different impacts by industrial sector, which is reasonable since we know that the ICT intensity varies across sectors. For example, the service sector, and more specifically, finance and insurance, are much more IT intensive than, say, agriculture. Unfortunately, the current research on broadband impacts is not sufficiently advanced to provide a reasonable basis for estimating differential impacts by SIC sector or rural/urban mix. Moreover, even if such data were available, the EBMM does not include adequate data about the geographic distribution of industry and employment, or wages and IT intensity to support a reasonable disaggregation of macroeconomic impacts that accounts for such things as rural/urban or SIC mix variation.

Benefits in less developed markets may be higher than expected

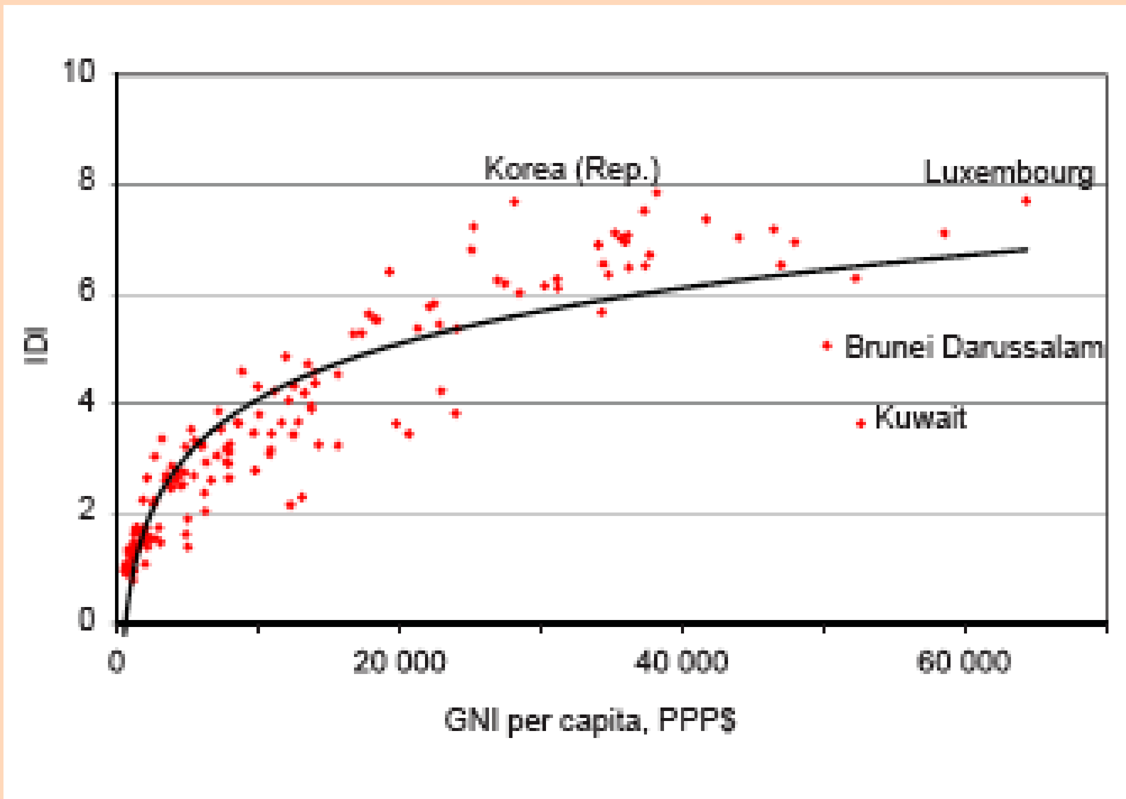
Finally, while there is evidence in the macroeconomic impacts literature that suggests that significantly positive broadband economic impacts may be limited or non-existent in less-developed markets with low penetration rates (Waverman, 2009), I believe the evidence remains incomplete. First, it is worth remembering that data for developing countries is usually much poorer and noisier than for the developed OECD countries. Whatever measurement problems plague studies based on more developed markets are usually worse in developing countries. There are significant differences in the cost of factor inputs and much of the output is unmeasured (e.g., gray market).

Second, at low levels of development, the economic impacts of investments in broadband are likely to be highly context dependent. While it is reasonable to believe that the lack of broadband infrastructure is positively correlated with deficits in other complementary resources that are needed to fully exploit broadband, that does not mean that returns are monotonically increasing. It is quite possible that returns may actually be much higher than aggregate studies currently suggest (a result that is obscured by noise in the data, just as data noise obscured earlier efforts to detect a positive impact for ICT more generally). For example, Jensen's 2007 study of south Indian fishery markets and the effects of cell phone use illustrated how a little ICT in the right circumstance can produce dramatic economic effects.[44] Similarly, there is substantial evidence of the positive economic benefits from expanding competition and market liberalization, not just for telecommunications services but more generally. Even relatively small investments in broadband of the correct kind have the potential to significantly alter the competitive landscape and stimulate significant economic growth.

Annex – Figures and Tables

Figure 1: ICT & Economic Development[45]

Chart 2.4: IDI and GNI per capita, 2008



Source: ITU and World Bank.

Figure 2: Internet Subscribers Exceed 2 Billion[46]

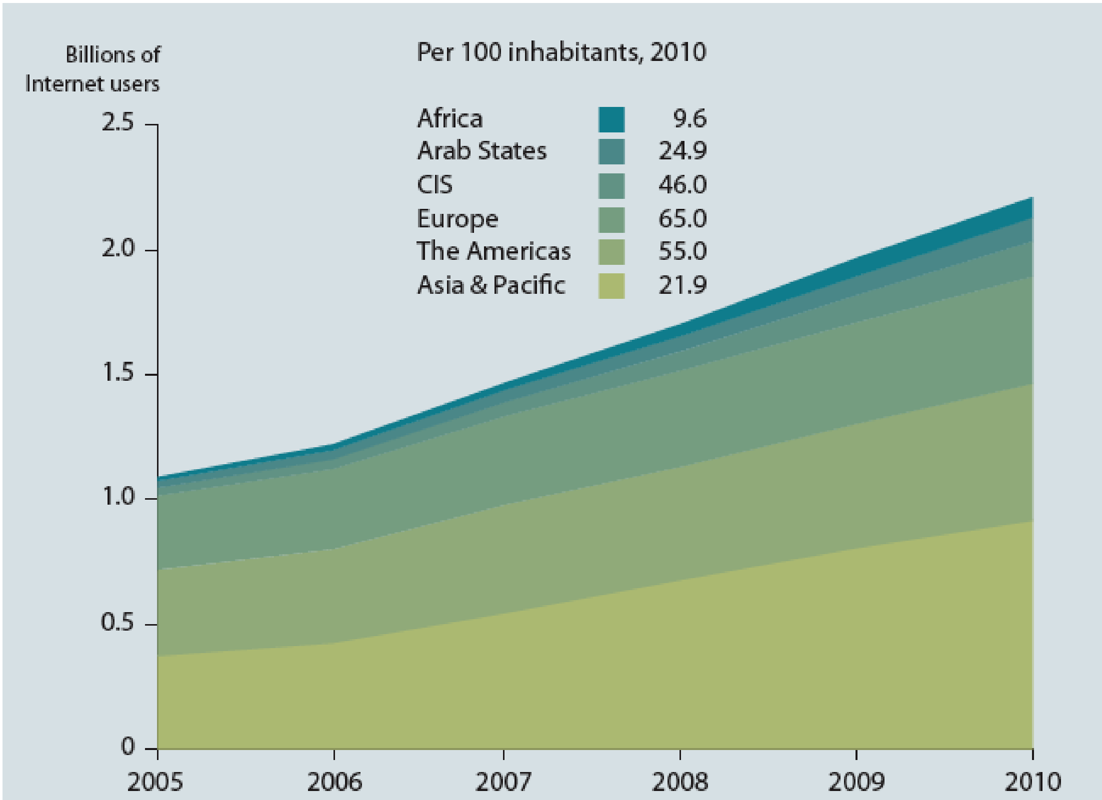


Figure 3: Digital Divides Persist[47]

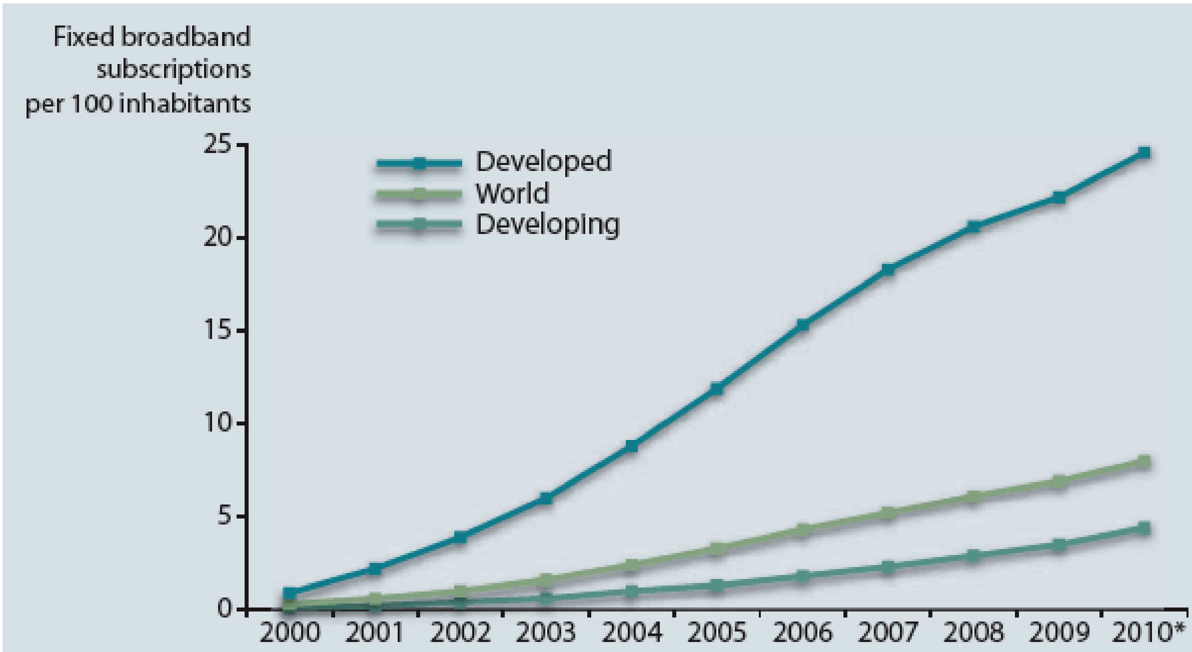


Figure 4: OECD Broadband Adoption Rates[48]

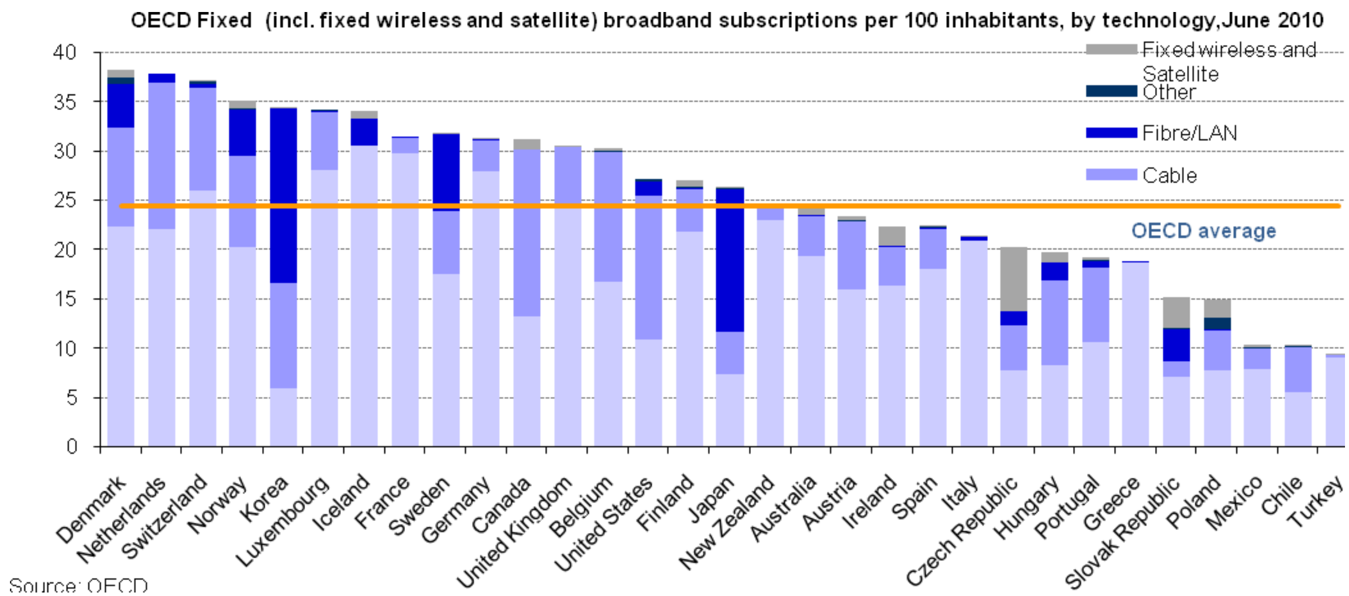
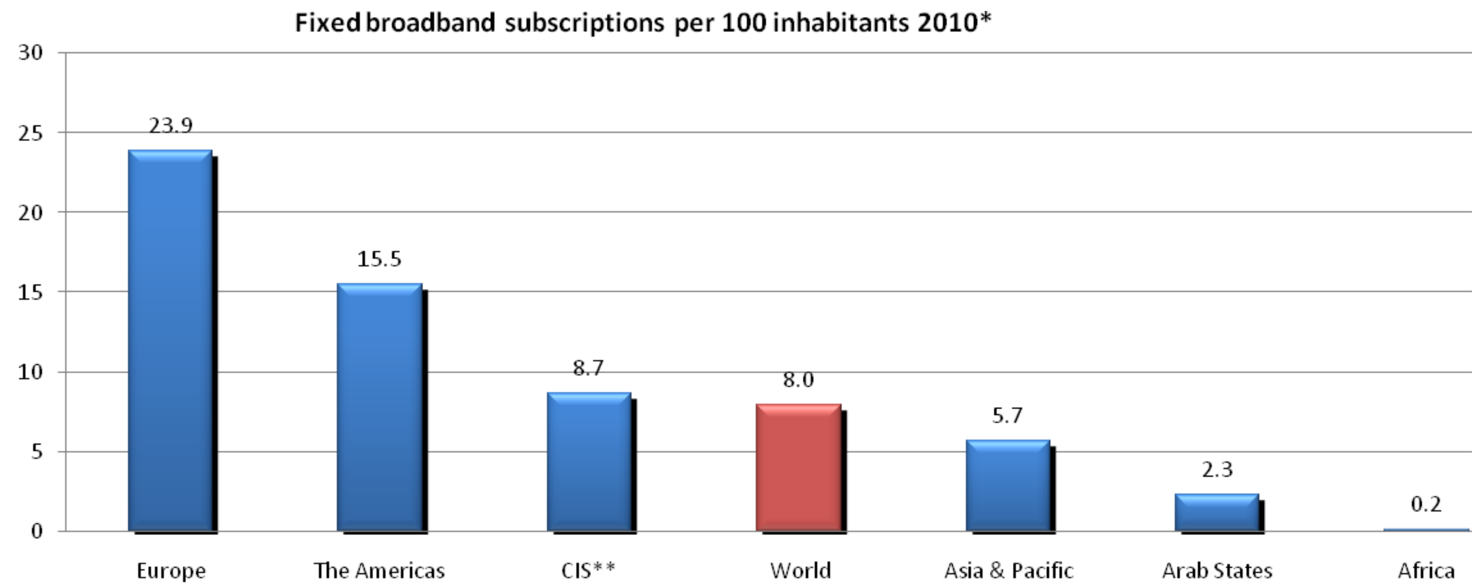


Figure 5: Worldwide Broadband Penetration Rates[49]



* Estimate
** Commonwealth of Independent States
Regions are based on the ITU BDT Regions, see: http://www.itu.int/ITU-D/ict/definitions/regions/index.html
Source: ITU World Telecommunication /ICT Indicators database

Figure 6: Mobile Broadband Penetration Worldwide[50]

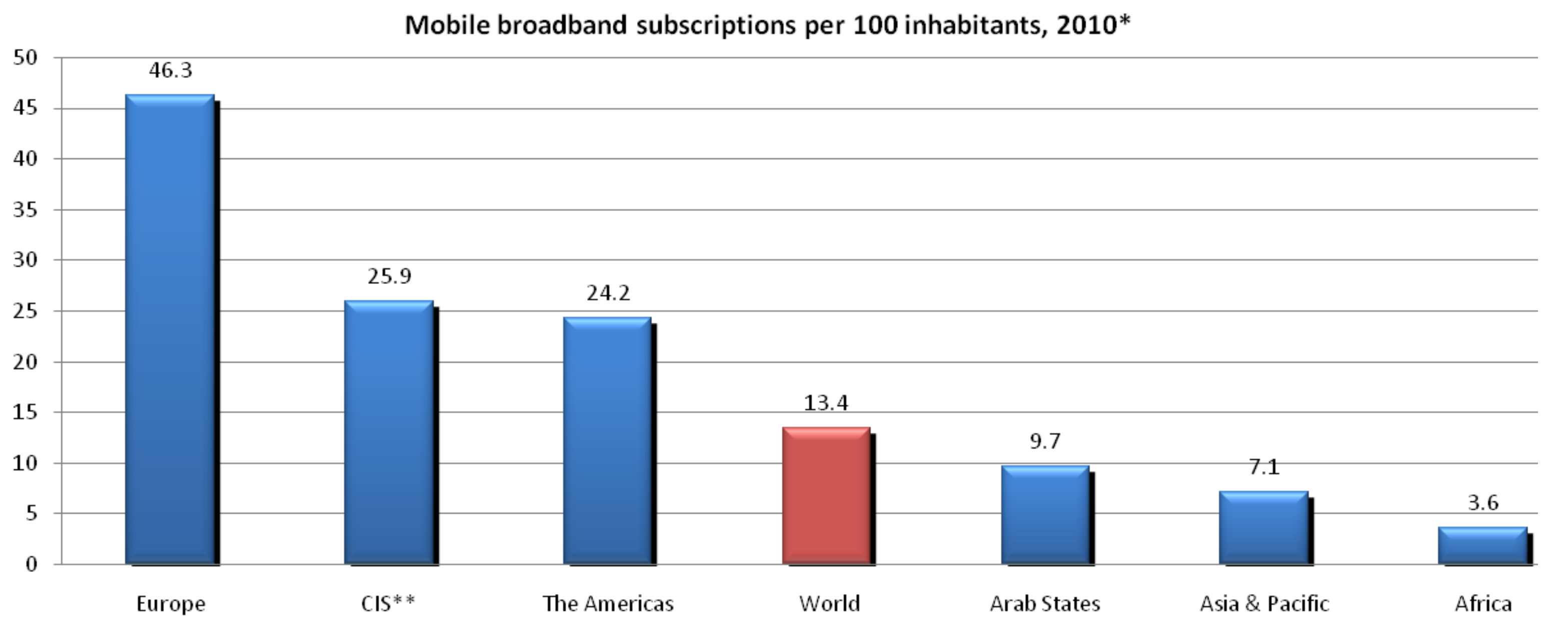


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Table 2: Econometric Studies of Broadband Economic Impact

Table 2: Econometric Studies of Broadband Economic Impact			
Authors	Study	Employment	GDP
Lehr, Gillett, et al. (2005)	US zip-code level (1999-2002 data)	1-1.4% higher employment growth in zips with BB by 1998.	
Lehr, Litan & Crandall (2007)	US state-level (2003-2005 data)	2-3% higher employment per 10% higher penetration	
Czernich et al (2011)	OECD panel 1996-2007		0.9-1.5% higher per capita GDP growth with 10% BB penetration… contribution to GDP growth is amplified by (1+pop growth)
Franklin, Stam & Clayton (2009)	European panel 2001-2005 of firm-level productivity	High-speed BB enhances employee productivity, but critical mass required	
Katz & Avila (2010)	Econometric analysis of panel of 24 countries in Latin America and Carribbean with data from 2004-2008.	Employment effect estimated of 1% BB penetration resulted in 0.18% increase in employment (Chile)	GDP impact is 1% BB penetration resulted in 0.0178% increase in GDP growth.

Koutroimpis (2009)	EU15 countries from 2003-2006, BB investment impact on GDP in multi-equation model.		0.26-0.38% higher GDP growth with 10% increase in penetration; with evidence of critical mass effect (above 20% per population penetration)
OECD (2011)	EU country study looks at 1980 to 2009 data		10% higher BB penetration results in 1.09% faster GDP growth. 10% faster IPv4 address per capita growth, 0.4% higher GDP.
Waverman (2009)	EU14+US 1998-2007 econometric analysis of BB impact		Productivity increased 0.0013 per % increase in BB penetration for MEDHIGH and no effect for LOW BB Penetration countries.

Table 3: Forecast and Bottom-up Models of Broadband Impacts

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Author	Study	Employment Effects	GDP Effects
Atkinson et al. (2009)	Estimate the impact of BB stimulus plan in US based on Input/Output multiplier estimates and literature	Employment multiplier of 49.8, with contribution from network effects of 26.8. Results in cost per job created of US$ 20,082.	
BCG (2009)	Cost-benefit case study analysis of Bangladesh, Serbia, and Thailand broadband plans in 2009.		Internet expected to add 2.6-5.2% to GDP by 2020, due mostly to productivity enhancements.
Crandall and Singer (2010)	Forecast of economic impact of U.S. broadband investment 2010-2015	Expect total investment of US$ 182.5 billion (US $30.4 billion average per year) to result in 509,546 jobs (16.8 multiplier, or cost per job created of US$	GDP multiplier of 2.97
Eisenach, Singer et al (2009)	US BB tax incentives for investment in BB investigated	Employment multiplier per US$ Million CAPEX 14.7-19.7	GDP multiplier per US$ of incremental CAPEX infra is 2.9-3.1

Fornefeld et al (2008)	EU27 study of BB economic impact due to adoption by businesses 2004-2006. Forecasts EU27 BB plans impacts on GDP and jobs.	BB added 105 thousand net jobs, with 1,319 lost due to displacement and 1,424 added due to new activity growth	BB added EUR 84 billion net to EU27 GVA in 2006, or 0.71% growth.
Katz & Sutter (2009)	Estimate the impact of BB stimulus plan in US based on Input/Output multiplier estimates and literature	Employment multiplier of 41.2, with contribution from network effects of 21.2. Results in cost per job created of US$ 24,261.	
Katz, Vaterlaus et al. (2009)	German National BB strategy impact from 2010-2020; basic and ultra BB plan for total investment of EUR 35.9 billion	Type II multiplier 19.95, Externality mult 15.75, total 35.70 (mult converted to US$ per million CAPEX)	Type II multiplier 0.93, Externality mult 3.83, for total of 4.76 (mult converted to US$)

Table 4: EBMM "Medium Forecast/Own Infrastructure" Scenario (July 2011)

Year	2010	2011	2012	2013	2014	2015
Broadband Subscriber Lines	2,357,011	3,297,157	4,567,509	6,310,484	8,510,081	11,405,964
Population	77,775,000	79,011,223	80,267,095	81,542,929	82,839,042	84,155,757
Total Investment (US$/millions)	0	322	313	429	527	661
Penetration	3.0%	4.2%	5.7%	7.8%	10.4%	13.7%
Year		2016	2017	2018	2019	2020
Broadband Subscriber Lines		15,069,668	19,351,470	23,946,989	28,703,530	33,439,356
Population		85,493,401	86,852,307	88,232,812	89,635,260	91,060,000
Total Investment (US$/millions)		837	957	1,023	1,057	1,058
Penetration		17.6%	22.3%	27.1%	32.0%	36.7%

Table 5: EBMM Macroeconomic Impacts estimated with GDP-Broadband Penetration Elasticity

"For each 1% increase in broadband penetration, GDP growth increases by X%"

GDP-Broadband Penetration -- Low Multiplier	0.018%
GDP-Broadband Penetration – High Multiplier	0.150%
Base year GDP (2009, US$ billions) (from EBMM)	$ 605.73
Growth rate GDP (from EBMM)	4.6%

Year	2010	2011	2012	2013	2014	2015	2010-2015	
GDP Base Forecast (US$ billion)	$633.59	$662.74	$693.22	$725.11	$758.47	$793.35		
Annual increase penetration	0	1.14	1.52	2.05	2.53	3.28		
GDP rev (low multiplier)	$633.59	$662.87	$693.40	$725.37	$758.80	$793.80		
GDP rev (high multiplier)	$633.59	$663.82	$694.73	$727.24	$761.22	$797.09		
GDP incr (low multiplier)		$0.13	$0.18	$0.26	$0.33	$0.45	$1.35	
GDP incr (high multiplier)		$1.09	$1.51	$2.13	$2.76	$3.73	$11.21	
Year		2016	2017	2018	2019	2020	2016-2020	2010-2020
GDP Base Forecast (US$ billion)		$829.85	$868.02	$907.95	$949.72	$993.40		
Annual increase penetration		4.07	4.65	4.86	4.88	4.70		
GDP rev (low multiplier)		$830.43	$868.72	$908.71	$950.51	$994.21		
GDP rev (high multiplier)		$834.70	$873.82	$914.28	$956.37	$1,000.10		
GDP incr (low multiplier)		$0.58	$0.70	$0.76	$0.80	$0.80	$3.64	$4.98
GDP incr (high multiplier)		$4.85	$5.79	$6.33	$6.65	$6.70	$30.31	$41.52

Table 6: EBMM Macroeconomic impacts estimated using the Investment Multiplier Approach

	Employment multipliers (jobs/US$ million invested)	GDP Multipliers (US$ GDP/US$ Invested)
Low	35	4.8
High	50	6.7

Year	2010	2011	2012	2013	2014	2015	2010-2015	
Broadband Investment (US$ million)	$-	$322	$313	$429	$527	$661	$2,252	
Employment (low multiplier)	-	11,270	10,955	15,015	18,445	23,135	15,764	
Employment (high multiplier)	-	16,100	15,650	21,450	26,350	33,050	22,520	
GDP (low multiplier) (US$ billion)	$-	$1.5	$1.5	$2.1	$2.5	$3.2	$10.8	
GDP (high multiplier) (US$ billion)	$-	$2.2	$2.1	$2.9	$3.5	$4.4	$15.1	
Year		2016	2017	2018	2019	2020	2016-2020	2010-2020
Broadband Investment (US$ million)		$837	$957	$1,023	$1,057	$1,058	$4,932	$7,184
Employment (low multiplier)		29,295	33,495	35,805	36,995	37,030	34,524	25,144
Employment (high multiplier)		41,850	47,850	51,150	52,850	52,900	49,320	35,920
GDP (low multiplier) (US$ billion)		$4.0	$4.6	$4.9	$5.1	$5.1	$23.7	$34.5
GDP (high multiplier) (US$ billion)		$5.6	$6.4	$6.9	$7.1	$7.1	$33.0	$48.1

Table 7: EBMM Scenarios Summarized

			Investment (US$ billion, 2010-2020)		
	Subscribers	Penetration	Leased Lines	Utility	Own infra
	2020	2020			
Slow	19,069,437	23%	$3,614	$4,164	$4,213
Medium	33,439,356	37%	$6,749	$6,929	$7,184
Fast	45,844,380	50%	$9,345	$10,281	$10,023

Table 8: Macroeconomic impact sensitivity analysis

	Medium, Own Infrastructure			Slow, Leased Line			Fast. Own infra		
Summary	2010-2015	2015-2020	2010-2020	2010-2015	2015-2020	2010-2020	2010-2015	2015-2020	2010-2020
Subcribers (first year)	2,357,011	11,405,964	33,439,356	2,357,011	7,006,980	19,069,437	2,357,011	17,581,266	45,844,380
Penetration (first year)	3.0%	13.6%	36.7%	3.0%	8.3%	20.9%	3.0%	20.9%	50.3%
Investment (US$ billion) (sum)	$2,252	$4,932	$7,184	$1,013	$2,601	$3,614	$3,656	$6,367	$10,023
GDP incr (US$ billion) (low GDP-penetration)	$1.35	$3.64	$4.98	$0.68	$2.00	$2.67	$2.28	$4.60	$6.88
GDP incr (US$ billion) (high GDP-penetration)	$11.21	$30.31	$41.52	$5.64	$16.63	$22.27	$19.00	$38.31	$57.31
Employ incr (low-mult invest)	15,764	34,524	25,144	7,091	18,207	12,649	25,592	44,569	35,081
Employ incr (high-mult invest)	22,520	49,320	35,920	10,130	26,010	18,070	36,560	63,670	50,115
GDP incr (US$ billion) (low GDP-invest mult)	$10.8	$23.7	$34.5	$4.9	$12.5	$17.3	$17.5	$30.6	$48.1
GDP incr (US$ billion) (high GDP-invest mult)	$15.1	$33.0	$48.1	$6.8	$17.4	$24.2	$24.5	$42.7	$67.2

Chapter 3.1

BROADBAND IMPACT ON THE ECONOMY: EDUCATION

Background

The explosion of the Internet in the 1990s ushered in a wave of ICT and education policies and projects designed to prepare students to effectively engage in the information age. More often than not, the programs had an inordinate focus on the technology and very little emphasis on the educational objectives of the investment. Most programs did not take a holistic approach to ICT, and failed to link the educational goal of expanded ICT use to necessary associated reforms of the curriculum, student assessment system, pedagogical approaches in the classroom, and teacher training.

Since 2000, the emergence of an increasingly interconnected and digital world has begun to transform the demand for skills from an industrial economy focused on specific repetitive skills to a knowledge economy focused on finding creative solutions to an ever changing set of problems. Education systems have in general been slow to respond to this new demand. They have tended to focus first on technical ICT skills and only recently have begun considering the full range of "21st century skills" which ask students to think creatively, problem solve, effectively communicate, identify and analyze existing information and create knowledge.[51]

In step with the changing educational objectives and in part due to research on how people learn, a range of pedagogical approaches have also been advanced as the most effective ways to engage learners to develop this skill set. These approaches include student-centered learning, active learning, project-based learning, and inquiry based learning to name a few. While the integration of ICTs into the learning process holds great potential to enhance these pedagogies and the development of a "21st century skill set", the implementation in most countries to date has fallen short of this promise.

The following is a general characterization of how a typical country's ICT in education policies have affected a typical school. The Ministry of Education (MOE) would finance investments (usually directly procured by the MOE or a related agency and delivered to the school in-kind) to equip the school with a room designed to be the computer lab. This room would be managed by a technician who had some understanding of computers but little understanding of how to use them for educational purposes. The lab would be timetabled for basic computer literacy classes for the students with very little time for teachers to use it either for their own skill development or to access or prepare digital resources for their own classroom teaching.

Training of teachers would be mostly done through ad hoc in-service training offered by NGOs or private companies. Most teachers' training is focused on basic ICT literacy skills -- explaining the functioning of a computer and the use of programs such as word processing, spreadsheets, and power point. Some of the more advanced countries launched programs to explore the integration of technology into subject matter teaching – many with a focus on collaborative, project-based learning methodologies. While the pedagogy of project-based learning using the Internet resonated with many teachers, most found it difficult to actually integrate this learning into their day to day lessons. Computer labs were in limited supply and it was logistically difficult to bring an entire class to a new learning environment. Moreover, at the end of the day the curriculum did not support this pedagogical approach. The national assessment system did not include any evaluation of students' computer skills nor 21st century skills and thus did not create incentives for teachers to shift from standard "frontal" teaching methods or from a focus on getting students prepared to memorize facts and perform well on the standardized assessment. Only the most enterprising teachers continued to engage in ICT-facilitated project-based learning, mostly as an extra-curricular activity and a means to break down the barriers of the school and interact with like-minded teachers around the world.

The introduction of ICT in education has been accompanied by an unprecedented growth in public-private partnerships in education. Most of the partnerships have been welcomed by systems of education that found themselves out of their depth in understanding the technologies and lacked resources to purchase and support the necessary infrastructure. At the same time, these partnerships have proved to be a challenge for Ministries to manage. The range of solutions presented by an array of different private sector partners often leaves policymakers confused and unable to sift through the technology options and find the most appropriate solution.

Despite efforts in virtually every country to keep pace with the global information revolution, education systems have been largely unable to stay as current as the average teenager with a computer at home (or a phone in her pocket). With access to a computer and the Internet, students have generally acquired ICT skills outside of the classroom at a much quicker pace than the schools have provided. This skill disparity has created pressure on teachers to stay relevant and on schools to provide the same access opportunities to less fortunate students in their countries. Today's learners want to be active participants in the learning process – not mere listeners; they have a need to control their environments, and they are accustomed to easy access to a staggering amount of content and knowledge available at their fingertips. How to make sense of this explosion of access to information: to find it, assess its validity, analyze its importance and relevance, 're-mix' it into new forms of information, share the results with others, and, ultimately, to transform information into relevant knowledge for action. These are challenges that education systems around the world must rise to meet.

This paper, as part of the broader, broadband study will review recent experience in Egypt with regard to implementation of ICT in education, share views on global trends in the field, explore global practice in critical areas related to broadband deployment and suggest potential opportunities for how broadband could further support Egypt's education reform initiatives and leverage future trends.

Egypt overview

The Government of Egypt gives educational reform a high priority on its agenda. In fact, education receives about one-third of Government spending on the services sector. The government has focused recent attention on a few critical questions -- how to make this investment more efficient? How to use ICT investments as a lever for reform? A further question that has emerged from recent events in Egypt is how to channel to the energy, passion and technological prowess of the Arab spring to transform education?

Egypt's public education system consists of a total of 40,868 schools comprising approximately 389,033 classes. The system services approximately 15,424,478 students with 810,000 teachers of which 47,600 are ICT teachers (6% of teaching staff).

Recent policy measures to infuse ICT into teaching and learning in Egypt include[52]:

- ***Incorporate technology into the curricula*** – a focus has been placed on the pedagogic use of ICT through curriculum reform for all subjects; the introduction of performance standards; an emphasis on a contructivist pedagogical model; emphasis on active learning; and more comprehensive integration of assessment and ICT.
- ***Enhance ICT infrastructure in schools*** – The government has invested in computer labs at 4,611 schools (11% of total population of schools) with high speed connections at 152 schools (.4%) and dial up at 22,000 (53%). Moreover, multimedia labs have been deployed at 1,800 pre-primary (27%); 11,925 at primary (72%); 6,195 preparatory (68%) and 1,205 secondary schools (53%). Over 80% of all schools have some computers and over 70% of schools have some connectivity. Schools however at pre-primary through general secondary have on average 2 computers per school, with technical secondary schools at around 12.
- ***Build human resources*** – The focus has been on development of IT teachers and training of subject matter teachers. For both teacher and technicians, the system is experiencing a deficit with 62% deficit among technicians and 22% among teachers at preparatory and secondary levels[53].
- ***Enhance EMIS, SMS (school management system) availability and usage*** – The government has deployed an online EMIS at central level and local level; SMS has been deployed at only 38 schools.
- ***Use distance learning for professional development*** – The government has installed a national video conference network for teacher training at 63 sites around the country.
- ***Support private-public partnerships for ICT deployment***.

The following challenges[54] have been identified in the implementation of this policy. First, the approach has been criticized as overly input oriented without sufficient focus on educational outcomes. Also, the monitoring and evaluation systems needed to determine outcomes and impact have been equally insufficient. The implementation of the policy has suffered from lack of coordination between providers and overlapping roles and responsibilities among government agencies. On the infrastructure front, replacement costs and strategies have not been factored for how to deal with obsolete and outdated technologies through maintenance and upgrading. Finally, improvements are needed in development of human resource capacity including trained teachers and technicians at the school level.

The learning and technology framework in Egypt is summarized below:

Figure 1: Learning and Technology Policy Framework in Egypt[55]

One of the program evaluations reviewed for the desk research was the monitoring and evaluation[56] results of the Egypt Education Initiative which was conducted in 53 schools in 15 governorates and measured the expected performance change in two areas: the use of ICT tools and applications at school and teachers pedagogical practice.

The results of the evaluation were as follows:

- Around 72% of the surveyed schools have a website but only 50% of the schools developed these sites during the period of the project.
- 69% of school staff has email accounts – most teachers opened their accounts during the ICT training and use the account to communicate with friends and relatives (42%) as opposed to colleagues and students (19%)
- 74% of schools use ICT for administration including staff data (63%) and student data (49%), while one 35% used it for budget and 7% for communication with staff and 5% for communication with parents.
- Only 31% of schools report use of their school management system (SMS)

- 92% of teachers report use of ICT in teaching and learning activities, however, only 30% use it 3 or more times a week. They use either subject specific material downloaded from the web or power points that they have produced. 49% assign subject-specific projects and assignments for students to work on.
- 52% of teachers use ICT to develop students' ability to undertake independent learning and 53% stated that they assign tasks for students to search for information using ICT. However, only half of the students successfully complete these tasks.
- 49% of teachers involved provide opportunities for students to get involved in cooperative and project-based learning through ICT. Most of this work occurs outside of the classroom period due to need for extensive interaction with computers.

The evaluation concluded that some challenges include:

- Lack of support from school leadership
- Lack of incentives and supportive environment for use of ICTs
- Lack of know-how on integrating ICT in education.
- Teachers do not engage students in production of knowledge
- Teachers use of ICT for communication with pupils is still in its infancy

Major recommendations include the need to go beyond IT training programs that emphasize use to more specialized training to integrate technology into day to day teaching and learning; broader use of mentors; and engagement in an extensive school change process.

Global ICT and Education Policy Directions

As Egypt takes stock of its experience to date and reviews the role of broadband for the reforms its pursuing, it is important to be cognizant of international policy directions in this field. In relation to ICT in education policies[57], during the last two decades, the tendency in many developed countries has been to start with the provision of infrastructure, (productivity) software and ICT skills training in order to ensure access to ICT. This initial stage of policy implementation was in many cases accompanied with government policies aimed at the infusion of ICT in the society and/or industry. Following this initial stage, countries defined policies that showed an emphasis on creating support mechanisms for the use of ICT, including for example, technical and pedagogical support, putting special attention on the use of ICT in teaching and learning. In many cases this second stage included the implementation of national support structures to ensure the adequate conditions and incentives for the use of ICT in the classrooms. Finally, today, many of the policies show an emphasis that goes beyond the school, including the use of ICT in the community and a broader variety of hardware and software (both stand-alone and on-line).

Regarding current policy emphasis, it is interesting to note that although the level of ICT development across countries is different, there are many commonalities, such as an emphasis on the development of teachers' ICT skills and competencies and the emerging trend to use mobile and/or home based ICT infrastructure as tools to extend teaching and learning possibilities (more on global trends in the next section). More specifically, common aspects of global policies and strategies under implementation are the following:

- **Teachers and teaching**: All OECD countries are implementing large-scale initiatives aimed at training teachers in the use of ICT. Many are also integrating ICT preparation into pre-service teacher training. Some countries have prepared guidelines for the integration of ICT in innovative teaching practices, with an emphasis on teaching styles to foster "personalized learning".
- **Students and learning**: Many countries are developing programs to foster students' independent, "anywhere" learning. Some of them also include major investments in distance education.
- **Curriculum**: Many countries are revising curricula to define and promote the development of 21st century skills and competencies, including technology literacy, higher-order thinking skills and life and collaboration skills.
- **Digital Educational Resources**: Virtually all countries have initiatives to increase the availability of digital educational resources, some of them promoting partnerships between schools and business companies and/or encouraging the production and development of high-quality ICT-related pedagogical resources. Some of them also include initiatives to monitor the quality of resources and to promote standardization.
- **Infrastructure**: Almost all countries' Ministries of Education finance the provision of ICT related infrastructure (Computers, Broadband Internet access), and replacement of old computers.
- **ICT, leadership and management**: Many countries include initiatives to encourage school leaders to include ICT in the school's vision and development plans, and to ensure appropriate technical and pedagogical support for the integration of ICT into the teaching and learning process. Many countries are also promoting ICT applications for school management information. Some countries are also considering the use of learning management systems in schools.
- **Research and development**: Most countries include initiatives to foster and support research and development in the field and some of them also include explicit funding and incentives for innovative applications and rigorous impact evaluation.

Global Trends in ICT and Education

While these policies are common today among a large number of countries, the challenge for any education policy maker is to anticipate the direction of the future and make investments today to prepare for this future. An important part of this forecasting exercise is to understand global economic and technological trends and link these trends to the context and reality of a specific country environment. These trends should be viewed from the context of a globalized world that will continue to connect countries and individuals, and use technology to create ideas, knowledge and wealth in new and innovative ways. The annual Horizon Report[58], considered by many to be the leading identifier and arbiter of key trends emerging in the field of educational technology, has over the years identified a number of trends that should be on the radar screen of educational policymakers:

*In 2009, In the first adoption horizon [within the next year] we find **mobiles**[59] and **cloud computing**[60], both of which are already well established on many university campuses in the OECD — and still more organizations have plans in place to make use of these technologies in the coming months.*

These trends continue to be identified in 2010 and 2011. The 2011 report writes:

The technologies we use are increasingly cloud-based, and our notions of IT support are decentralized. This trend, too, was noted in 2010 and continues to influence decisions about emerging technology adoption at educational institutions. As we turn to mobile applications for immediate access to many resources and tasks that once were performed on desktop computers, it makes sense to move data and services into the cloud.

The Horizon Report provides an insight into both the rapid pace of ICT development and specific technologies that will become increasingly important for education policymakers in 2011 and beyond. But at present, even in the most advanced OECD countries, the application of these technologies in education has not filtered below the higher education level.

However, this can be expected to change quickly, especially for the two areas mentioned above – mobile learning and cloud computing. And there are a number of other clearly identifiable trends (both technology related and non-technology related) that are already on the agenda of education policymakers at the basic education level. These trends need to be understood and considered when crafting policies and programs today.

1. **Mobile Learning**. New advances in hardware and software are making mobile "smart phones" indispensible tools. Just as cell phones have leapfrogged fixed line technology in the telecommunications industry, there is a possibility that personal mobile devices such as tablets and smart phones with internet access and computing capabilities will soon overtake personal computers as the information appliance of choice in the classroom.
2. **Cloud computing**. Applications are increasingly moving off of the stand alone desk top computer and increasingly onto server farms accessible through the Internet. The implications of this trend for basic education systems are huge; they will make cheaper information appliances available which do not require the processing power or size of the PC. ***The challenge is to provide the ubiquitous connectivity to access information sitting in the "cloud".***
3. **One-to-One computing**. The trend in classrooms around the world is to provide an information appliance to every learner and create learning environments that assume universal access to the technology. Whether the hardware involved is one laptop per child (OLPC), or – increasingly -- a net computer, tablet or a mobile phone, classrooms should prepare for the universal availability of personal learning devices.
4. **Ubiquitous learning**. With the emergence of increasingly robust connectivity infrastructure and cheaper computers, school systems around the world are developing the ability to provide learning opportunities to students "anytime, anywhere". This trend requires a rethinking of the traditional 40 minute lesson. In addition to hardware and Internet access, it requires the availability of virtual mentors or teachers, and/or opportunities for peer to peer and self-paced, deeper learning.
5. **Gaming**. A recent survey by the Pew Internet and American Life Project found that massively multiplayer and other online game experience is extremely common among young people, is

rich and varied, and that games offer an opportunity for increased social interaction and civic engagement among this group.[61] The phenomenal success of games with a focus on active participation, built in incentives and interaction suggests that current educational methods are not engaging students enough and educational games could more effectively attract the interest and attention of learners.

6. **Personalized learning**. Education systems are increasingly investigating the use of technology to better understand a student's knowledge base from prior learning and to tailor teaching to both address learning gaps as well as learning styles. This focus transforms a classroom from one that teaches to the middle to one that adjusts content and pedagogy based on individual student needs – both strong and weak.
7. **Redefinition of learning spaces**. The ordered classroom of 30 desks in rows of 5 may quickly become a relic of the industrial age as schools around the world are re-thinking the most appropriate learning environments to foster collaborative, cross-disciplinary, students centered learning. Concepts such as greater use of light, colors, circular tables, individual spaces for students and teachers, and smaller open learning spaces for project-based learning are increasingly emphasized.
8. **Teacher-generated open content**. OECD school systems are increasingly empowering teachers and networks of teachers to both identify and create the learning resources that they find most effective in the classroom. Many online texts allow teachers to edit, add to, or otherwise customize material for their own purposes, so that their students receive a tailored copy that exactly suits the style and pace of the course. These resources in many cases complement the official textbook and may, in the years to come, supplant the textbook as the primary learning source for students. Such activities often challenge traditional notions of intellectual property and copyright.
9. **Smart portfolio assessment**. The collection, management, sorting, and retrieving of data related to learning will help to better understand learning gaps and customize content and pedagogical approaches. Moreover, assessment is increasingly moving toward frequent formative assessments and less on high-pressure exams as the mark of excellence. Tools are increasingly available to students to gather their work together in a kind of online portfolio; whenever they add a tweet, blog post, or photo to any online service, it will appear in their personal portfolio which can be both peer and teacher assessed.
10. **Teacher managers/mentors**. The role of the teacher in the classroom is being transformed from that of the font of knowledge to an instructional manager helping to guide students through individualized learning pathways, identifying relevant learning resources, creating collaborative learning opportunities, and providing insight and support both during formal class time and outside of the designated 40 minute instruction period.
11. **Child online safety and security concerns**. While access to ICTs and the Internet offers exciting new opportunities for student learning and social development, it also exposes young people to a wide range of new threats – and old threats in new forms – that are a troubling component of life spent 'on-line.' From exposure to predators to cyber-bullying to identity theft and privacy issues, a new responsibility of policymakers in the education sector is to ensure a safe on-line learning environment.

These trends are expected to continue and to challenge many of the delivery models fundamental to formal education as it is practiced in Egypt and other countries. The ability of an education system to respond and adapt to such trends, let alone to anticipate and harness them productively and effectively in support of desired developmental and learning objectives, will put new strains and stresses on educational policymakers – and education budgets. Global best practice in this context is an evolving concept; even in countries considered the 'most advanced' in their use of educational technologies, experience is largely informed by 'learning-by-doing.' That said, there are education experiences and education systems that are worthy of attention from policymakers seeking to leap-frog technologically and/or capitalize on global best practice. This global practice discussed in the next sections of the paper will focus on three critical shifts in deployment of education that will be drive and benefit from enhanced broadband capacity in Egypt:

1. **School ICT Infrastructure** – a move from labs to cheaper, ubiquitous personal devices
2. **Educational Content** – a move to more cloud applications accessed by the cheaper personal devices
3. **Teachers and teaching** – continued emphasis on teacher training including in-class pedagogical strategies as well as enhanced interaction with students outside of traditional class hours by mentors and teachers.

School ICT Infrastructure

The appropriateness and utility of 'computer labs in schools' has been a matter of scholarly and practitioner debate for at least two decades[62]. In schools with existing, well-equipped computer labs[63], the trend towards mainstreaming of computers into classrooms is clear. This trend is driven by a number of factors: i) increasing affordability (which makes larger numbers of computers possible), ii) space constraints (i.e. there is no more room in the labs for additional computers), iii) fashion (for lack of a better term) and the growing popularity of one laptop/device per child policies; and iv) concerns about the well-documented difficulties in coordinating computer- and non-computer activities in core subject areas. General consensus from the ICT/education communities and constituencies in the OECD is that, for computers and other ICTs to be effectively integrated into the teaching and learning process, such devices need to be mainstreamed more fully into all learning environments, especially classrooms. This process of 'mainstreaming' is typically seen as a mechanism for helping to enable a transformation of pedagogical practices at the classroom level.[64]

Such debates have taken on an increased urgency with the emergence of low cost devices such as smart phones and 'netbooks,' as well as tablet PCs whose increased affordability and portability has given rise to broad movements targeting '1-to-1 computing.' Prominent examples include, the U.S. state of Maine, which has had the earliest and most studied experiment at scale in providing laptops to all students (The Maine Learning Technology Initiative[65]) and the One Laptop Per Child (OLPC) initiative[66] that has subsequently received a great deal of press and mindshare around the world. For instance, Uruguay[67] has rolled out free OLPC XO laptops to all of its primary school students in public schools, and is moving to do the same for private and secondary school students. Peru has set similar goals[68]. It is too early to say anything of substance about the on-going implementation of the OLPC initiative in Uruguay and Peru, and especially its cost over time and impact, due both to the newness of the initiatives and the lack of credible scholarly attention[69]. That said, preliminary data[70] is starting to emerge from Plan

Ceibal, which is overseeing the roll-out of the OLPC initiative in Uruguay. The country had met its targets for distribution of 380,000 laptops to teachers and students and connecting 2,068 schools to the Internet, achieving essentially full coverage at the primary level. Uruguay has trained 18,000 teachers under this initiative, receiving on-going assistance from 500 'support teachers' and 1500 volunteers. An educational portal and educational television channel have been rolled out to complement these efforts. The total investment costs per student for the program – assuming a four year depreciation period for the computer hardware -- are estimated by Plan Ceibal[71] at US$ 248 (US$ 188 for the laptops and US$ 60 for connection and server costs). Thereafter, annual recurrent maintenance costs are expected to total about US$ 25/year per student.

The financing of 1-to-1 computer deployments does not follow any set models. In Maine, the programs were seeded with the proceeds from an unforeseen US$ 70 million budgetary windfall, and the ongoing costs of the program have been met through combinations of federal, state, district and philanthropic funds that have changed over time. In Uruguay, funding has come largely from the national level, through *Plan Ceibal*.[72]

Costs associated with 1-to-1 computing initiatives, or the large-scale deployment of other ICTs, such as interactive whiteboards, are difficult to determine, given the variety of funding mechanisms typically deployed. Most fundamentally, "total cost of ownership" (TCO) is often underestimated, sometimes grossly, when calculating costs of ICT in education initiatives in developing countries. Estimates of the ratio of initial equipment purchase costs to overall costs over time vary widely; typically the initial hardware costs are only 10-25% of total cost. That said, there is a dearth of reliable data, and useful tools, to help guide education decision-makers in their assessments of the true costs of educational technology initiatives. Cost assessment work associated with the Maine and U.K. initiatives is still on-going.[73]

The United States, like other OECD countries, has been moving quickly toward 1:1 computing environments, which implies significantly higher annual expenditures per student on ICT. It is essential to note that moving towards 1:1 computing also entails larger expenditures on school networking and connectivity (LANS and WANS) technologies. US schools in 2006 reported spending an average of US$ 15 per student per year on instructional networks, a figure that is expected to grow at an annual rate of 10 percent, to US$ 25 per student by 2011[74].

Going forward, it is expected that the trend toward device variety, and a corresponding complexity in learning environments supported and enabled by such technology, will only increase. With the trend towards device variety, the issues of how to select appropriate technologies and deploy, coordinate and integrate the use of such devices to support teaching and learning inside and outside of school are more complex. While the costs of new devices can be expected to keep dropping sharply, the technological obsolescence/depreciation period for new ICT investments is also becoming shorter. Over time, personal ownership of devices may negate the need for bulk one to one purchases by the government; however policies to address equity issues such as loans and subsidies will certainly continue to be important to insure equal access to technology. Moreover as more of the content and software shifts from the desktop to the cloud, software costs and overall maintenance costs will also decline. The challenge for education ministries is to maintain within the Ministry the technical capacity to monitor global trends and markets and to be able to make the conceptual link between newly available technologies and their relevance for national teaching-learning processes and goals.

In this area, the main lessons from international experience can be summarized as follows:

- There is a clear trend in OECD countries to move the primary locus of student interaction with ICTs out of the computer lab and into classrooms (and other settings for learning).
- A growing number of countries and states are opting for universal roll-out of ICTs in schools, including the 1-to-1 computing initiative in the U.S. state of Maine, the introduction of interactive whiteboards in every classroom in the U.K., and the one-laptop-per-child initiatives of countries such as Uruguay and Peru.
- Initiatives to measure the impact and cost of 1-to-1 computing on student achievement are still in their early days, and evidence to date is limited and mixed. Nonetheless, most OECD countries are expected to move to 1-to-1 computing (but likely via smart phones or other devices rather than only laptops) over the next 3-5 years. A fundamental flaw in many large-scale ICT/education investments is to first consider questions of technology choice, and then attempt to determine the best educational uses for such equipment. Lessons emerging from such initiatives stress the need to place ICT infrastructure decisions within and in the service of larger educational and national development goals.

Educational Content – Digital learning resources in the cloud

The second major trend with broadband implications is the movement of content and applications into the cloud. First, it is important to note that international experience with digital learning resources cannot be decoupled from the pedagogical and instructional reform that many countries aim to achieve. The use of digital resources has evolved over the years from use of proprietary stand alone drill and practice software to Internet based content and learning resources which are more open, collaborative, and contextualized. Indeed, pedagogical reforms such as movement away from silo subjects to interdisciplinary themes, from single teacher expert to teacher teams and external expert knowledge sources, from rote style learning to inquiry based and collaborative project based learning are increasingly reflected in the design of digital learning resources.

Apart from supporting new approaches to pedagogy, many countries also see the use of on-line digital Internet based resources as a means of transcending the time and space constraints of the traditional classroom and to achieve "anytime, anywhere" learning. Indeed, the emergence of open digital learning materials holds the promise for delivering an increasing share of education services in informal and non-formal settings rather than traditional classrooms. It has also provided an impetus for the development of open learning spaces and collaboration spaces in schools.

Each of these digital content strategies increasingly depends on robust connectivity with content in the cloud and accessed by increasingly mobile and personal learning devices. Within this broad context, the strategies that different countries are promoting can be characterized as follows:

1. **Development of national, provincial and local web portals for aggregation and sharing of learning resources linked to curricular objectives.** Over the past decade, countries have embraced the use of digital resources through development of web portals for aggregation and sharing of learning resources linked to curricular objectives. Most of these portals also

encourage development of teacher communities to share and comment on digital resources. In some cases, development and/or identification of digital resources by teachers has been integrated into in-service programs as a means of professional development.

2. **Integration of learning management systems with digital learning resources.** A number of countries are expanding the functionality of their educational portals by integrating learning management tools. One example is the development of a "Digital Textbook" pilot in Korea. This initiative aims to provide a set of Korean language digital learning resources bundled with learning management applications. Students can do self-evaluations, access multimedia resources, check course schedules and notifications, collaborate with peers on group activities, create and maintain their own learning portfolio, etc. Teachers can organize course materials, target learning resources to students depending on their levels, provide instructions for a specific lesson, monitor student progress, grade student work, assign homework and interact with students. The system is also bundled with a set of subject specific tools, games and resources. The pilot in Korea aims to completely replace the textbook with this digital learning environment.

3. **User-generated content and personalized webs**. With so much content available on the Internet for teachers to use, many countries have supported the development of personalized web spaces for teachers to both aggregate their most relevant content as well as create their own resources. For instance, in Australia, EDNA has launched a social networking feature called me.edu.au. This feature allows teachers to create their own profile and connect with other teachers with similar interests. Through this network teachers are able to share relevant resources and highlight their own lesson plans to a network of trusted peers. While user generated content is prevalent across countries, the reality is that a small number of individuals create the vast majority of the content (20% create 80% of the content).

4. **Fostering private sector capacity to produce and sustain DLR and open source digital educational resources**. A tension continues to exist in most countries between proprietary content and open content. Many countries encourage the private sector to develop educational resources by subsidizing schools to purchase licenses or subscriptions to this content. This practice often occurs in countries with unique language requirements where free content may not be available or of high enough quality on the Internet and a policy to stimulate private sector development of digital content is desired.

In some cases the sustainability of proprietary digital content can be a challenge. In the UK, for instance, the Curriculum On-line initiative sought to provide a repository of content for schools to purchase through an "e-learning credit". The site however was closed due to the discontinuation of the credit and the inability of schools to purchase proprietary on-line software and learning materials from providers. In another example, the Jordan Education Initiative developed a policy to promote local business by mandating that international companies partner with local companies for development of subject specific digital content. As of 2005, this partnership approach resulted in a transfer of US$ 3.7 million to Jordanian companies.

Other, particularly English speaking, countries have espoused an open content approach whereby learning materials, lesson plans, and assessment materials are published under a creative commons license for open use. For instance, at the tertiary level, one of the most well known examples of open educational resources is the MIT open courseware project[75]. Countries are also looking to combine the two approaches by encouraging private publishers to create open digital learning resources. In June

2009, the state of California for instance announced that it would adopt a policy of free digital textbooks for secondary schools in certain topics. The program estimates that a district with 10,000 students could save up to US$ 2 million through the program[76]. California expects to have at least 15 commercial publishers signed on to the program who will be allowing open access to districts. Once approved by the State, high schools will still have a choice to download the book or not. Experimentation will still take place with the media in which the content is contained – be it an e-reader, a 1:1 laptop solution or printing.

The main lessons in this area include:

- Robust connectivity is needed to access and share on-line digital resources.
- Effective integration and use of digital learning resources must be part of a holistic strategy for reform including pedagogy, assessment, infrastructure, professional development, etc.
- Architecture and creation of learning spaces that facilitate collaboration should be considered as part of the strategy to encourage effective pedagogical use of digital resources.
- Teacher professional development is critical to successful integration of digital learning resources in the lab – teachers need to buy-into the reform, attain comfort level with technology, and understand the practical implementation of a pedagogical reform such as student-centered learning or project –based learning.
- Exclusive use of digital content as a replacement of textbooks is being piloted in a few countries but no evaluation data is yet available.
- Countries emphasize use of digital resources for "anytime, anywhere" learning to allow students to access content outside of class hours and also as a strategy to both support slower learners and allow faster learners to engage with more sophisticated content.

Teachers and Teaching

International evidence suggests a consensus view that the critical success factor for integration and utilization of ICT in education is effective teacher professional development. Getting teachers' buy-in and commitment to use ICTs in support of educational reform is one of the greatest challenges countries face.

The emergence of mobile devices, social networking, and the broader adaptation of technology for personal use presents an opportunity to further engage teachers in use of the technology for professional purposes. Beyond basic ICT literacy, the effective use of ICT in teaching and learning can require teachers to collaborate, create, share and assess students in a new way. While some embrace the change, many feel intimidated. Some of the countries considered most successful in implementing teacher professional development strategies for ICT integration such as Australia, Canada and the UK, have focused more on the pedagogical and instructional reforms than on the technology to support those reforms.[77]

An additional important increase in costs in the US is increased spending on teacher professional development. The "No Child Left Behind" legislation encourages that 25 percent of all technology purchases be allocated to professional development. In reality, however only an estimated 5% of all ICT spending is devoted to teacher development. While the US Department of Education does estimate that school level spending on professional development will grow from US$ 19 to US$ 25 per student between 2006 and 2011, the Department still considers this figure too low, as professional development is perhaps the single largest factor in the success or failure of effective use of ICTs in the classroom. The DOE estimates professional development costs to support successful 1:1 implementation should be on the order of US$ 95 per student per year.[78]

Looking at the international experience, the following is a list of the common policy areas that can be identified in the different countries and initiatives.

1. Defining ICT-related professional standards for teachers and corresponding certification mechanisms.

UNESCO has articulated a set of ICT competency standards for teachers,[79] based on emerging good practices from around the world and leading edge thinking in this area. The standards are designed to promote three education policy objectives: (i) increase the technological uptake of the workforce by incorporating technology skills in the curriculum — called "**technology literacy"**; (ii) increase the ability of the workforce to use knowledge to add value to economic output by applying it to solve complex, real-world problems — called "**knowledge deepening"**; and (iii) increase the ability of the workforce to innovate and produce new knowledge and of citizens to benefit from this new knowledge — or "**knowledge creation"**. Teacher standards for the "knowledge creation" approach include, for example, teacher knowledge of complex cognitive thought processes, ability to structure situations in which students apply their cognitive skills, design ICT-based knowledge communities and use ICT to support the development of student's knowledge creation skills and their continuous, reflective learning, etc.[80]

The International Society for Technology in Education (ISTE)[81] has established another standard in the U.S. which encourages teachers to: facilitate and inspire student creativity and innovation; design and develop digital age learning experiences and assessments; model digital age work and learning; promote and model digital citizenship and responsibility; and engage in professional growth and leadership. ISTE standards are adopted or adapted by U.S. States in vary with regard to use and implementation.

Additionally, and notably, standardized performance indicators for school administrators are gaining momentum in many U.S. states, in response to the definition of a set of such standards also by ISTE. These standards encourage administrators to: provide visionary leadership; promote a digital age learning culture; inspire excellence in professional practice; encourage systemic improvement; and model digital citizenship.

2. Foster the development of a community of learners and broader collaboration between teachers.

Peer to peer learning and access to networks to gain just-in-time responses to questions and engage in dialogues around learning practices provide powerful learning opportunities for teachers introducing technology into their classrooms. In Hong Kong, teachers are actively encouraged to interact with colleagues from grades above and below their instructional level. Teachers of students in grade 2 collaborate with teachers in grades 1 and 3 on lesson planning and development of a digitized curriculum to insure continuity and synergy across grade levels. In a similar vein, the Government of

Ontario has created a program that includes a group of 30 “demonstration” teachers (23 elementary and 7 secondary) who engage in a professional development program in which they learn from each other and define their own goals for incorporating technology into their teaching practice. Education portals offer another tool for fostering teacher communities. The Saskatchewan on-line portal[82] offers a host of learning opportunities for teachers and links to free professional development opportunities including conferences, podcasts, and fora.

One of the great benefits of the array of on-line tools is the flexibility it provides teachers to learn at their own pace and to broaden professional networks and connections to other subject matter teachers who are applying innovative practices and new forms of content in the classroom. As described in the prior section, EDNA has launched a new social networking feature called me.edu.au. This feature allows teachers to create their own profile and connect with other teachers with similar interests. Through this type of network, teachers are able to engage in peer to peer learning and identify colleagues who can provide informal pedagogical support.

3. Integrating digital competency standards into pre-service and in-service teacher training.

For example, in the United States, the ISTE Educational Technology Standards and Performance Indicators for All Teachers (NET*S•T)[83] detailed above, provides a framework that colleges of teacher education can use to evaluate teachers’ digital literacy. The standards define fundamental concepts, knowledge, skills, and attitudes for applying technology in educational settings. This is currently the leading framework for digital competency training and assessment schemes targeted at teachers across the US. Teachers’ ability to demonstrate competencies for teaching of 21st century skills is also currently being incorporated into the US National Board Certification process and in-service teacher training programs. It is envisioned that standards will continue to evolve as a younger and more technology-literate generation of teachers enters the profession. The focus will increasingly shift from basic ICT literacy to competencies for 21st century skills and digital learning.

The main lessons in this area are:

- Networking master teachers is an effective strategy to share good practice in the classroom.
- School leadership is essential for implementation of innovations in the classroom.
- The pedagogical focus of a reform needs to be reinforced through curriculum reform, teacher training reform and assessment reform. For instance, if a student-centered, project-based, inquiry-based, etc. approach is taken, then these pedagogies need to be supported throughout the system. Country experience shows that the alignment of these factors plays a big role in determining how quickly and well ICT and digital resources are utilized.

Issues for Tertiary Education

While this chapter has primarily focused on basic and secondary education, broadband policies have enormous consequences for quality and access to tertiary education. A few of the most promising implications for increase access to broadband for tertiary education include affordable access for the masses, research and learning consortia to expand knowledge.

First, the continued improvement and evolution of distance and e-learning provides new opportunities to reach those who for reasons of either space or affordability constraints have been denied access to national and private universities. The proliferation of free content through the open content movement highlighted earlier in the chapter and the increased opportunities for peer to peer learning through social networks provide new opportunities to reduce traditional cost structures for delivery of instruction. For instance, some are experimenting with an Open Education Resource University (OERu)[84] while other are creating tuition free on-line institutions such as the University of the People[85] in which students simply pay an application fee to attend.

Next, ICT and broadband are transforming the way research is conducted and collaboration between universities takes place. Universities have increasingly recognized the benefits of collaboration and pooling of resources and ICTs have facilitated this trend. The most evident form of collaboration has been the sharing of bandwidth costs through national research and education networks such as GEANT in Europe and Internet II in the US. The formation of these networks was predicated on the recognition that research is collaborative and digital and de facto requires broadband infrastructure to share files, access virtual labs and create sophisticated simulations. Beyond the connectivity cost sharing, universities are increasingly developing shared applications for both administration and learning. Initiatives such as development of shared learning management systems, student registration systems, and other applications have evolved. For some universities collaboration has extended to creation of Meta-Universities by "collaborating on engineering-design projects and research activities, exchanging students and professors, and pooling their expertise to work more closely with industry."[86]

Conclusion

One of the main challenges for policymakers is the lack of quality cost and impact data on ICT and education initiatives. Cost data are notably hard to obtain, and reliable, independent cost data for large-scale programs are typically not matters of public record (if indeed they exist at all). This greatly complicates the task confronting educational policymakers in this area, as the answers to two fundamental questions guiding any policy planning process – what does it cost? what are the results? – are for the most part not at hand. Even within educational reform processes – and the use of ICTs in education are almost always linked to processes of 'reform' of one sort or another – the pace of technological innovation outruns the pace of institutional innovation, and policymakers are challenged to keep up (Trucano, 2005).

Nevertheless, Ministries of Education must continue to monitor global experience and trends in the field. The process of learning by doing is also important to try and test new ideas that push reforms forward. The three key trends and associated global experience highlighted in this paper – one to one access and the proliferation of cheaper, mobile personal devices; content available in the cloud; and the central role of the teacher and the expansion of role of teachers and mentors to engage with students beyond the traditional classroom all depend heavily on a robust broadband infrastructure. While additional studies are required to better determine the cost-benefit of these trends for Egypt, all three merit further consideration by policymakers in evaluating existing progress on ICT and education initiatives and formulating new policies and reforms involving ICT.

Chapter 3.2

BROADBAND IMPACT ON THE ECONOMY: JOB CREATION AND IT-BPO

Introduction

Telecommunications investment has been identified as one with a strong potential to spur economic growth and create employment. Investments in telecommunications infrastructure could not only provide a short-term boost to the economy, but also lay the groundwork for long-term improved growth and employment perspectives. Many fiscal stimulus programs adopted by national governments to lessen the impact of the recession and boost economic recovery include substantial stimulus investments related to digital infrastructure. Indeed research findings indicate that telecom investment has an impact far beyond the scope of the industry itself, promoting growth in adjacent industries and creating new industries. Telecommunications investment explains up to one third of economic growth (Wieck et al, 2010). As to broadband Internet access, it has been argued that it can boost productivity growth and competitiveness, cut transaction costs, improve business and market organization and promote more efficient social discourse and education (ITU, 2009).

According to Atkinson (2007), broadband distinguishes itself from other digital technologies in two key ways. Firstly, it is not a not just a consumer technology but a “prosumer” technology that is enabling consumers to also be producers who contribute to economic growth and innovation. Secondly, it exhibits positive externalities[87] where the benefits from broadband adoption accrue not just to individual consumers, but to other broadband users and society as a whole. Because of this, the social returns from investing in more broadband exceed the private returns of companies and consumers. As a result, market forces alone will not generate the societally optimal level of broadband, at least for the foreseeable future. In markets like this, public policies – in this case a proactive national broadband strategy – are needed to maximize overall societal welfare.

Spurring robust job growth, lowering the unemployment rate, and creating dynamic job market are one of the main macro-economic concerns that most countries are facing and should carefully address with their public policies. On the other hand, as mentioned above, the broadband Internet access can play a major public policy role in enhancing well-being among citizens. Taking these into consideration, job creation is indeed a topic to which broadband make a contribution.

Previous Studies on Broadband and Job Creation

The preliminary research for this note could not find many studies on the relationship between broadband Internet connection and job creation. This is probably because broadband is a new issue, which is approximately ten years old even in a well-developed countries. This note cites three previous case studies in the literature; nationwide research, provincial-level research, and city-level research.

Nationwide Research - Case in US

Pociask examined, in his 2002 research in US market, the important stimulative effects that IT investment had had on the economy, and highlighted the need for IT investment as an economic stimulus for the future. More specifically, it examined the economic impact of building a robust nationwide broadband network and estimated the number of new and permanent jobs that could result directly from that action, as well as the indirect job gains once that network was in use. Notably, he concluded that

- It is estimated that totally 1.2 million new and permanent jobs would be created in US, including,
- 166,000 jobs in the telecommunications sector,
- 71,700 manufacturing jobs generated by the direct purchase of network plant and equipment and customer premise equipment, and
- 974,000 indirect jobs created if a next generation network were built.

Box 1: Broadband Investments To Spur Job Creation and Economic Opportunity in Rural America

Even today, even in one of the most developed countries like US, the broadband deployment is highly important from the viewpoint of job creation particularly in rural areas. On April 20, 2011, United States Department of Agriculture (USDA) announced almost US$ 40 million in loans for broadband improvement projects in Georgia, Illinois, Iowa, Kansas, North Dakota, Montana, and Oklahoma. Agriculture Secretary Tom Vilsack mentioned, "Investment in broadband technology will create jobs across the country and expand opportunities for millions of Americans. Broadband provides the opportunity for rural Americans to receive improved educational services, health care, and public safety. These USDA broadband loans provide rural communities the level of financial assistance required to make them full partners in the digital age and keep them competitive on a local, national and global level."

The telephone companies and cooperatives that have been selected to receive the financing would construct more than 1,000 miles of Fiber-To-The-Premises (FTTP) systems. USDA Rural Development funded more than 16,000 miles of FTTP projects during fiscal year 2010 to upgrade, expand or replace networks and perform system maintenance.

Through its Rural Development mission area, USDA administers and manages housing, business and community infrastructure and facility programs through a national network of state and local offices. These programs are designed to improve the economic stability of rural communities, businesses, residents, farmers and ranchers and improve the quality of life in rural America. Rural Development has an existing portfolio of nearly US$ 149 billion in loans and loan guarantees.

Source: News Release No. 0173.11 by USDA on April 20, 2011, titled "Agriculture Secretary Vilsack Announces Broadband Investments To Spur Job Creation and Economic Opportunity in Rural America"

Provincial-level Research - Case in California, US

Van Gaasbeck et al conducted a study (2007) on Economic effects of increased broadband in California[88], US, and forecasted three scenarios; a moderate level, strong level, and dramatic level of broadband growth scenario, in terms of ten year cumulative job creation and payment increase compared to the baseline forecast of economic growth. More specifically,

- Even in a moderate level of broadband growth scenario, 57,000 jobs and US$ 7 billion of payroll can be generated.
- In a strong level of broadband growth scenario, 1.8 million jobs and US$ 132 billion of payroll can be generated.
- In a dramatic level of broadband growth scenario, 2.2 million jobs and US$ 267 billion of payroll can be generated.

This illustrates that a strong correlation between broadband growth in California and the number of new jobs available. The study also concludes that even a small increase in broadband use could generate a substantial cumulative gain over the next 10 years compared to what could be expected under business as usual conditions.

City-level Research - Case in the City of Cape Town

A city-level research was conducted in Cape Town, South Africa (Standish et al, 2007). In the macro-economic benefits section of the detailed analytical study, the macro-economic estimates relate directly to the actual cost of developing the infrastructure, as well as the operating cost and productivity gains that business would experience. Thus all the backward economic linkages for construction and maintenance and the forward economic linkages where construction workers and others spend their salaries were theoretically included in the research. Their finding on employment effects is that, after the broadband rollout project, the total direct and indirect jobs were expected to amount to 2,412 in 2007-2008 and 4,837 in 2008-2009. It was also expected that 14,828 direct and indirect jobs would be created in 2010 and nearly 252,000 by 2027 in the City of Cape Town, whose population is approximately 3.5 million[89].

Types of Jobs that Have Positive Effects by Broadband

It is acknowledged that the job growth resulting from the deployment of a broadband network can occur from three sources; (1) direct labor associated with deploying and maintaining broadband investment; (2) direct labor associated with manufacturing the infrastructure components and customer premise equipment; and (3) indirect labor associated with creating services and applications, including supporting industries that would result once the network is deployed (Pociask, 2002).

Direct labor associated with deploying and maintaining broadband investment

When broadband is widely deployed, job growth is expected in labor in directly related to broadband infrastructure. This may notably include;

- Telecommunications operators. Especially, workers in network and facility planning department, maintenance operation department, and sales department that directly deals with broadband customers.
- Telecommunications facility construction companies, which often obtain contracts from the telecommunications operators to install facilities, such as network devices (e.g. routers, switches, etc), optical fiber cables, cell phone towers and antennas for mobile broadband, and non-telecommunication infrastructure (e.g. utility masts and ducts).

Direct labor associated with manufacturing the infrastructure components and customer premise equipment

Hardware or equipments are not necessarily manufactured in the own countries. However, it should be noted that many equipments, especially ones for end-users, are made in developing countries and they are well accepted in developed countries too. The industries that can create jobs may include;

- Networking hardware vendors, which sell telecommunications equipments mainly to operators. They also sell software that is used for monitoring and controlling the hardware.
- Consumer hardware vendors, which sell home-based equipments, such as set-top boxes or DSL modems. Owing to the recent advent of mobile broadband, broadband-enabled mobile handsets manufactures should be included here.
- Fiber optical cable manufactures.

Indirect labor associated with creating services and applications, including supporting industries that would result once the network is deployed

The indirect effect on job creation caused by broadband is highly extensive. The industries that can create jobs may include;

- Retailers of consumer electronics, which is one of the sales channels for home-based broadband equipment. They are sometimes available not only at telecommunications operators, but also at retail shops. They also sell computers and mobile phones whose sales can be drastically increased by broadband usage.
- Contents and applications creation industries. Especially, broadband-enabled mobile phones (e.g. smart phones) can accommodate complicated software. Contents and applications development has been under continuing expansion.
- Consulting services on IT related matters, which aims mainly to efficient business management and improved operation such as supply-chain (this issue is specified in the section for IT-BPO).

Positive Effects vs. Negative Effects

Negative Impacts Broadband Might Cause

It has been widely discussed that there are two types of negative impacts on employment that broadband Internet connection may cause. The one is the productivity effect, and the other is the displacement effect (Wieck et al, 2010).

Firstly, the adoption of broadband-based processes should lead to process improvements and productivity gains (Wieck et al, 2010). A company improves its processes to increase its employees' efficiency. After the change has been made, the company is able to produce more with the same personnel or produce the same with fewer personal (Fornefeld et al, 2008).

Secondly, not unrelated to the direct productivity effect mentioned above, the displacement effect is also negative (Wieck et al, 2010). The productivity improvement allows companies to engage in increased specialization in knowledge-intensive activities. This structural evolution in business environments generates jobs displacement from the traditional sectors of the economy to the services sector, where labor productivity is usually higher than in the rest of the economy. Thus, structural displacement of employment from a low-productivity to a high-productivity sector has a negative effect on employment (Wieck et al, 2010).

Positive Effects Outweighs Negative Effects

Fornefeld et al conducted analysis (2008) on the positive effects too. A company takes advantage of its improved production processes to improve its position in the market. After a certain time, the benefits of the process improvement become reality: sales increase and more input is needed to face the demand. The previous level of employment may be reached or even overtaken[90]. Additionally, innovation and new economic activities (e.g. new services and applications in technologically more advanced sectors) can have a positive impact. Their finding from knowledge-intensive business services in European economy, the employment balance is positive.

What is intriguing for policy makers is that this positive result is largely due to innovation. The development of broadband has to be closely associated with innovation policies, providing the best conditions for the creation of new services and improving competitiveness of companies. To put it the other way around, understanding and fostering innovation in the services sector is necessary to guarantee that broadband's impact on employment are positive.

Supporting Issues Related to Job Creation

It is noteworthy that there exists several "supporting" issues that can reinforce the positive impact on employment by broadband.

Telecommuting:

Broadband can enables telecommuting, the process of working remotely, such as at home. The broadband Internet connection and Virtual Private Networks (VPNs) provide workers with a very similar working environment. This flexibility in working condition encourages people to work, especially women that are supposed to field a number of household chores.

Facilitation of Job Search:

Broadband Internet connection allows job seekers to conduct job research at home, with ease. They can access the website of many organizations, and send a job application online. They can also get interviewed with Internet video conference in a non-costly manner.

Reduced Job Relocation to Abroad:

Because of the broadband, linkages between international labor markets are forged. This means that people can get employed without leaving their home countries. This is particularly true of efficient young people in developing countries, where brain drain have been a huge problem in the labor policies.

Impact of Broadband on IT-BPO Employment in Egypt

Introduction and Description

The global addressable market for IT and Business Process Outsourcing services (IT-BPO) is estimated at US$ 756 billion in 2011[91], and developing countries such as Egypt have already benefitted tremendously from increased export revenues, diversified economies, and mass employment for youth and women. IT services typically include IT applications and engineering services, while BPO involve a wide range of services delivered over electronic networks, such as finance, accounting and customer service contact centers[92].

The global IT-BPO industry is largely urban and formalized in its current form. However the digital economy has resulted in the emergence of IT-BPO on a rural and informal basis, which provides digital earning opportunities for semi-skilled and unskilled workers with access to relatively basic digital infrastructure.

One rapidly emerging area within the IT-BPO industry are rural BPOs (RBPOs). These RBPOs provide the same or less sophisticated types of BPO services as their urban counterparts but operate at a village or community level; and they have proved to be lucrative to both the employers in spite of primary obstacles like poor infrastructural facilities, lack of broadband connectivity or electrification. Analysts believe they are highly sustainable as they are cost efficient, and empower rural inhabitants to earn and live with dignity[93]. In addition RBPOs can generate employment for youth and women, upgrade rural services and attract economic migration from cities. A number of success RBPO stories have already emerged in South Asia. According to NASSCOM[94] estimates there are around 50 odd rural BPOs in India spread across the nation, employing about 5,000 rural youth[95]. These numbers are growing rapidly, and Annex A provides more information on a number of existing RBPOs in the country.

In contrast microwork is an informal segment of IT-BPO which can occur at an urban or rural setting. It involves breaking insurmountable computational problems for businesses into simple human intelligence tasks, or “microtasks”, that can be distributed to human workers via the Internet. Examples of such microwork include market research, data input, data verification, copywriting, web research, tagging and categorizing, and even software development[96]. A market study estimated that over one million workers have earned US$ 1–2 billion via crowdsourced work allocation in the past 10 years[97], and it is suggested that the market could be worth US$ several billion within the next five years. Hence there have been a growing number of crowdsourcing and microwork aggregators that employs unskilled workers from various parts of the world; including Amazon Mechanical Turk, LiveWork, ShortTask, and Clickworker. These aggregators outsource microwork to anonymous Internet users, and provide supplementary income to unskilled workers as long as they have Internet or mobile connections and basic skills. Somali refugees in Kenya, for example, were able to earn money as microworkers after being provided training by Samasource (a non-profit aggregator), even though they have never seen a computer before. Similar to RBPOs, microwork also has significant economic and social development implications, especially as it relates to the employment of youths in developing countries.

Status of the Egyptian IT-BPO Industry

Egypt's attractiveness as an outsourcing destination has grown in recent years along with an impressive development of its ICT infrastructure. The Egyptian ICT segment has maintained a 20 percent growth rate and attracted local and foreign investments of more than US$ 8 billion over the past three years. A.T. Kearney ranked Egypt as 4th in providing IT offshore services worldwide[98], and the country is listed in Gartner's Top 30 global outsourcing locations study, along with favorable rankings in numerous other indices and reports. These accolades not only demonstrate the leaps that Egypt has made in terms of infrastructure, talent and attractiveness as an outsourcing destination; but also show the world what Egypt has to offer local and multinational companies.[99]

It is estimated by ITIDA that Egypt's IT-BPO had generated over US$ 1.1 billion in exports in 2010; and hires over 60,000 professionals (30,000 export-oriented, and 30,000 domestic-oriented professionals)[100]. In addition indirect employment is estimated at 120,000 in the same year. The country is continuing in its drive to develop the IT-BPO industry further as a plan is underway to raise exports to US$ 2 billion by the end of 2013, and the industry is expected to grow to US$ 10 billion throughout the next 10 years. If the number of employees working in exporting IT services increases constantly, Egypt is also expected to have a total 490,000 by the end of 2020; 140,000 of them will have direct jobs while the rest will work indirectly or as technicians.[101] However these notable achievements to date are focused only on the urban and formalized IT-BPO segments. Hence the significant potential of RBPOs and microwork for employment remains largely untapped in Egypt.

Internet Connectivity and IT-BPO

In general cost effective and reliable internet connectivity is the vital lifeline for IT-BPO services industry. This is underscored by the inclusion of broadband availability, cost and reliability as one of the key measures in almost all global rankings of outsourcing destinations. In this aspect Egypt has one of the best communications and IT networks in the Middle East and Africa region as the country is connected to international telecommunication infrastructure via three major submarine fibre-optic cables, with three more expected shortly. It is this high level of connectivity that provides Egypt a considerable advantage over other potential African BPO suppliers[102].

However Egypt's advantage in connectivity is largely relevant only the urban and formal IT-BPO sub-sector, as its consumer broadband connectivity still has significant room to grow. Broadband access is particularly important for RBPOs and microwork as it also serves as the lifeline for these RBPOs and microworkers to access IT-BPO opportunities and deliver services. For example, the HDFC Bank was one of the first large company to set up a RBPO in India, and all it required is a broadband connection as it is the only infrastructure issue that could not be addressed by the bank[103]. Similarly microwork requires only for youth or women to have a computer with internet access to participate. However affordable and reliable broadband is needed for them to access these opportunities and provide their services, as the entire concept of microwork is based on distribution of work over the Internet.

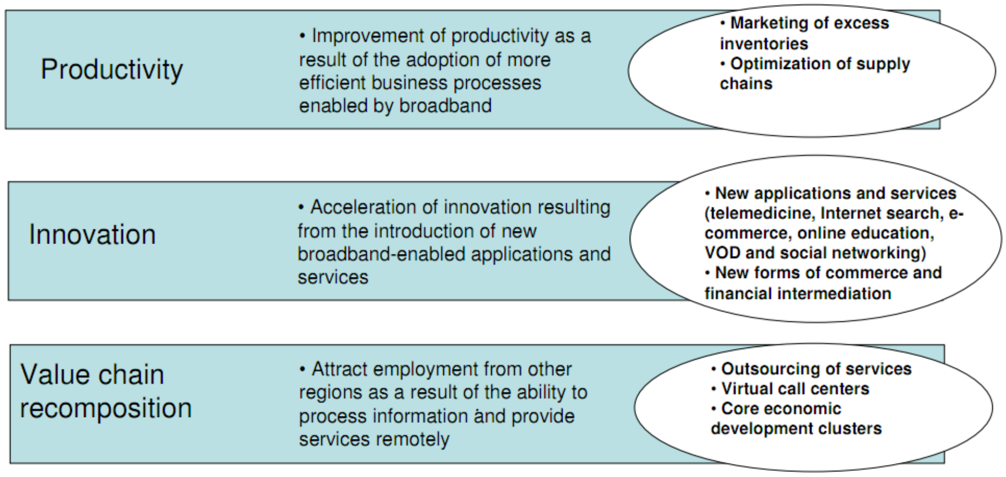
The General Impact of Broadband on Development

Broadband connectivity is proving its value as a "general purpose technology" (GPT) that enables and sustain long term growth and innovation. Other GPTs include steam power, internal combustion engine, electricity, plastic and the micro-processor; whose impacts can be regarded as transformational. In addition, broadband is seen as having a "multiplier" effect (*i.e.*, increasing in broadband access results in additional increases in other related activities). Broadband availability stimulates business activity, spurs upstream investment and creates new industries[104].

However there are limited studies on the impact of broadband on development to date. From a GDP perspective a World Bank study has estimated that a low or middle-income economy with an average of 10 or more broadband subscribers for every 100 people would have enjoyed a per capita GDP growth higher by 1.38 percentage points on a recurring basis[105]. On a country level the World Bank has also estimated that a 10 percentage point increase in broadband penetration in Lebanon[106], would result in a recurring point estimate of 1.38 percentage point increase in the growth rate of GDP per capita.

There are also limited studies on the impact of broadband on employment in general, and this paper has found no existing study on its employment on the IT-BPO industry in particular. One study on the impact of broadband for Germany postulates that broadband infrastructure results in 3 types of network effects - these being productivity, innovation, and value chain recomposition (refer to Figure 1)[107]. The value chain recomposition effect mentioned is directly relevant for RBPOs and microwork as they are the direct outcome of outsourcing of services and call centers described.

Figure 1: Three Network Effects from Broadband Infrastructure



Source: Dr. Raúl L. Katz et al. 2009. *The Impact of Broadband on Jobs and the German Economy*. Columbia Institute of Teleinformation. http://www.teleadvs.com/images/NYU_Katz.pdf

However a case study on the United States offers the most relevant findings from an employment perspective. This study found the broadband network multiplier to be one of the sources expected to spur employment; and estimated that with every one percent increase in broadband penetration, employment rises from 0.2 to 0.3, or approximately 290,000 jobs[108].

Impact of Broadband on IT-BPO Employment in Egypt

Since there is no existing literature on the impact of broadband on IT-BPO employment, this paper builds on the limited studies described above to estimate its impact on IT-BPO employment in Egypt. The estimate is for a 10 year period (2011 – 2020) to provide a longer term perspective, and a highly conservative approach is adopted for the estimation. The approach also focuses only on employment increase in the RBPO and microwork sub-industry (which is part of the "value-chain recomposition" effect referred to above). This is because it is not expected for consumer broadband to have significant impact on the formal and structured IT-BPO industry in general, as Egypt already offers competitive and reliable connectivity for businesses through multiple undersea cables.

The government's IT-BPO employment estimates and projections mentioned above are used as the base industry employment numbers for the estimation, since RBPO and microwork is a sub-industry within IT-BPO. Hence it begins with ITIDA's last available estimates of 60,000 direct and 120,000 indirect jobs in 2010; and ends with the projected 140,000 direct and 350,000 indirect jobs by 2020. Based on these numbers, the estimated number of jobs for the years in between is calculated on a straight line basis for the purpose of simplicity. A conservative broadband penetration rate is also assumed for this calculation. Hence it is assumed that broadband penetration will start to increase by 5 percent in the year 2013, and reach a cumulative 20 percent increase by 2020. This assumption is highly conservative in view of the fact that Egypt has already aimed in 2009 to increase broadband penetration by four-fold in four years[109]. In addition the broadband network multiplier from the United States case study is also used for the extrapolation in direct and indirect employment (i.e. each percentage increase in broadband penetration leads to 0.2 to 0.3 percent increase in employment). The higher estimate of 0.3 percent is used as the multiplier for this calculation, since RBPOs and microwork are expected to be impacted to higher degree than other sectors or industries. However the 0.3 percent multiplier is expected to be a conservative estimate, since broadband should have highly significant impact on RBPOs and microwork.

Annex 2 provides the details of the calculation based on these base numbers, assumptions and multiplier used. The impact of broadband on IT-BPO employment in Egypt is estimated to result in an increase of 136, 841 jobs by the year 2020. This consists of 39,886 direct and 96,955 indirect jobs in IT-BPO; and the yearly increase in employment is also included in the annex. As discussed this estimate is highly conservative as it covers only the rural and informal IT-BPO sub-sector, and is based on the conservative assumption on broadband penetration rates and multiplier used. Given the industry's preference it is also expected for these jobs to be filled mostly by Egyptian youth (and women in particular); hence the benefits from a social development impact should also be taken into account when assessing the overall impact of broadband for IT-BPO.

Annex A: Examples of Rural BPOs in India

RURAL BPO	LOCATION	PROPOSED PLANS	CURRENT STATUS	SERVICES OFFERED
DesiCrew Solutions	Six delivery centers across Tamil Nadu	Planned to employ 1,000 people by end of 2010 and 5,000 employees in 50 centers across India by 2015	By August 2010, DesiCrew had around 170 employees in six delivery centers across Tamil Nadu	Digitization services such as data entry and data conversion. Content creation and validation, GIS based mapping services, transcription and localization
Source for Change	Bagar, Rajasthan	Plans to hire 500 employees by the end of 2012 by following a 'hub and spoke' system comprising centers with 30–50 employees each.	As of early 2010, the operation had around 25 employees in Bagar	Data entry, web research and local language call services
RuralShores	Seven delivery centers throughout South, West and East India.	Mission to establish 500 centers and employment for 100,000 rural youth by around 2015	Between 100-300 people in seven delivery centers	Data capture, documents processing, expense processing, Image indexing, reports generation, trend analysis
SourcePilani	Pilani, Rajasthan	Plans to grow to 150 employees by 2010 end and five centers and a strength of 500 by 2015	By September 2010 the company had 60 employees	Medical transcription, call center customer support
eGramIT	Three villages of Andhra Pradesh	No available information on growth plans	About 500 rural youth in 3 villages of Andhra Pradesh by 2010	Digitization, vendor payment processing, translation services, desk research, voice support

Source: Kumar Parakala. 2011. *Rural BPOs in India: Are they over-hyped?* Global Services Media, March 2011 Newsletter. www.globalservicesmedia.com

Annex 2: Calculation for Estimated Increase in Employment

Year	2010	2011	2012	2013	2014	2014	2015	2016	2017	2018	2019	2020	*Subtotals*
Urban and Formal IT-BPO Industry Employment													
Direct Jobs (Cumulative) *Based on ITIDA's IT-BPO industry estimates for 2010, and projections for 2020.*	60,000	67,273	74,545	81,818	89,091	96,364	103,636	110,909	118,182	125,455	132,727	140,000	-
Indirect Jobs (Cumulative) *As per above note.*	120,000	140,909	161,818	182,727	203,636	224,545	245,455	266,364	287,273	308,182	329,091	350,000	-
Broadband Penetration & Employment Rates													
Assumed BB Penetration Rate (Cumulative)	-	-	-	5%	7%	9%	11%	13%	14%	16%	18%	20%	-
Percentage Employment Increase *Based on the broadband network multiplier of 0.3% increase for every percentage point increase in broadband penetration*	-	-	-	2%	2%	3%	3%	4%	4%	5%	5%	6%	-
RBPOs and Microwork													
Direct Jobs (Incremental)	-	-	-	1,227	1,838	2,530	3,303	4,159	5,097	6,116	7,217	8,400	39,886
Indirect Jobs (Incremental)	-	-	-	2,741	4,200	5,894	7,824	9,989	12,389	15,024	17,894	21,000	96,955
Total Increase in Employment	-	-	-	3,968	6,038	8,424	11,127	14,148	17,485	21,140	25,111	29,400	***136,841***

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Chapter 3.3

BROADBAND IMPACT ON THE ECONOMY: THE BANKING AND FINANCIAL SECTOR

Introduction

In the past decades the adoption of new technologies by the banking and financial sector has triggered remarkable changes in the ways business is conducted and products and services are developed. All actors of this sector have been impacted, including central banks who have played an leading role in encouraging adoption of new technologies with a view to improve transparency and quality of service, and lower risks and costs, in particular through their national clearing systems. These changes have touched front-, middle- and back office operations of banks and financial institutions, and have led to changes in the qualifications needed amongst banks staff and managers. Those changes have also been spurred by the evolving demand expressed by households and businesses that have in parallel benefited from increased competition rising from reforms and private sector participation in the banking sector. And indeed, those changes have been allowed by investments in telecommunications infrastructure, and in particular thanks to the availability of broadband connectivity. The Egyptian banking and financial sector has experienced similar structural changes.

While the literature on the impact of information technology (IT) on the banking industry in industrialized and developing countries is abundant, there has been no study on the relation between availability of broadband and banking sector development. Hence this chapter of the Paper on the Broadband Impact on the Egyptian Economy will (i) provide some general examples of the impact of adoption of information and communication technologies (ICT) in the banking industry in particular in terms of efficiency worldwide, and highlight the benefits of broadband connectivity to enhance ICT usage, (ii) give some specific examples of the potential of banking sector development relying on the availability of broadband in Egypt, and (iii) suggest in conclusion some policy recommendations that could be reinforced by further analytical work.

ICT, broadband and banking sector development

In this first section, we are providing a rapid literature review that discusses the benefits of ICT for the banking industry. This section concludes that while there is a number of studies and cases looking at the relationship between ICT and banking performance, there are no studies done on the underlying relationship between broadband availability, ICT investments by banks and banking performance. It suggests some possible areas of further data collection and analysis.

The impact of ICT on the banking industry worldwide – literature review

Short literature overview

Some earlier literature defends the Solow Paradox in showing that ICT in the early stage affected negatively banks efficiency and may have reduced productivity. For instance Shu and Strassmann (2005) surveyed 12 banks in the US between 1989 and 1997 and showed that though information technology has been one of the most essential factors of investment, it did not translate into a direct improvement of banks earnings. The Solow Paradox is explained by the time lag between investments and actual results in efficiency and productivity. This lag can largely be attributed to factors such as human resources capacity building and obsolescence factors playing at full. In industrialized countries, thirty years into the ICT revolution, investments in ICT in the banking sector have clearly been vital to improve banks competitiveness. In developing countries, investments in ICT are proving to play the same effect.

Another set of literature has on the contrary highlighted a positive impact of ICT on the banking industry performance. In the 1990's, Webster (1997), using the rate of return on assets (ROA) and the rate of return on equity (ROE) as a measure of banking performance, demonstrated that technological change is significantly related to banking performance. A positive relationship between ICT on the one hand, and productivity and cost savings on the other hand was also demonstrated by Kozak (2005). Jalal-Karim and Hamdan (2010) identified in their literature review, two main outcomes in the relationship between ICT and banking performance: a cost advantage when ICT contribute to bring down operational costs of banks; and a network effect when economies of scale diminish marginal cost of adding points of sale and services. Egusquiza and Sastre de Miguel (2001) in their study on Spanish banks call for more nuanced conclusion and further analysis (Box 1).

Box 1 - Impact on operating costs and revenues, efficiency and productivity, and risk – example of Spain

Egusquiza and Sastre de Miguel (2001) analyzed the effects of technology on the costs, productivity and risks of Spanish banks in the 1990's. They have analyzed time series of ratios such as IT expenses over operating expenses, IT expenses over overheads, IT expenses over number of employees, IT expenses over number of branches, ATMs (annual rate of growth), IT expenses annual rate of growth distinguishing between total expenses and expenses without outsourcing costs. The result of their analysis is that in the long term one can expect a reduction in average costs, however in the short term the influence of the technological development on costs in banking activities is harder to demonstrate.

The study also looks at the relationship between total factor productivity (as the ratio of total customer credits and deposits over the number of employees and the banks own funds) and spending on technology , to conclude that ICT may have helped to improve total factor productivity, but that further testing is needed at a disaggregated level.

In the case of Sri Lanka, in a presentation to the industry in 2008, the Deputy Governor of the Central Bank of Sri Lanka[110] pointed out at a number of improvements that has characterized the Sri Lanka banking and financial sector in the past two decades, through the adoption of ICT: speedy processing and transmission of information, easy marketing of banking products, enhancement of customer access and awareness, wider networking and regional and global links on an unprecedented scale. She underlined the impact of foreign and private sector participation as an accelerator to this trend, as those banks were first to bring in the latest technology-based services, offering multichannel distribution solutions to their customers through telephones, cell phones and the Internet. The Deputy Governor also highlighted the importance of IT outsourcing by the banks which has benefited countries like Sri Lanka that can provide BPO solutions for foreign banks. Finally she insisted on the leading role played by the Central Bank in initiating the RTGS system (real time gross settlement) for interbank and third party settlements, as well as the push for Cheque Imaging and Truncating (CIT) system that had a tangible impact in improving the speediness quality of the retail segment of payments and clearing.

Overall the literal review shows that there has been a positive relationship between ICT adoption and banking performance although some studies call for more nuanced analysis in particular with regard to the impact on labor productivity and human capital. Katz and al. conclude that broadband spill-over employment effects are not uniform; they tend to concentrate in service industries (e.g., financial services, health care etc.); these effects can also lead to a net reduction in employment resulting from capital-labor substitution.

Ways of doing business - Illustrations of changes linked to ICT adoption in the banking sector

For the banks, increased investment in ICT has been spurred by competitive pressures and regulatory incentives. Facing an increasing competition driven by sector liberalization and increased private sector competition, banks have been more and more forced to improve their services in order to safeguard and expand their market shares. Regulatory incentives have also played an important role. For instance in Europe, the single currency adoption in 2000 (combined with the year 2000 transition) created an important incentive for the banks to invest in ICT and hire highly qualified new staff. Greater transparency and accountability is also required from banks that have to transmit more and more regularly information to regulatory bodies in charge of insuring level playing field competition and financial sector stability.

Central banks have driven ICT investments in the banking sector, notably through the upgrade of their payment systems (RTGS system) and the automation of clearing houses. In addition, international regulatory frameworks (Bale 2 and Basel 3) are requiring the development of information systems and compliance solution frameworks that are more and more sophisticated and memory hungry, and involve an even greater ubiquity and speed in data transfers.

For the customers, ICT enabled new banking services have meant an easier and cheaper access to banking information and services. Banking services can now be accessible through ATMs, on the phone (especially mobile phone) and over the internet.

For the employees, the mainstreaming of ICT in their workplace has displaced/disqualified some staff, and required from the employers that training be offered, or new hiring be done. Studies point at two opposite effects: on the one hand, ICT in banking operation has allowed a greater efficiency and a lower cost of labor; on the other hand, better qualified staff for the information management systems has increased average employee cost.

Broadband enabled ICT development and banking performance

Questions unexplored

While studies on the relation between ICT and banking performance are abundant, the specific topic of the existence of broadband as an enabler to banking sector development has not been tackled.

El Kasheir and al. (2009) looked at the factors affecting continued usage of internet banking among Egyptian customers, but relies solely on behavioral theories, in particular the technology acceptance model and the diffusion of innovations theory. It does not factor in the actual amount of investment in telecommunication infrastructure as a determinant of customers' continued usage of internet banking. Yet one can argue that the cost of access to the internet, and/or quality of the internet (both related to an broadband infrastructure regulated under an open access framework) can significantly influence the usage of internet banking.

Katz and al. explores the specific impact of broadband development on employment and output of Germany's economy. Over two time horizons (2014 and 2020, based on national strategies), the researchers estimate that the economic impact of broadband development over a ten year period in Germany will amount to 968,000 additional jobs and EUR 170.9 billion in incremental output. The financial services represent only 5,000 out of the one million or so new created jobs, and the study does not disaggregate the contribution of the financial services to the incremental outputs.

Overall the literature on broadband and banking performance is quasi nonexistent. Hence there is a need for further research in:

- broadband availability and impact on recurring telecommunication expenses for banks, which would probably be lowered and leading to improved profitability,
- broadband availability and impact on total output: through improved automated data management that would increase total factor productivity through technology and human capital development ;
- continuity of network connection, which would presumably improve the risk management;
- broadband availability and increased access to finance.

ICT and access to finance

Technology adoption by banks varies depending on their strategy: all banks have adopted technology albeit at a different pace. This aspect is important because it illustrates how priorities (branch development versus technology adoption) can impact the investment in new technology in the banking business. However there is little research on the relationship between availability of broadband and strategic priority given to branch development or to technology adoption.

Egusquiza and Sastre de Miguel (2001) demonstrate that different types of banks in Spain have had a different pace of technology adoption, depending on their strategy. They compare three sets of indicators: operating costs, output (through two indicators: total assets and total customer credits and deposits), and branch network, for three groups of banks: the major commercial banks, the small and medium banks, and the savings banks and credit cooperatives. The savings banks and credit cooperations have recorded higher growth in their activities than the commercial banks. At the same time their branch network and total number of employees have grown, in contrast to the trends for the same variables of commercial banks. This illustrates different strategies, one of geographical expansion for the savings banks, versus one of rationalization for the commercial banks. Both strategies however are bandwidth hungry: savings banks need to connect their physical points of contact, whereas commercial banks are developing branchless technologies and services. In the study, the contribution of IT and communications spending to the growth of overheads and operating is however greater in the case of commercial banks. This latter may testify that some of the branches run by savings banks and credit cooperatives are not connected, and that transfer of data are done through batch-processing mode.

An interesting study on the Brazilian branchless banking in Brazil, published by CGAP[111], shows a relatively successful enabling banking regulation promoting branchless banking (with 40.5 ATMs and 1,667 POS for 100,000 inhabitants). In analyzing the bottlenecks to a more successful financial inclusion policy (still 70% of the adult population is lacking a bank account), the author points at pricing regulation and mobile network operator platform interoperability, more than to the limitation to access to broadband, although the study reminds that broadband internet penetration remains low at 5.3%.

In conclusion to this paragraph, desk research did not look in-depth into the relationship between availability of broadband and banking performance, including access to finance. This probably means that availability of broadband has not been considered as a top bottleneck to banking expansion and performance.

Potential gains of the broadband for the banking sector in Egypt

Under the assumption that broadband is conducive of banking sector development, this sections looks as the specific cases of banking sector outreach (financial inclusion) and reliance of Egyptian banks on broadband to improve their effectiveness and soundness (sector risk).

Financial inclusion: bank branches and branchless banking require broadband

Banking outreach in Egypt and the predominance of Egypt Post

A brief overview of the banking sector in Egypt shows that it is currently predominantly represented by public sector institutions with relatively late adoption patterns of new technologies. The banking sector is dominated by state ownership, in terms of assets and number of branches. Collectively, state-owned banks account for more than 60 percent of total assets, and 85 percent of branches (2006 data). Compared to their private counterparts, state-owned banks lag in efficiency and in performance generally, as evidenced in their financial indicators. State-owned banks have also been slow to modernize and innovate. Management indicators, such as expense ratios and earnings per employee, show that on aggregate the banking system is not operating efficiently, as it suffers from high operating costs and low earnings. Additionally disparities between private and state-owned banks in Egypt due to variations in management performance show up in performance measures.

Another characterization of the banking sector in Egypt lays in the differences in access to finance in urban areas versus rural area. Egyptian banks have relatively few outlets for basic banking services (Table 1), and private banks have the fewest number of branches. There are a very limited number of ATMs per 100,000 inhabitants (1.8, versus 17 in Lebanon or 40.5 in Brazil for instance) as well as limited number of branches (3.6, versus 18 in Lebanon). In their strategy, private banks prioritize higher margin customers who tend to live in urban areas between Cairo and Alexandria.

Table 1 - Branching and ATM presence – Cross country comparison (source: Nasr and al. Access to finance and economic growth in Egypt, 2007)

Country	Branches *per 100,000 people*	ATMs *per 100,000 people*	GDP per Capita *(US $, 2003)*
Honduras	0.73	3.56	1,001
West Bank-Gaza	3.27	3.24	1,026
China	1.33	3.80	1,094
Egypt	**3.62**	**1.78**	**1,220**
Bosnia	3.86	5.36	1,682
Colombia	8.74	9.60	1,747
Belarus	4.79	5.06	1,770
Dominican Republic	6.00	15.08	1,821
Jordan	10.02	9.38	1,858
Albania	2.11	2.37	1,933
Kazakhstan	2.47	7.01	1,995
Iran	8.39	1.25	2,061
Lebanon	18.01	16.81	4,224
Chile	9.38	24.03	5,462
Mexico	7.63	16.63	5,968
Czech Republic	11.15	19.57	6,123
Argentina	10.01	14.91	7,483
Saudi Arabia	5.36	14.7	8,366
Bahrain	13.48	26.83	10,791
Kuwait	8.27	19.69	14,848
Israel	14.74	18.81	16,686
Sweden	21.79	29.56	28,858
Regional Average	9.46	12.5	6,787
Industrialized Average	35.31	73.54	28,983
Other Developing (average)	6.89	13.3	2,748

Source: World Bank, Measuring Banking Sector Outreach, Indicators of Access to and Use of Financial Services across Countries, Thorsten Beck, Asli Demirguc-Kunt, and Maria Soledad Martinez Peria (2005).

Egypt National Postal Organization stands out as the first ranking institution in terms of number of savings accounts (18 million) and size of its network. Egypt Post is present in 218 cities and 4,500 villages throughout Egypt. With 47,000 employees, 3,600 post offices and 6,500 licensed postal agents (franchised post offices through private-public partnerships), Egypt Post serves 20 million customers. In the Upper Egypt and Delta regions, where there are very few bank branches, there are 2,800 postal outlets, placing Egypt Post in a unique position to improve access to finance in these regions. It has an ambitious plan to interconnect all its post offices in order to allow high speed transfer of data, with a view to improve management information systems, service developments, and strategic partnerships with financial institutions looking for a broader outreach (without incurring network fixed costs) such as the Social Development Fund with which Egypt Post recently signed an agreement to distribute on its behalf, micro-finance products and services. Similar partnerships with financial institutions could develop in the future that would lead to a higher utilization of the postal network. Further information has been requested from Egypt Post with regard to their recent and future investment plan to interconnect their post offices, and how the current availability of broadband in Egypt has helped or hindered its plan so far.

The case of Bank Misr

State-owned banks, like Banque Misr and National Bank of Egypt, have also a relatively large number of outlets, of about 500 each. Their strategic approach caters for a wider customer basis than most of the private and foreign banks active in Egypt. Box 2 illustrates the case of Banque Misr and shows how one of the first banking institutions in the country has relied on ICT to grow, and how the availability of broadband will enable its future development.

Box 2 – The use of ICT by Banque Misr

Current architecture: 2 datacenters (400 to 500 servers), 470 branches in 29 provinces, 1,000 ATMs connected through 128 kbps, 3G or satellite

Connectivity: MPLS technology from the 3 largest ISPs in Egypt (Vodafone, Telecom Egypt, Etissalat Misr), with branches bandwith ranging from 256 Kbps to 2 Mbps depending on branch size

Product portfolio: saving and investment certificates, ATM services, SWIFT, payment, loan, e-payment, online banking

MIS applications: core banking (Flexcube), email-file-print sharing (Microsoft), investment applications (mutual funds), card application (OASIS), HPS Switch (Point of Sale Gateway), IP telephony and call center (Cisco)

ICT corporate services: IP telephony, video collaboration, email and voicemail, Internet, file sharing, printing

Investments in technology: around EGP 111 million (2005-2010) and EGP 11 million in the coming 5 years for new ATMs, queing system, kiosk and digital signage, unified communication, telepresence and videoconferencing, virtualization (datacenter and desktop), internet and mobile banking, Oracle financials, and close-circuit television over IP

Banque Misr is a clear illustration of the growing importance of ICT in the banking sector in Egypt. Most of the products and application are "bandwidth hungry" and the availability of affordable and quality broadband can affect considerably its development as it impacts:

- Time to market performance such as the launching of new products (through digital signage and video streaming)
- New ways of doing business such as virtual expert (HD video calls with clients)

- Reliability and efficiency through the diminution of network downtime
- Security through CCTV over IP to secure remote branches

Mobile banking in Egypt

Mobile banking is likely to take off in Egypt. The socio-demographic of rural/urban and the high penetration rate of mobile telephony indicate that the Egyptians are likely to be early adopters of mobile banking solutions. The enabling environment will progressively be in place. There are already 24 financial institutions that have received a license to conduct ebanking services (Table 2), and a new law related to mobile banking was reportedly adopted in 2010. However no analysis of these recent developments and its potential impact on the sector in the near and longer term was found available.

Table 2: Banks licensed to carry out eBanking (source: CBE, Annual report 2008-2009)

Name of The Bank	No	Date of licensing	Type of Transaction
National Societe Generale Bank	1	13/11/2002	Fona Banking
	9	22/12/2003	Internet Banking
	12	5/8/2004	Mobile banking
Egyptian Gulf Bank	2	22/12/2002	Internet Banking
Arab Bank PLC	3	22/12/2002	Mobile-Phone banking, Internet banking
Commercial International Bank	4	2/2/2003	Phone banking, E-CIB
	8	22/12/2003	Internet Banking
Credit Agricole	5	26/2/2003	Phone plus
	13	20/12/2004	Smart Card
	14	23/6/2005	Internet Banking
HSBC-Egypt	6	25/3/2003	Internet banking, Phone banking
Citibank N.A	7	27/3/2003	Citi connect, Citi direct, Citi Bank on line
Faisal Islamic Bank of Egypt	10	18/3/2004	Internet banking
BNP Paribas	11	20/5/2004	Internet banking
		3/7/2007	Internet banking (Connexis Cash, Connexis Trade)
Principal Bank for Development and Agricultural Credit	15	20/2/2007	Visa Prepaid card (Sounbalah)
Bank Audi	16	4/4/2007	16555 Call Center
	16	3/7/2007	Internet Banking (Audi On Line)
Mashreq Bank	17	25/9/2008	On Line Internet Banking
Blom Bank	18	3/12/2008	Internet Banking
Ahly United Bank	19	6/1/2009	Internet Banking
Bank of Alexandria	20	6/1/2009	E-Banking
Housing & Development Bank	21	11/2/2009	Vodafone Full-Cash
Misr Iran Development Bank	22	28/10/2009	Internet Banking
National Bank of Abu Dhabi	23	2/11/2009	Online Banking
Piraeus Bank	24	5/11/2009	E-Banking

Overall the financial sector in Egypt is ready to cater to a larger number of customers, including those at the lower layers of the pyramid and living in rural areas, using new electronic delivery channels. In this context the need for greater, cheaper availability of broadband connectivity seems large.

ICT and risk in the banking sector

The CBE is inviting the financial institutions to be quick adopters of new ICT tools as it sees it as a way to reduce risks, speed up settlements, enhance reliability and confidentiality of settling payments with a view to move to a cashless society. The RTGS was enhanced in 2009 to better prevent systematic risks related to payment systems and credit risks, as well as reducing the risk of liquidity management. The CBE also set up the Disaster Recovery Site of the RTGS system. It supports several initiatives to develop electronic disbursement of salaries, improve its banking sector database, and finalize the the data network that links the CBE with other banking sector stakeholders.[112] These initiatives are bandwidth hungry,

On the other hand, the development of ICT in the financial sector creates new challenges to the regulator in charge of the soundness and the stability of the financial system. The introduction of new technology platforms for payments, clearing and settlements require new regulations. The CBE has to adjust its regulatory supervision, and was lately consulting with the sector to assess the risk of allowing more outsourcing of ICT systems management to the private sector.

Hence increased access to affordable broadband in the banking sector also requires that regulation be adapted and forward looking.

Conclusion

This note confirms that while there has been several analysis of the relationship between ICT adoption by banks and banking performance, there is no available analysis of the relationship between the availability of broadband connectivity and the development of the banking and financial sector. Qualitative statements point at a positive relationship; however no analysis has quantified the impact on the banking sector growth and contribution to the GDP, or the creation of employment.[113]

In order to bring more substance to this analysis, additional information pertaining to the Egyptian context could look at the following aspects:

- Capital investment by Egyptian banks and financial institutions over the past 10 or 20 years, and in particular investments in ICT (including and excluding outsourcing), to compare with total factor productivity, ROA, ROE and branch/network development
- Telecommunication and ICT recurrent costs incurred by Egyptian banks in 2000-2010, and analysis in relation to branch expansion 2000-2010, credits and deposits by clients, profitability, and employment
- Mobile banking development in Egypt: current situation and prospects depending on different scenarios of broadband availability, pricing, and quality, in the wake of smart phones (special attention should be paid to reachability to the marginalized people)
- Mobile banking development in Egypt and the enabling legal and regulatory framework (especially, information security and privacy issues should be carefully addressed)
- Link between e-commerce and mobile banking development: contribution to GDP and employment creation

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Chapter 4.

STRATEGIC POLICY OPTIONS TO DEVELOP BROADBAND IN EGYPT

Introduction

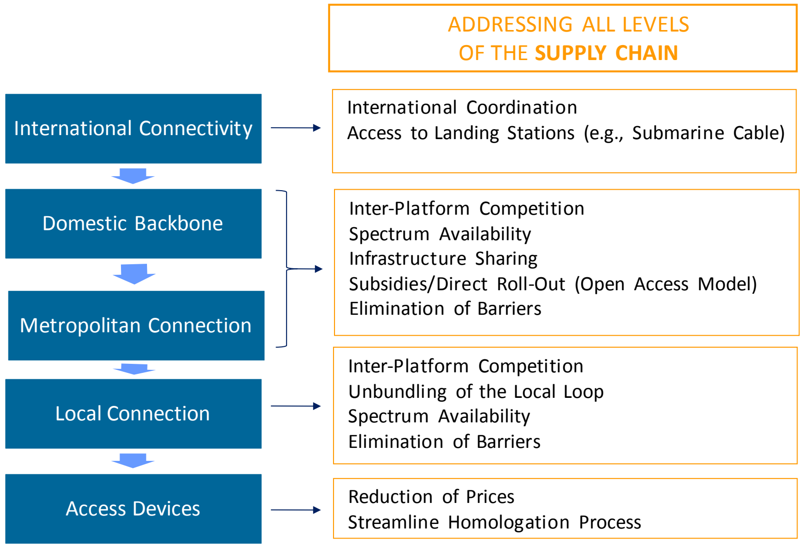
This chapter is divided into three parts. The first part assesses the strategic importance of broadband and the current market structure in Egypt, the second part assesses the main issues in the area of broadband development, while the final chapter presents concrete options, presenting them into an action plan.

Strategic Importance of Broadband in the Egyptian Context

Broadband as an Engine of Economic Growth and Job Creation. Broadband is a crucial enabler of economic growth and job creation. As discussed in Chapter 2, numerous studies have found an impact from broadband in economic growth. Econometric results from different countries show that a 10 percent increase in broadband penetration could result in over 1 percentage point of GDP growth. Broadband also drives competitiveness and job creation.[114] There are also numerous studies that confirm broadband impact on job creation. Based on multipliers from these studies, Chapter 2 shows that the base scenario of broadband diffusion from Chapter 1 could result on an average of 25-30 thousand new jobs. Additionally, increase on internet users (a likely result from broadband penetration) has also been found to be correlated with export growth. Particularly, a one percentage increase in internet users is correlated with a boost of exports of 4.3 percentage points.[115]

Broadband Supply Chain. For broadband to be wide-spread available for the population at affordable prices, it is needed that the broadband supply chain is efficient. In simple terms, the broadband supply chain can be divided into international connectivity, domestic backbone and metropolitan connection, local connection and access devices. For a well performing and efficient broadband market to function, all segments of the broadband supply chain need to be addressed with appropriate policies (see Figure 1). Competition is the key growth driver, at all levels of the supply chain. Any bottleneck in each of the segments of the supply chain will translate into higher prices and lower quality for the customer.

Figure 1.- Broadband Supply Chain and Policies to Address Bottlenecks in Each Level



Source: Strategic Options for Broadband Development in Egypt (World Bank FBS Product)

The following two sections will provide a brief overview of the sector and its impact on the efficiency of broadband supply chain in Egypt.

Brief Summary of Telecommunications Sector in Egypt

Regulatory Framework

Applicable Laws. Telecommunications in Egypt is governed by the Telecommunications Regulation Act (Law No. 10/2003), which was introduced in February 2003, coming into force in October of the same year. The law aims to oversee the development of the market and the introduction of competition in the fixed line sector, in compliance with the 1997 Basic Telecom Agreement (BTA) framework outlined by the World Trade Organisation (WTO). A number of new laws were enacted to facilitate liberalization, including the Investment Law (13/2004), the e-Signature Law (15/2004), the Tax Reform Law (91/2005), and the Competition and Anti Trust law (03/2005).

Responsibility of MCIT and NTRA. Ministry of Communications and Information Technology (MCIT) deals with ICT and telecommunications policy and strategy formulation (encourage access to high-quality ICT services at affordable price to the widest number of people possible, promote ICT industry, streamline government procedures by e-Government implementation, foster ICT-enabled services, etc). After the enactment of Telecommunications Regulation Act in 2003, National Telecommunications Regulatory Authority (NTRA) was established as an independent regulatory body, with a view to implement the abovementioned policies and strategies. Specifically, NTRA has responsibility for all aspects of licensing, numbering, interconnection, universal service (via the management of a Universal Service Fund launched in early 2005), consumer rights, management of the frequency spectrum, and regulation of imports and the manufacturing of telecoms equipment.

Creation of Telecom Egypt. Telecom Egypt (TE), the incumbent telecommunications operator, was established in 1998 to replace the former Arab Republic of Egypt National Telecommunication Organisation (ARENTO). In December 2005, 20 percent of stocks were sold in Initial Public Offering (IPO), while 80 percent is still owned by the Egyptian Government. NTRA awarded to TE a new operating license, allowing it to construct, operate, and manage the PSTN and giving TE the right to provide all forms of telecoms services except mobile in January 2006. TE currently provides a full portfolio of retail and wholesale services, including local, long-distance and international voice telephony, ISDN, ADSL, SDH, X.25, frame relay, ATM, IP, managed bandwidth, LAN/WAN intranet, VoIP, fixed wireless and VSAT; it offers internet and data services via its majority-owned subsidiary TE Data. As of today, TE Data dominates the broadband market with over 60 percent of market share.[116]

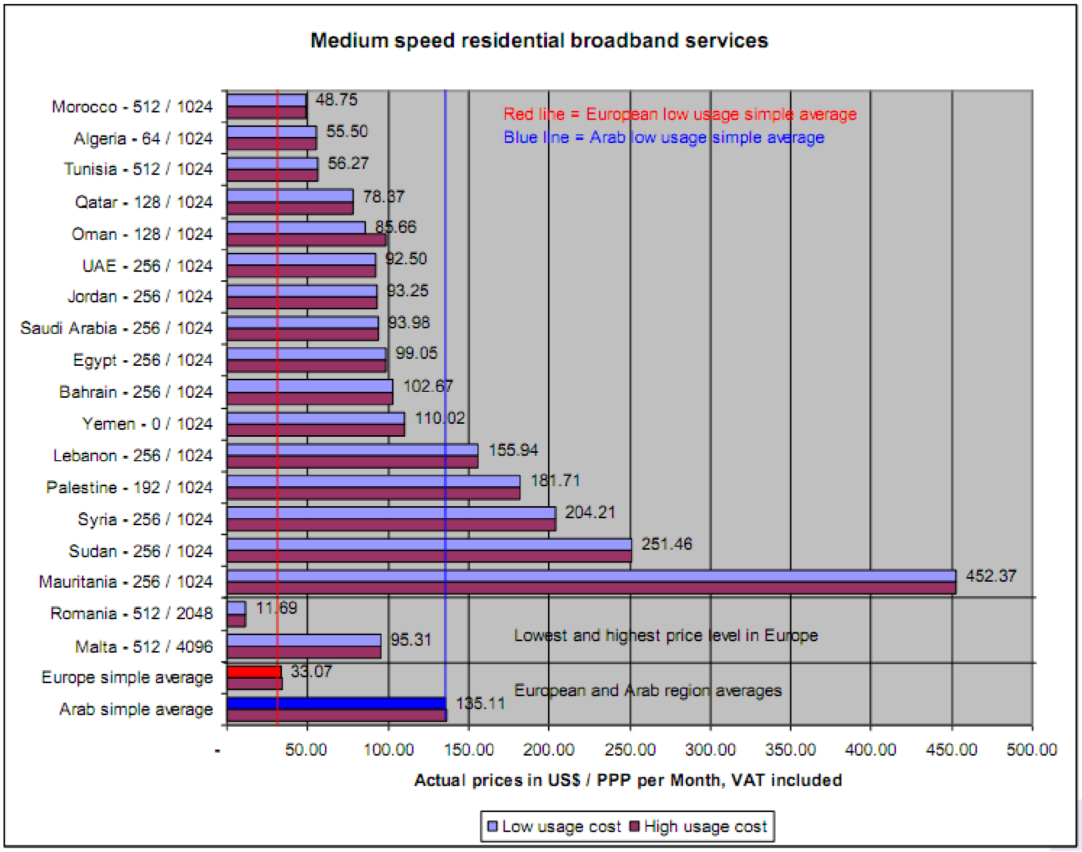
Mobile licenses. The mobile market featured a duopoly of Vodafone Egypt and MobiNil until May 2007 when Etisalat launched Egypt's third GSM cellular network, after winning an auction with EGP16.7 billion (US$ 2.93 billion). Vodafone Egypt and MobiNil paid EGP3.34 billion to NTRA to obtain 3G licenses, starting the service in May 2007 and in September 2008, respectively[117].

Data licenses. All internet service providers (ISPs) require a concession to launch services and licences are divided into three categories: Class A, to build and operate a nationwide internet backbone; Class B, to build and operate a nationwide public data network with co-location at TE facilities; and Class C, to provide internet services only. Only Class A concessions allow licensees to offer wholesale services. At the end of March 2009 (latest available data at end-August 2010) there were 210 licensed ISPs (four with Class A concessions, eight Class B and the remainder Class C), as well as four licensed VSAT operators.

Market Analysis and Status of Supply Chain

Low fixed broadband penetration. Fixed broadband penetration is low in Egypt with less than 1.5 percent of the population subscribed to the service (see Annex 1).[118] As reported by MCIT, ADSL has been the major fixed broadband method in Egypt.[119] Four companies, TE Data, LINKdotNET, Etisalat (acquired EgyNet in 2009), and Vodafone Egypt, offer ADSL. In October 2009, TE Data and TE announced the launch of fiber-to-the-home (FTTH) services in the Cairo suburb of Qatamiya, offering downlink speeds of up to 70Mbps and a triple-play bundle options, although availability is very limited. Fixed broadband prices are not high if compared with the region (Figure 2). Indeed, Egypt fixed broadband prices are below the Arab countries' average. However, availability of service (coverage) and affordability (given lower GDP per capita of Egyptian population vis-à-vis countries with similar prices, such as Saudi Arabia, UAE, Oman or Qatar) may represent a barrier for adoption in the market, resulting in overall low penetration (Figure 3).

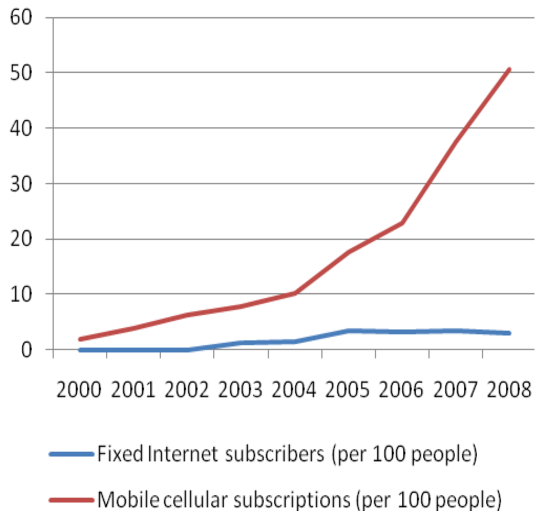
Figure 2.- Residential medium speed (1-4 Mbps) broadband – applying OECD basket methodology

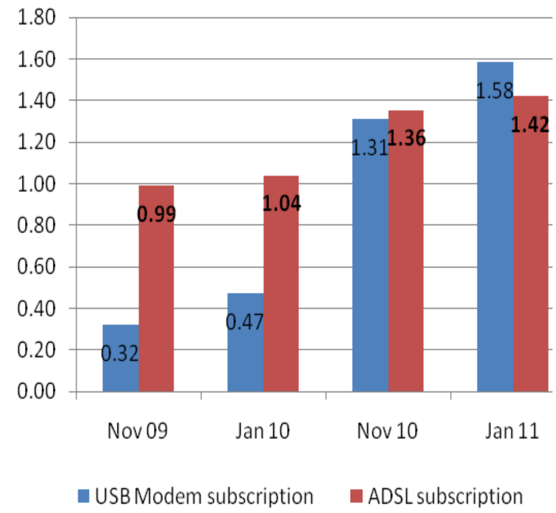


Source: Bahrain Telecommunications Regulatory Authority

Increasing wireless broadband. Building on mobile telephony wide penetration and growth in Egypt, wireless broadband is growing fast, having already surpassed ADSL's (the main fixed broadband technology in Egypt) broadband users (Figures 3 and 4). Over 15 million subscribers (almost 20 percent of the population) have 3G (mobile internet) services and over 1.5 million people is subscribed to mobile broadband through USB modems.[120] Etisalat, the third mobile operator which entrance in 2007 spurred the mobile market (resulting in over 12 percent of mobile market share by the end of 2010)[121], launched HSPA with an offer of up to 7.2 Mbps (download), as soon as November 2007. Vodafone and MobilNil followed suit and launched 3G services too. Etisalat is updating its mobile broadband network to offer higher speeds (of up to 42 Mbps).[122] Competition (especially since Etisalat entry) seems to be driving the mobile broadband market, with low prices overall and prepaid offerings.

Figures 3 and 4.- Mobile telephony and fixed broadband penetration growth (2000-2008) and Mobile broadband subscription (USB modem) vs. ADSL subscription (million users)





Source: World Bank Database and MCIT, Egypt.

Main Sector Issues

From the dialogue with the sector stakeholders, we understand that the main issues that should be considered in assessing the development of broadband in Egypt are the following:

a) **Limited broadband penetration, most users only have basic access.** Mobile broadband is growing at a high rate. On the contrary, the fixed broadband market, dominated by DSL, is witnessing a much slower growth. The growth in high-income compounds is quite good.

b) **The price of international connectivity, broadband backbone backhaul is a multiple of good international practice.** Higher wholesale prices at upstream level translate into higher prices for the consumers. In addition, operators, which are often driven by short term financial performance, are less inclined to spend in CAPEX at access level, as the input prices for wholesale access drive up operational costs.

c) **Limited effective competition in fixed broadband.** There are only a few, facilities-based DSPs. International connectivity is controlled by Telecom Egypt. Most of long distance infrastructure is controlled by Telecom Egypt.

d) **Liberalization and Telecom Egypt.** In addition, there is a concern that further liberalization opening may negatively affect Telecom Egypt, a company that employs over 51,000 people,[123] which may result in a political challenging environment for such liberalization policies. Revenues from international communications (retail and wholesale), and revenues from backbone and backhaul constitute an important part of the revenues of Telecom Egypt. Any policy that would negatively affect the revenues and profitability of Telecom Egypt may result in high political costs. Any exercise in cutting Telecom Egypt personnel is also challenging. However, the policy makers are also aware that there is an equally important "cost of non reform" for the Egyptian telecommunications sector, and, due to the important role played by broadband on economic growth, on the overall economy. This is probably the most complex issue faced by policymakers in the sector as it moves towards further reform. The balance of concerns needs to keep into account multiple considerations. First, aggressive measures that would undercut Telecom Egypt's revenue base are reported to be politically unfeasible. Second, measures that would extend Telecom Egypt's dominant position on essential infrastructure would be politically undesirable. Third, slow progress towards broadband development is also politically unacceptable, given the strong pressure on creating job opportunities for young people, an imperative objective that broadband can contribute to achieve. Incumbent operators do adapt to change, and can even prosper. For example, before the introduction of competition in the United Kingdom's telecom sector, in the mid 80's, British telecommunications was deriving over 40 percent of its overall revenues from international communications. Ten years after, the percentage was only 8 percent. But the overall revenues of BT increased dramatically in the same period. This is not an isolated example. It has been repeated by incumbents in most of liberalized markets. Incumbent operators can adapt to the changing market conditions. However, there needs to be a drastic change in the business model and the corporation needs to introduce organizational changes ranging from personnel, to IT systems, investment plans, internal organization etc. Given the political reality in the country, any broadband development plan will need to address two top concerns: a) introduce strong competition at each segment of the broadband supply chain, as a driver for accelerated broadband development and b) actively manage the transition for Telecom Egypt, bringing the company to path of sustainable financial performance, at acceptable job losses in the company. These two policy objectives would need to be strictly coordinated for a politically successful outcome.

e) **The sector generates a good amount of fiscal revenues**, which adds political pressures to further reform of the sector. In addition, there are fees on the main operators that can fund an extension of access through Public-Private Partnerships in an open, transparent and non-discriminatory environment.

Policy Reform

Supply and Demand Measures. This report advocates a substantial opening of the telecommunications sector in Egypt to further competition, allowing multiple network operators and service providers to offer broadband network access and services. This opening is coupled with measures to expand access and to build a solid FTTN infrastructure to support the future development of wireless broadband and FTTH. In addition, the Government would also support the demand of broadband services, through targeted demand stimulation measures (See Figure 4). Finally, this approach advocates a transition plan for Telecom Egypt to address the abovementioned political reality and reorganize the company to be a key partner in the development of broadband infrastructure in Egypt, transforming this company into a broadband operator with a sustainable business model.

The areas of reform advocated by this report are:

a) Removal of all entry barriers at Networks and Services Level; including provision of additional spectrum for wireless broadband (4G spectrum)

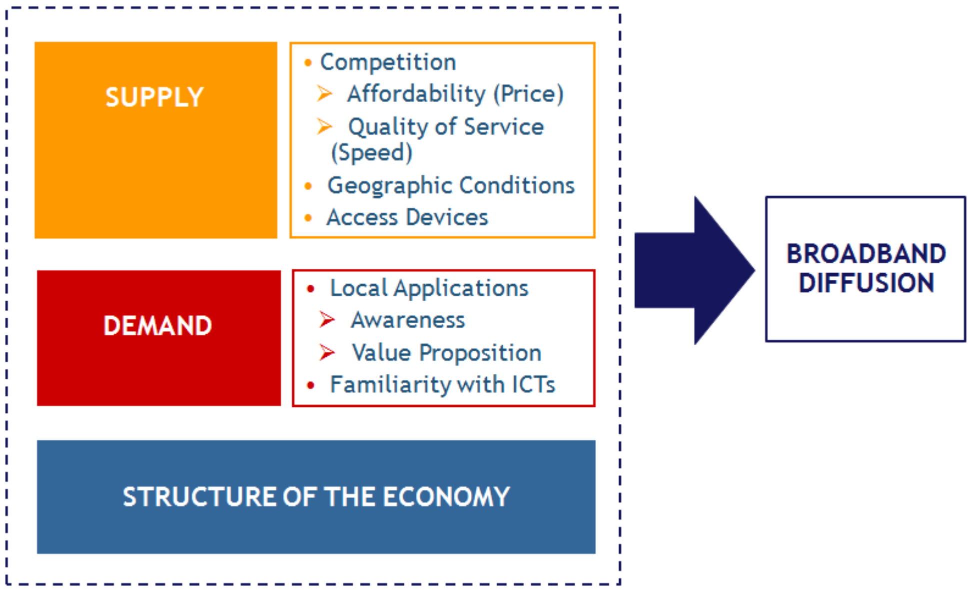
b) Proactive Competition in the area of Backbone and Backhaul, Leveraging on Fiber Optic Investments of Electricity and Transport Utilities;

c) Implementation of an ambitious Ultra-Fast Broadband (UFB) Plan, Structural Separation between Active and Passive Infrastructure and creation of a new company (SPV) for the development of passive infrastructure, and deployment of USO funds to extend broadband to rural areas;

d) Strengthening of NTRA's attributions in the area of anti-trust monitoring and enforcing in the telecom sector;

e) Stimulate demand through targeted measures for specific user groups, selecting measures with high potential employment generation, and/or high social value.

Figure 4.- Areas of policy action to foster broadband diffusion



Source World Bank, Strategic Options to Develop Broadband in Egypt (first phase deliverable).

Removal of all entry barriers at Networks and Services Level. International successful experiences in broadband development, such as those from OECD countries and of countries like Lithuania, Korea, Chile and Turkey, all point out to a common feature. The development of broadband in the country has been coupled with full liberalization of the telecom infrastructure. All of OECD countries, as well as Turkey and Bahrain (to quote two countries in the same region of Egypt), have introduced full competition. Most of Latin America and emerging Eastern European countries have also introduced full competition. In Egypt, the authorities have placed considerable efforts to increase the level of competition in the market in the last few years and have achieved excellent results. Mobile penetration increased dramatically, reaching most of the population (almost 90 percent of population as of 2010).[124] And prices are among the lowest among countries with a comparable income (see previous section on market description). These results were the product of a specific policy of introduction of effective competition in the mobile and the data market. As a result of this policy, the mobile market experienced a strong growth and prices dropped. However, the overall telecommunications market is only partially liberalized. Entry in the sector is limited and there are certain areas where Telecom Egypt is still the only or the dominant provider of infrastructure (for example, this is the case in international connectivity, access to landing stations, domestic backbone and backhaul). Mobile operators have the right to have their own international access, but this right is limited by the need to use the gateway to serve own mobile customers. In terms of backbone and backhaul infrastructure, there can be additional avenues to introduce effective competition. The number of data and international operators is limited, while there is scope for additional entry in these market segments. If all of Eastern European countries and Turkey have introduced full competition and achieved very positive results in doing so, Egypt could also follow the same policy and market structure, aligning its policies and market results to that of many of the neighborhood countries. Other countries in the North Africa and Middle East Region (such as Morocco and Tunisia) would likely follow the same example, creating a truly harmonized, regional market for telecommunications networks and services, which is likely provide increased economic benefits to the whole region.

To implement this measure, the Government of Egypt should set a date for full liberalization, for example, this date could be January 1, 2012, similarly what European Countries did when adopting the "EU Full Liberalisation Directive 1998", providing for removal of all entry barriers to telecom networks and services by January 1, 1998[125]. Turkey took a similar decision and announced the full liberalization date as being 1/1/2008. The Turkish market grew dramatically as a result of this decision.[126] In addition, in advance of the full liberalization date, the Government should introduce uniform licenses, to meet demand for additional licenses once the market is fully open.

As stated above, international experience shows that full liberalization coupled with sustainable competition, is the policy which results in highest market development and economic benefits. As such this is the policy advocated by this report. For achieving the highest economic benefits from its broadband policy, Egypt is recommended to follow such full liberalization policy. In some instances, due to political or other type of constraints, some countries have followed more gradual approaches. Although not the best technical policy approach, such avenue may be deemed necessary by policymakers to overcome the political reality in a given country. If this kind of path is seem as the only political solution in the country context, this report advocates for choosing temporary solutions that would allow to continue to the full liberalization approach in the short term.

Although not recommended as the most economically efficient solution, if a more gradual approach is chosen, the four existing network operators could be given uniform licenses, so that they could enter the reciprocal markets and open later these licenses to any other interested operator. This could involve allowing Telecom Egypt (TE) to bid for a wireless services license, provided that this does not distort the market (an ex ante analysis of market competition by NTRA would be highly advisable) and such award of the license (if obtained by TE in fair competition with other bidders) is coupled with increased competition in all other market segments. In this regard, the wireless service license to TE could be used to mandate TE (as dominant operator) to open its backbone network to competition in an effective (and regulated) manner and at cost-oriented and non-discriminatory conditions (under supervision of NTRA). These obligations can be attached to the spectrum provided in the new unified license in case TE success in obtaining such license. This open, non-discriminatory and cost-oriented access would provide the other network operators an infrastructure to complement their network deployments. At the same time existing restrictions on gateways (or any other distortions) should be removed for alternative operators (restrictions on TE should remain or be removed according to NTRA market analysis). NTRA would establish prices and access conditions and it would ensure effective access from other operators before TE begins wireless service operations (in case TE obtains the license). Finally, if this approach is followed combined with the deployment of Ultra Fast Broadband leveraging other fiber infrastructure (a policy recommended below), this could result in more than one neutral and open backbone network for all operators. It should be noted however that this option is not the most effective economic policy, that it is a highly risky policy approach and that, in order to minimize higher risks and market distortions, it requires thorough and strict ex ante and ex posts market analyses from NTRA that ensures most effective competitive conditions in the market and the voluntary agreement among all operators.

Complementing liberalization measures, additional spectrum for 4G wireless broadband technologies should be made available to the market. Mobile broadband market is the most competitive and efficient market in Egypt. Competition in the mobile market makes mobile broadband offerings more dynamic. Mobile broadband has already surpassed fixed broadband and it has highest potential to reach a broader set of population than fixed broadband. Moreover, mobile operators have proven very effective at increasing affordability in the mobile voice service, through pre-paid and commercial packages, which can be easily translated into mobile broadband. Investment in new network infrastructure is also happening at rapid pace, as shown by the 3G network developments in country. Providing additional spectrum and eliminating restrictions for further market entry (e.g., additional operators) will likely spur wireless broadband market further, expanding broadband access through the population and providing affordable offerings (e.g., by using pre-paid offerings similar to those in the voice mobile market). Spectrum for 4G technologies (such as LTE and WiMAX) can complement existing 3G networks and provide an IP solution through wireless with broader coverage than any fixed broadband infrastructure in place. However, in making new spectrum available, the competent authority must ensure that spectrum is obtained in fair and competitive conditions and that spectrum hoarding by existing operators is avoided. Ensuring access to spectrum for new operators can play a key role in fostering competition through the wireless platform, as the entrance of Etisalat in 2007 shows.

Proactive Competition in the area of Backbone and Backhaul, Leveraging on Fiber Optic Investments of Electricity and Transport Utilities. The removal of entry barriers, and the right given to existing operators to enter each other market, will certainly stimulate competition. However, in the segment of backbone and backhaul service, a more proactive approach to stimulate competition may need to be pursued. The transport, electricity and gas utilities offer a good opportunity. Egypt's electricity company, the Egyptian Electricity Transmission Company (ETTC) is planning to considerably extend its electric grid and to achieve interconnection with the Saudi grid, as well as with the Jordanian grid (in turn, connected with the Syrian and Turkish grids). ETTC is considering to lay down fiber optic alongside the electric grid in order to enhance grid-related applications (broadband enabled a better deployment of load management applications, as well as smart grid and smart meter applications). There is a strong potential to use any excess capacity for telecom purposes, increasing the competition in the backbone and backhaul market segments. The regional dimension of this strategic project may also provide additional avenues to introduce competition at international connectivity level. This can increase the amount of international capacity available to Egypt, increase network redundancy, and allow for more competition in this crucial market segment.

The Egyptian railways and highways are also planning to undertake similar investments on a national level. The railways are planning to lay down fiber optics to enhance its signaling and network management systems. The highways are also planning to lay down fiber for signaling purposes.

The opportunity to use these fiber investments for telecommunications purposes has several advantages. First, it increases the viability of the investment made by the non-telecom partner. The electric utility and transport companies have the opportunity to increase the return on their investment, while modernizing their core networks. The infrastructure can be used for telecom purposes, increasing competition and reducing prices. The utility company usually does not have the technical internal expertise to be a telecommunications operator, and the partnership with a telecommunications operator can bring substantial benefits in terms of know-how. It is also important that a separate subsidiary is created to allow the utility to exploit telecom assets. This is to avoid cross-subsidy from the core business (usually a regulated monopoly), to the telecom business, which is competitive.

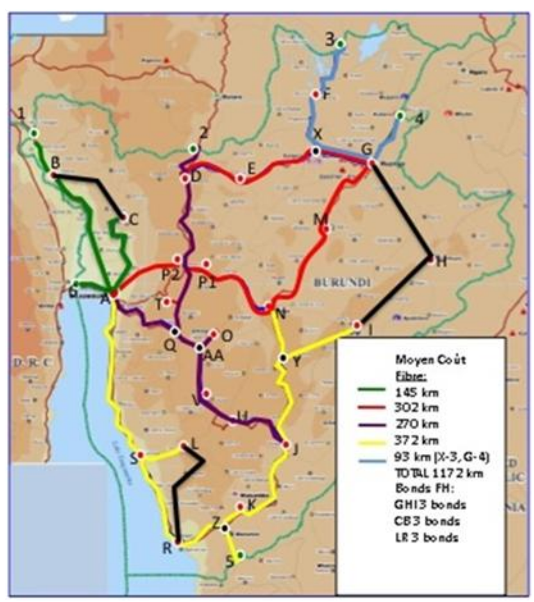
There are multiple business models that can be activated in this area. A simple scheme provides for the utility company to lease access to the right of way and to the Points of Presence (PoP) to a licensed telecommunications operator. For example, a licensed mobile operator, with the right to develop their own backbone infrastructure may enter into an agreement with the electric utility and lease access to the right of ways and PoPs. In this case, the telecom operator would develop and own the infrastructure. Other variations of this first option exist. For example, the agreement can be in the form of a Build-Operate-Transfer (BOT) model. A different model provides for the non-telecom utility to build the infrastructure and then to lease the capacity to a licensed operator. There are variations of this model, according to whether the non-telecom utility leases dark fiber or end-to-end fiber. It is uncertain whether this option would be allowed in the Egyptian regulatory framework. A variation of this approach is the wholesale operator model, where a newco or SPV is created (usually as a partnership between the non-telecom utility and other telecom partners), which obtains a wholesale operator license, and leases capacity to licensed network operators and service provides on a wholesale base according to open, transparent and non-discriminatory conditions. This model would require the newco to obtain a wholesale operator license. A less common model is the model where the utility obtains a network operator license and enters in competition with existing operators.

There are different models that could be used to increase the amount of competition in the backbone and backhaul market. To determine the model that better suits Egypt, a tailored study to the country market conditions is recommended. Notwithstanding this, we would recommend to adopt a solution that actually increases effective competition in the market and to mandate open access provisions. Use of this strategic infrastructure by only one operator is suboptimal, even if it may strengthen competition in an important market segment (for example, one of the current mobile operators partners with the electric utility and builds long distance infrastructure in competition to the incumbent).

The exhibit below shows an actual case, Burundi, where multiple utilities joined forces and developed a domestic broadband backbone network, subject to open access provisions.

Figure 5.- Burundi backbone project configuration

- Case of Burundi: Problem
  - All domestic network infrastructure is wireless
  - Limited broadband
  - National fiber optic network would not be feasible without government subsidy
- Strategy
  - Operators form company to develop and operate network
  - Government co-finances development of national backbone network through WB project
  - Government finance is through subsidy, no public ownership
  - Operators invest equity, government injects subsidy/pre-payment
  - WB project finances studies and designs
  - Construction and operation governed by PPP contracts and license/concession agreement



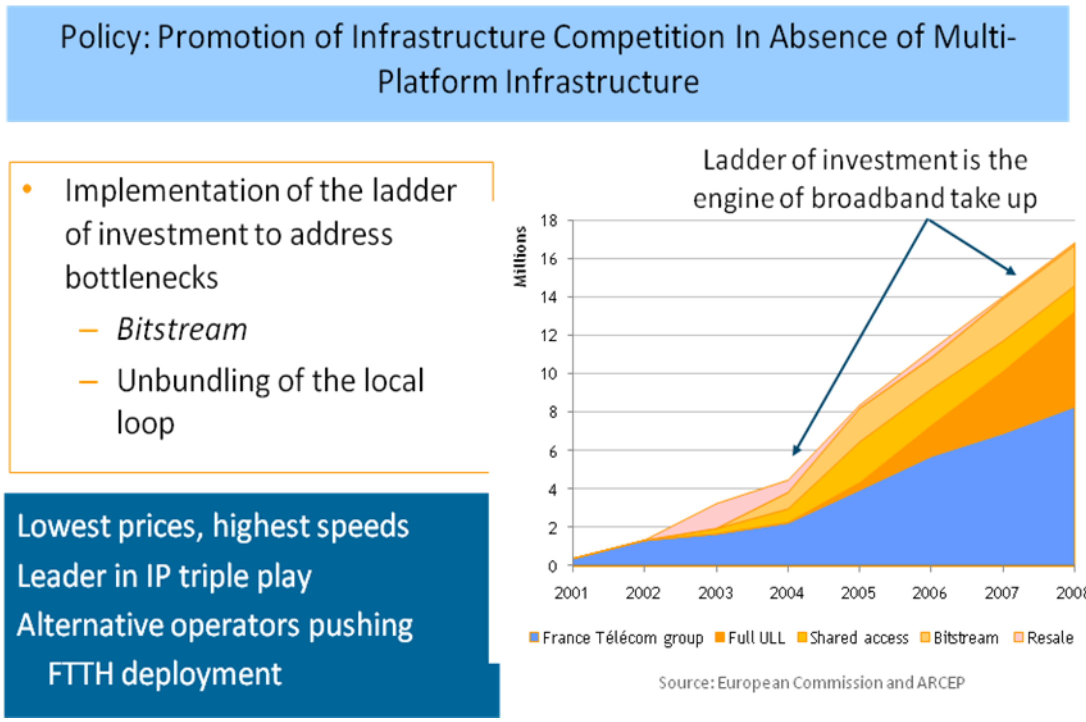
Source: World Bank

Implementation of an ambitious Ultra-Fast Broadband (UFB) Plan. Egypt should set an ambitious long term expansion plan aimed at bridging the gap with developed countries by a reasonable date, for example 2020. This has several strategic implications. First, as DSL is a slow growing technical option, technically inferior to fiber, and in the context of a sluggish fixed line market, the broadband strategy should not aim at replicating the EU model, based on a complicated regulatory framework to allow for the progression of DSL. DSL has a place in the current market, but due to the limiting factors, outlined above, it is strategically important that Egypt sets objectives both in terms of broadband and Ultra Fast Broadband (UFB). Moreover, this deployment of UFB should be complemented with fostering wireless broadband technologies, particularly 4G by providing spectrum to the market and introducing new operators for the provision of 4G broadband technologies. Wireless broadband technologies, coupled with sound and competitive backhaul infrastructure, may provide the most rapid and efficient solution to deploy widespread ultra-fast broadband throughout the economy.

The rationale behind setting directly UFB and 4G targets is the opportunity of technology leapfrog. Slightly over ten years ago, Lithuania still had the full legacy of a telecom network developed under communist rule: old switches, a decrepit fixed line, and incoherent network planning. Lithuania introduced the EU model of full competition, and developed a fiber optic plan at the same time. Lithuania now enjoys a fully competitive market and the highest penetration of households passed by fiber, way higher than other European countries, like France and Germany, which have based their strategy on a cumbersome regulatory process of unbundling of the local loop. Similarly, Vietnam has made use of mobile broadband technologies to provide nationwide affordable broadband solutions to its population. Through 3G Vietnam has more than doubled fixed broadband penetration (from 4 percent to over 11 percent) in less than 2 years. Now, Vietnam's mobile operators are already preparing to deploy 4G technologies, such as WiMAX and LTE, throughout the country.

A good strategy has tactical goals and long term objectives. DSL development through unbundling regulatory provisions can be a tactical objective (and it may be required temporarily by the industry, as TE is considerably strengthening its grip on the market). The example of France shows that a good ULL strategy can yield results in terms of stimulating the broadband market and opening competition further. However, it must be noted that DSL is only an interim solution for the UFB goal and that a transition to NGN will be needed down the road. In choosing this option the benefits of investing in the development of a widespread DSL market should be weighted with the costs of its future transition to an NGN environment. Improving competition in the existing DSL market could be a sensitive solution if combined effectively with a sound UFB forward-looking policy.

Figure 6.- France's policies for ULL



Source: The World Bank, Strategic Options to Develop Broadband in Egypt (first phase deliverable).

Most EU countries are developing plans to bypass the current broadband approach and to move to UFB, realizing the existence of a gap with countries like Korea and Japan, or learning from the quick progress achieved by countries like Lithuania. Germany, for example, has set an explicit target in terms of UFB penetration.

Different models exist for the achievement of an ambitious UFB plan. The development of an UFB plan should, however, recognize that the driver of growth in the industry, in Egypt, and abroad, has been the establishment of an effective telecommunications market. Effective competition has driven growth and reduced prices. The same competitive dynamics should be at play in UFB. This presents challenges, as, due to the nature of the industry, the first operator that would reach most of buildings in Egypt would probably have a localized monopoly on that building for the next several years (*first mover advantage*). At the same time, the provision of heavy regulatory burden on new infrastructure (such as the requirement to fully open the infrastructure to new competitors may also discourage investors; the FCC in the US examined this issue and decided against mandating unbundling for new fiber investments). The burden on opening up access to the infrastructure to other operators has been imposed on the new operators that were awarded the "compound" licenses. But this decision was made on the ground that these operators would have a first mover advantage on some of the most lucrative parts of the market. This was a good rationale, in light of the need to avoid so-called *cream skimming*.

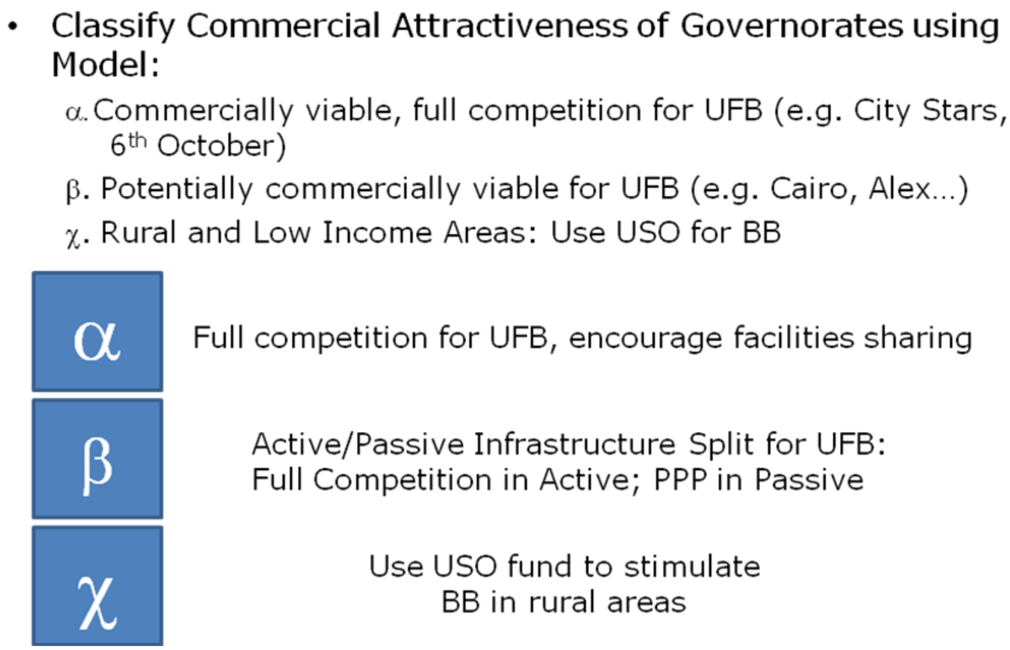
Going forward, the issue of dominance in the fiber business can be tackled in different ways. We propose here to have a diversified approach based on the three following steps:

a. Divide the market in commercial areas where facilities-based competition can exist (areas α), commercial areas that would be exposed to dominance due to first mover advantage, and non commercially viable rural and low income areas (the model completed as part I of this deliverable can be used to classify the industry in these groups);

b. Launch a new FTTH/FTTN model for area β;

c. Use USO funds to stimulate broadband in area χ.

Figure 7.- Classification of areas for broadband development following market attractiveness

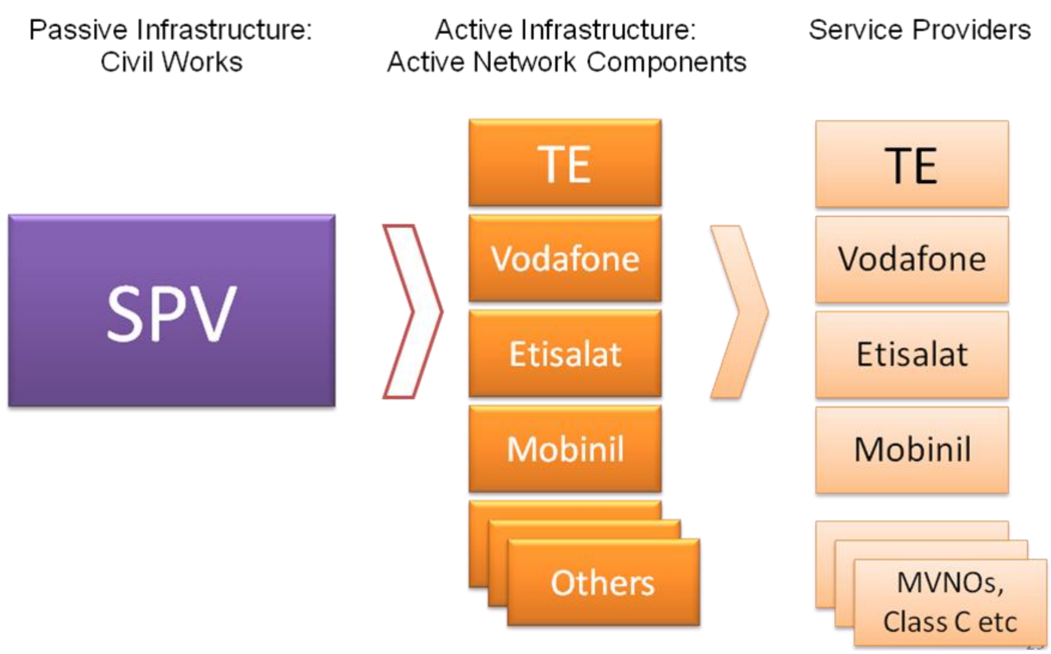


Source: World Bank

Commercial areas where facilities-based competition can exist (areas α). In these areas, different facilities-based operators can reach the final building. Operators can be encouraged but not mandated to mutualize passive infrastructure efforts. In cases where rights of way are a barrier to entry for later operators (e.g., because civil works limitations or authorizations required), such as may be the case in big cities, operators should be mandate to build and share ducts that have enough space for other operators to install their fibers and their equipments (collocation space) in the node/curb. Lease conditions should be cost oriented (with an additional return to reward the risk of being the first mover into the location) and non discriminatory under the oversight of NTRA.

Commercial areas exposed to dominance due to first mover advantage (area β). In these areas, there are multiple models to mitigate the first mover risk. We support the establishment of structural separation. There are different structural separation alternatives. One possibility is to create a new special purpose vehicle company (SPV), to handle passive infrastructure works (civil works). SPV would lease access to the duct to multiple active infrastructure operators, which would own the cables or different pairs within the same cable. Ownership of the cable can be extended to the existing licensed operators and new operators, which would be full competitors on the active network operator side. This would also create competition in the relationship network operators/service providers. This SPV would also be available for mobile operators to use as backbone for mobile broadband. It is important to note, however, that there are two levels of infrastructure for this model. The backbone network and the access network (e.g., FTTH/FTTN). To determine which levels of the network (and in which geographies) area β conditions should apply, NTRA should do a thorough market analysis. To this regard it is important to note that whereas in the backbone network, dominance conditions are more stable (due to the economics and limitations of building existing infrastructure), in the access network level competition conditions may evolve more rapidly (e.g., previously β areas become α areas). To be able to have as much flexibility as possible to switch from one area conditions to the other, SPV should build wide enough ducts to share them with other operators in the future and have available collocation space in the curb/node. This obligation, however, has to be measured carefully so as to avoid imposing unnecessary economic costs to operators.

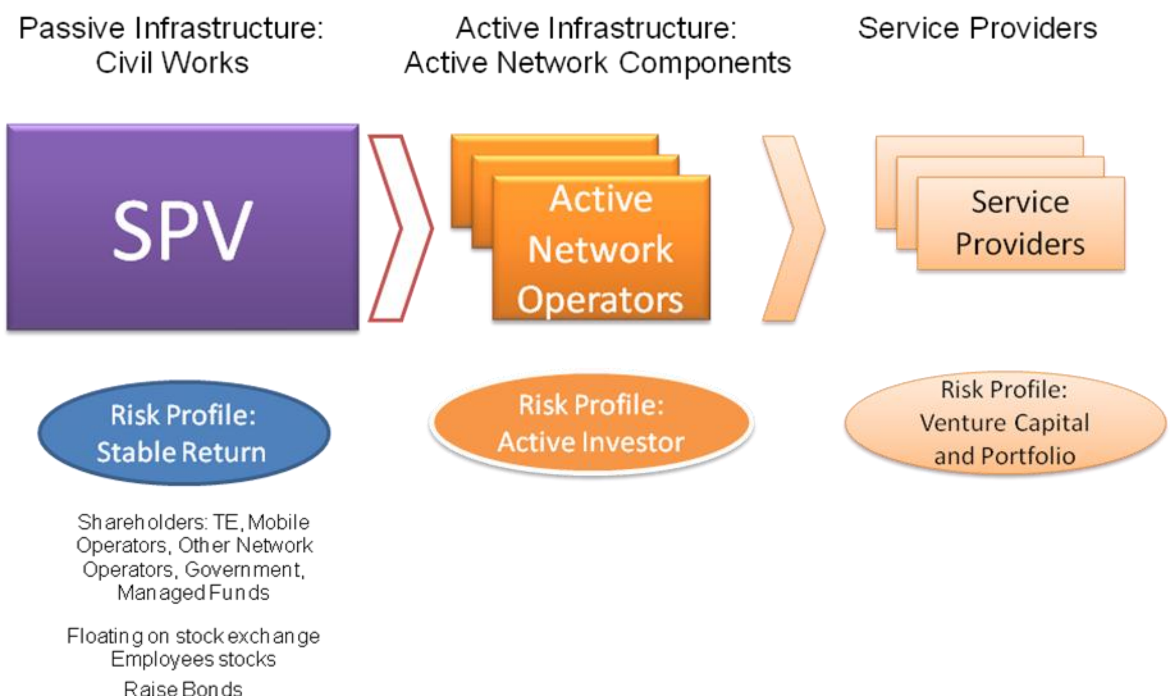
Figure 8.- Scheme of SPV Model in β areas



Source: World Bank

The creation of the SPV would also respond to different risk profiles of different actors in the value chain (Figure 9). The SPV would be extended to a large amount of shareholders. Key shareholders would be Telecom Egypt (which may also be able to provide in-kind contribution), Mobile Operators, and other operators could also be part of the capital of this company. In addition, the company's capital could also be opened to the local capital market. Part of the shares could also be sold to institutional investors (such as mutual and pension funds), and listed on a foreign exchange, to strengthen governance requirements. The SPV could also raise bonds on the international capital markets. In this way, the governance of the company would reflect a well diversified range of shareholders. The lease of the access to the ducts and other passive infrastructure will be strictly regulated, at a set return rate, so that to provide stability to the return of this company. This will be attractive to passive investors. The company could also absorb part of the employees of Telecom Egypt, and part of the shares of the new company could be given to the employees. The active network operators would be able to lease access to the ducts at regulated prices, and own their own infrastructure, conserving effective competition on the active network side.

Figure 9.- Risk profiles in SPV model



Source: World Bank

Non-commercially viable parts of the country (Area χ). The Universal service funds should be used to enhance broadband development, through wireless broadband, in non-commercially viable parts of the country. Area χ can be divided into two areas :

d. area χ

e. area χ ultra-remote.

In area χ, universal service funds can be used to extend the access to broadband, through wireless broadband, possibly using a reverse subsidy auction schemes. In area χ ultra-remote, for the moment, no broadband development would be envisaged or it is too costly to be envisaged. The rationale is that area χ consists of those areas that, through a specific subsidy, can be brought back within the frontier of commercial sustainability. Area χ ultra-remote would be those desert and scarcely populated areas where the provision of broadband would be provided only at the cost of a huge subsidy.

Strengthening of NTRA's attributions in the area of anti-trust monitoring and enforcing in the telecom sector. Competition entry in the market will need to be safeguarded by NTRA. Due to existence dominance is critical infrastructure, such as backbone or access networks, oversight of cost-orientation and access conditions to network elements will be critical for any of the models described above to work. Moreover, market analysis based on competition and antitrust principles will also be needed to be performed on a sustainable basis to monitor the market and inform decisions to modify regulatory conditions in different geographic areas, markets (e.g., wireless, wireline) and geographic levels. Therefore, it will be critical that NTRA reinforces its structure to have the human capital and skills required to these tasks. This will require, at a minimum, of a new division in charge of market analysis that is able to perform market definition and analysis of telecommunications segments based on competition and antitrust principles. It will also require reinforcements for analyzing, modeling and establishing cost-orientation and non discriminatory conditions and for monitoring their compliance. Cost-orientation models are a complex issue and usually required a very specialized and focused team. Finally, NTRA would need to have the power (legally and effectively) to enforce the competition models described in the paragraphs above and it should also have the authority to conduct market analysis and use its results to inform NTRA's decisions.

Stimulate demand through target demand stimulation measures, selecting measures with high potential employment generation, and high social value. The supply-side measures should remain the core of Egypt's broadband plan. However, increased recognition should be given to demand-side measures (Table 1). Few studies have concrete results showing the impact of demand-side measures on the development of broadband. Many demand stimulation measures may be politically motivated, to increase the appeal of politicians vis-à-vis their constituency. In addition, several demand-side measures were introduced by several governments as part of stimulus packages plans[127]. Stimulus packages plans are now under extreme criticism. Local and central governments are afflicted by huge amounts of public debt, crippling economic growth prospects and raising the specter of a generalized public debt crisis. In this light, the economic rationale of any use of public money needs to be thoroughly justified. There is an increased pressure on showing the return on the tax money spent. Demand stimulation measures have a weak economic justification. There are few studies showing the impact of public expenditures in stimulating broadband demand and this need to be taken into account when spending public money.

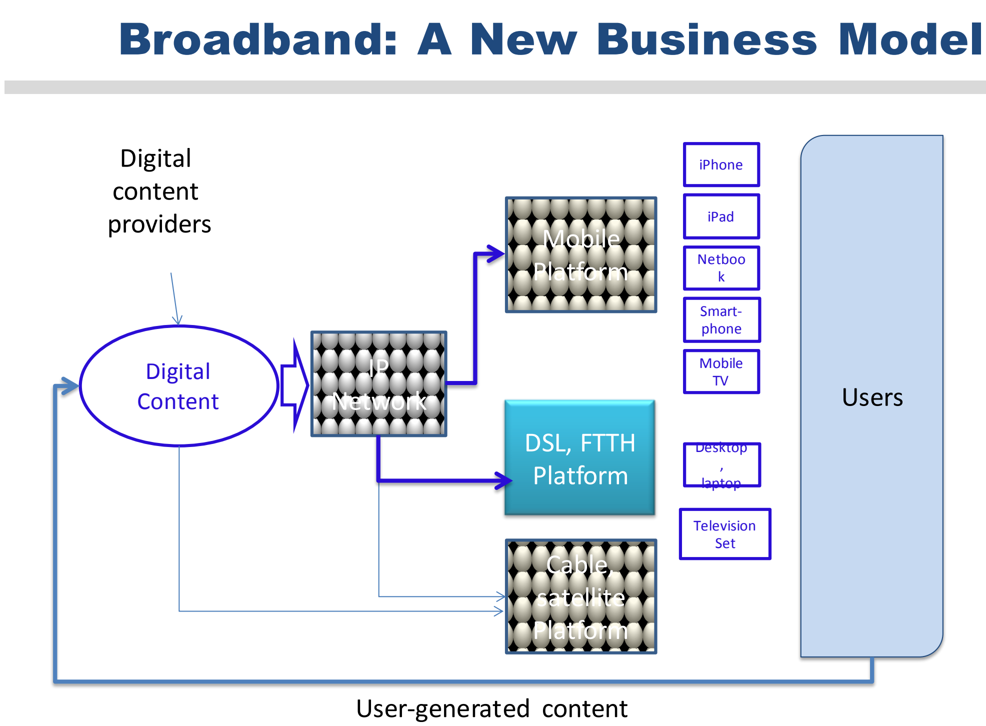
Table 1. Example of policies to increase demand

Accessibility	Affordability	Attractiveness
• Setting up broadband access centers, telecenters, kiosks, and other **public access** points • Connecting **educational** institutions to broadband networks • Providing wireless Internet services in **public spaces** such as airports and business districts • **Digital literacy** programs • **Inclusion:** People with disabilities, elders	• Lowering the cost of **user terminals** by securing international supply chain as well as reducing import duties, and other taxes or through targeted subsidies • Subsidizing broadband **equipment** used in educational institutions • Building **consumer awareness** on providers, pricing options, and available technology	• Supporting **local**, relevant Internet content in local languages • Putting government and **public information** online and creating e-government and other e-applications (such as for health, education, and agriculture) • Providing a legal framework for **e-commerce** and other applications • **Promoting broadband** use to businesses and user communities

Source: World Bank

Users as the engine of web 2.0. Moreover, broadband development is increasingly led by users (Figure 10). Among the top ten websites in the United States, China and Turkey, for example, there is no government service or website. Search engines (like Google, Baidu and Yahoo Maktoub) and social networking sites (facebook and Wikipedia) dominate the top ten list. Demand-side measures should take advantage of this trend and allow citizens participation and crowd-sourcing in as much as possible. For instance, quality of government services could benefit from citizen's feedback though internet or mobile data networks. Crowdsourcing and open data initiatives allow for obtaining feedback and applications of public data that can tackle public needs not previously addressed.

Figure 10.- Broadband new business model



Source: Rossotto, 2010.

Annex 1 – Regional Comparison of Egypt Telecommunications Market

Country	Mobile penetration (pop)	Fixed Penetration (pop)	Broadband penetration (pop)	Population covered by mobile cellular network	Mobile Adoption Gap	Mobile broadband penetration (% subscribers are 3G)	GDP per capita	Population
Algeria	96.46%	8.38%	2.13%	*81.50%*	-14.96%	0.00%	4,029	34,895,470
Bahrain	220.35%	30.07%	19.96%	*100.00%*	-120.35%	25.52%	28,240	791,473
Egypt, Arab Rep.	**71.07%**	**11.51%**	**1.44%**	**95.00%**	**23.93%**	**21.95%**	**2,269**	**82,999,393**
Iran, Islamic Rep.	86.02%	34.70%	3.09%	82.00%	-4.02%	0.00%	4,540	72,903,921
Iraq	66.85%	4.99%	0.01%	*99.00%*	32.15%	0.00%	2,090	31,494,287
Jordan	117.21%	8.42%	3.43%	99.00%	-18.21%	0.00%	3,829	5,951,000
Kuwait	147.85%	18.93%	2.15%	*100.00%*	-47.85%	27.71%	54,260	2,794,706
Lebanon	62.71%	18.94%	5.28%	*100.00%*	37.29%	0.00%	8,157	4,223,553
Libya	146.89%	17.15%	1.32%	*70.70%*	-76.19%	4.98%	9,714	6,419,925
Morocco	87.15%	10.99%	1.50%	98.00%	10.85%	7.73%	2,795	31,992,592
Oman	142.06%	9.39%	1.55%	96.40%	-45.66%	6.80%	21,649	2,845,415
Qatar	190.78%	20.24%	9.69%	100.00%	-90.78%	17.67%	62,451	1,409,423
Saudi Arabia	185.30%	16.43%	6.21%	*98.00%*	-87.30%	25.19%	14,540	25,391,100
Syrian Arab Rep.	46.03%	18.35%	0.22%	*95.00%*	48.97%	0.93%	2,474	21,092,262
Tunisia	109.46%	12.25%	4.36%	100.00%	-9.46%	0.00%	3,792	10,432,500
Turkey	82.33%	22.05%	8.91%	100.00%	17.67%	15.26%	8,248	74,815,703
United Arab Emirates	254.88%	33.95%	16.28%	100.00%	-154.88%	37.54%	58,272	4,598,600
West Bank and Gaza	73.05%	9.17%	2.56%	*95.00%*	21.95%	0.00%	1,123	4,043,218
Yemen, Rep.	33.49%	4.11%	0.30%	*68.00%*	34.51%	0.00%	1,118	23,580,220
Average	116.84%	16.32%	4.76%	93.56%	-23.28%	10.07%		
Upper Middle-Income Avg.	95.27%	21.64%	8.16%	*93.95%*	-1.32%			

Sources:

Telegeography 2010, except Fixed Penetration (2009).

Cellular coverage, population, GDP and Upper Middle-Inncome Avg. data from World Bank Database (latest available year).

Notes

[1] According to *the BBC: "Four in five adults (79%) regard internet access as their fundamental right, according to a new global poll conducted across 26 countries for BBC World Service." (See "Internet access is a 'fundamental right'," BBC News, 8 March 2010, available at: http://news.bbc.co.uk/2/hi/technology/8548190.stm). Finland became the first nation to make broadband Internet access a legal right in July 2010 (see, "First nation makes broadband access a legal right," CNNTech News, 1 July 2010, available at: http://articles.cnn.com/2010-07-01/tech/finland.broadband_1_broadband-access-internet-access-universal-service?_s=PM:TECH).*

[2] *For example: President Obama has reaffirmed this position. Speaking for his administration, Susan Crawford commented in a speech on May 14, 2009 that "Broadband is the new essential infrastructure." (see http://www.broadcastingcable.com/article/232506-President_Obama_Focused_On_Broadband.php). Similar positions have been adopted in Europe, where the European Commission has concluded that "widespread and affordable broadband access is essential to realize the potential of the Information Society" (see http://ec.europa.eu/information_society/eeurope/2005/all_about/broadband/index_en.htm); in Australia, where a government report concludes that "ubiquitous, multi-megabit broadband will underpin Australia's future economic and social prosperity" (see http://www.dcita.gov.au/communications_for_consumers/internet/broadband_blueprint/broadband_blueprint_html_version/chapter_one_broadband_as_critical_infrastructure); in Japan, where the Japanese have joined with regional partners to "enable all people in Asia to gain access to broadband platforms" by 2010 (see http://www.dosite.jp/asia-bb/en/pdf/abp005.pdf); and other countries.*

[3] *For example, the American Recovery and Reinvestment Act of 2009 (Pub. L. 111-5, 123 Stat. 115, 2009), allocated $7.2B in public funding for stimulating investment in broadband in the United States. Around the same time, a number of other countries were also allocating significant funds to stimulate broadband investment, including Australia ($33B), Japan ($28B), Germany ($215M) and Canada ($213M) (see Reynolds, T., "Telecommunications Investment as an Economic Stimulus," OECD presentation to World Bank Workshop, 22 June 2009, available at: http://siteresources.worldbank.org/INTEDEVELOPMENT/Resources/Reynolds-2009-06-22-BroadbandStimulus.pptx). See, also, Qiang, C. (2009), "Broadband Infrastructure Investment in Stimulus Packages: Relevance for Developing Countries, briefing paper prepared for Global ICT Department, World Bank, June 2009, available at: http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/282822-1208273252769/Broadband_Investment_in_Stimulus_Packages.pdf.*

[4] See the EBMM which (wherever possible) is the reference source for key statistics, in order to maintain consistency in this report and the overall project. The EBMM relies on estimates of population and national income reported from the Egyptian CAPMASS database, and the estimates relied on in this report are from the EBMM as of July 2011.

[5] See Figures 4-6 which provide estimates of broadband penetration from the OECD (Figure 4) and the ITU (Figures 5,6). OECD penetration rates (Figure 4) are significantly above the penetration rates in the Arab states (Figure 5). The data on mobile broadband penetration (Figure 6) is included to remind us of the rapid growth of mobile service, but these data are significantly more noisy and the quality of mobile broadband varies substantially.

[6] These penetration estimates are based on the EBMM "medium, own infrastructure" scenario for broadband deployment. The penetration expected will change if the policy is more or less aggressive, and actual penetration will likely differ due to unavoidable forecasting errors. Penetration estimates are reported in terms of subscriber lines per 100 population.

[7] Forecast is for the "Medium, Own Infrastructure" base scenario in the EBMM (July 2011).

[8] New York Times, May 20th, 1987, p. A1.

[9] For example, a study by Oliner & Sichel based on an analysis of aggregate data found almost no contribution from computers to productivity growth through the early 1990s (see, Oliner, S. and D. Sichel (1994), "Computers and output growth revisited: How big is the puzzle?" *Brookings Papers on Economic Activity* (2): 273-317. See, also, Loveman, G., "An Assessment of the Productivity Impact of Information Technologies", mimeo, Massachusetts Institute of Technology, September 1990; Morrison, C., and E. Berndt, "Assessing the Productivity of Information Technology Equipment in U.S. Manufacturing Industries," NBER Working Paper No. 3582, January 1991; Roach, S., "America's Technology Dilemma: a Profile of the Information Economy", Morgan Stanley Special Economic Study, New York, April 1987; or, Bailey, M. and R. Gordon, "The Productivity Slowdown, Measurement Issues, and the Explosion of Computer Power", *Brookings Papers on Economic Activity*, vol 2 (1988) 347-432.

[10] See Oliner & Sichel (1994), note 9 *supra*.

[11] For example, for management information systems, accounting, customer-service operations, and other support functions. While ICT is also used increasingly in factory automation and manufacturing processes, this is not where the bulk of ICT is employed.

[12] See Bresnahan, T. and M. Trajtenberg (1995) “General purpose technologies: Engines of growth,” *Journal of Econometrics*, vol. 65, p. 83-108.

[13] See, for example, Brynjolfsson, E. and L. Hitt (1998), “Paradox Lost? Firm-level Evidence on the Returns to Information Systems Spending,” *Management Science*, April (reprinted in Willcocks, L. and Lester, S. (eds.). Beyond The IT Productivity Paradox: Assessment Issues. McGraw Hill, Maidenhead. (1998)); Lehr, W. and F. Lichtenberg (1999), "Information Technology and Its Impact on Productivity: Firm-level Evidence from Government and Private Data Sources, 1977-1993," *Canadian Journal of Economics*, vol 32, no 2 (April 1999) 335-362; Lehr, W. and F. Lichtenberg (1998) "Computer Use and Productivity Growth in Us Federal Government Agencies, 1987-92," *The Journal of Industrial Economics*, 46(2), 257-79; or, Brynjolfsson, E. and L. Hitt, "Beyond Computation: Information Technology, Organizational Transformation, and Business Performance," *Journal of Economic Perspectives*, vol. 14, no. 4 (Fall 2000) 23-48.

[14] See Jorgenson, D., "Information Technology and the U.S. Economy," *American Economic Review*, Vol. 91, Number 1 (March 2001) 1-33.

[15] See Jorgenson, D., M. Ho, and K. Stiroh (2007), "A Retrospective Look at the U.S. Productivity Growth Resurgence," draft mimeo, Federal Reserve Bank of New York, February 21, 2007.

[16] See Fuss, M. and L. Waverman (2006), "Canada's Productivity Dilemma: the Role of Computers and Telecom," report prepared for Bell Canada's submission to the Telecommunications Policy Review Panel, 2006 (updates results in included in "The Networked Computer: the Contribution of Computing and Telecommunications to Economic Growth and Productivity," London Business School Working Paper, DT05-001-2005). An analogous finding was reached by Timmer and van Ark (2005), who concluded that "higher ICT investment explains more than half of the US advantage in labor productivity growth over the EU from 1995 to 2001" (see Timmer, M. and B. van Ark (2005) "Does Information and Communication Technology Drive Eu-Us Productivity Growth Differentials?" *Oxford Economic Papers*, 57(4), 693-716).

[17] See Crandall, R. and C. Jackson (2001), The $500 Billion Opportunity: The Potential Economic Benefit of Wide-spread Diffusion of Broadband Internet Access, mimeo, Criterion Economics, Washington, DC, 2001.

[18] See Pociask, S. (2002), Building a Nationwide Broadband Network: Speeding Job Growth, white paper prepared for New Millennium Research Council by TeleNomic Research, February 2002.

[19] See Litan, R. (2005) "Great Expectations: Potential Economic Benefits Ot the Nation from Accelerated Broadband Deployment to Older Americans and Americans with Disabilities," white paper prepared for New Millennium Research Council, Washington DC, December 2005.

[20] See, for example, Strategic Networks Group (2003), Economic Impact Study of the South Dundas Township Fibre Network, prepared for the United Kingdom's Department of Trade and Industry, 2003; Kelley, D. J. (2003), A Study of the Economic and Community Benefits of Cedar Falls, Iowa's Municipal Telecommunications Network, available at http://www.iprovo.net/projectInfoDocs/economicAndCommunityBenefitsStudy.pdf. Summarized and updated in Broadband Properties Magazine, www.broadbandproperties.com, May, 2005; or, Ford, George and Timothy Koutsky (2005), "Broadband and Economic Development: a municipal case study from Florida," Applied Economic Studies, April 2005 (available at: http://www.aestudies.com/library/econdev.pdf).

[21] See Lehr, William, Carlos Osorio, Sharon Gillett, and Marvin A. Sirbu (2005) "Measuring Broadband's Economic Impact," paper prepared for Telecommunications Policy Research Conference, Arlington, VA, September 2005.

[22] See Crandall, Robert, William Lehr, and Robert Litan (2007), "The Effects of Broadband Deployment on Output and Employment: A Cross-sectional Analysis of U.S. Data," *Issues in Economc Policy*, The Brookings Institution, Number 6, July 2007 (available at: http://www.brookings.edu/views/papers/crandall/200706litan.htm).

[23] See Czernich, N., O. Falck, T. Kretschmer and L. Woessmann (2011) "Broadband Infrastructure and Economic Growth" *The Economic Journal*, 121(552), 505-32 (original study 2009).

[24] See Franklin, M., P. Stam, and T. Clayton (2009) "ICT Impact Assessment by Linking Data," *Economic and Labour Market Review*, 3(10), 18-27.

[25] See Katz, R. and J. Avila (2010) "Estimating Broadband Demand and Its Economic Impact in Latin America," *Proceedings of the 4th ACORN-REDECOM Conference,* Brasillia, May 14-15, 2010

[26] See Koutroumpis, P. (2009), "The economic impact of broadband on growth: A simultaneous approach" *Telecommunications Policy*, 33.

[27] See OECD (2011) "Economic Impact of Internet/Broadband Technologies," DSTI/ICCP/IE(2011)1/REV1, Working Party on the Information Economy, Directorate for Science, Technology and Industry, OECD, Paris, 30 May 2011.

[28] See Qiang, C. and C. Rossotto (2009), "Economic Impacts of Broadband" published in "Extending Reach and Increasing Impact," *2009 Information and Telecommunications for Development*, World Bank.

[29] See Waverman, L. (2009) "Economic Impact of Broadband: An Empirical Study," LECG, a study prepared for Nokia-Siemens Networks as part of the *Connectivity Scorecard 2009*."

[30] The estimates typically do not consider what would happen if the investment in broadband were made elsewhere and so are of gross job creation, rather than net job creation effects.

[31] For example, Eisenach et al. (2009) (note 38 below) assumes these effects are fully realized within one year, citing the Bureau of Economic Analysis treatment of input-output effects.

[32] The studies do not estimate compatible multipliers. For example, Crandall & Singer (2010) (note 36 below) and Eisenach et al. (2009) (note 38 below) do not estimate the additional employment that may be expected from productivity improvements and other spillover effects.

[33] The Katz, Vaterhaus et al. (2009) (note 41 below) study is the only one that estimates a separate multiplier impact for externality effects. The range of total effects is computer assuming the Katz et al. estimate is applicable to the other studies.

[34] See Atkinson, R., Castro, D. & Ezell, S.J. (2009). The digital road to recovery: a stimulus plan to create jobs, boost productivity *and revitalize America*. The Information Technology and Innovation Foundation, Washington, DC.

[35] See BCG (2009), "Towards a connected world: socio-economic impact of Internet in Emerging Economies," The Boston Consulting Group (BCG), 16 September 2009.

[36] See Crandall, R. and H. Singer (2010) "The Economic Impact of Broadband Investment." Broadband for America, Washington, DC, available at: http://www.broadbandforamerica.com/sites/default/themes/broadband/images/mail/broadbandforamerica_crandall_singer_final.docx).

[37] See Crandall, R., C. Jackson and H. Singer (2003) "The Effect of Ubiquitous Broadband Adoption on Investment, Jobs, and the US Economy." Criterion Economics, LLC, report prepared for the New Millennium Research Council (available at: http://newmillenniumresearch.org/archive/bbstudyreport_091703.pdf).

[38] Eisenach, J., H. Singer and J. West (2009) "Economic Effects of Tax Incentives for Broadband Infrastructure Deployment," Empiris Consulting, prepared on behalf of the Fiber-to-the-Home-Council, January 5, 2009.

[39] See Fornefeld, M., G. Delaunay, and D. Elixmann (2008), "The impact of broadband on growth and productivity," a study on behalf of the European Commission, DG Information Society and Media, Germany, 2008.

[40] Katz, R. and S. Suter (2009) "Estimating the Economic Impact of the Broadband Stimulus Plan," *Columbia Institute for Tele-Information Working Paper,* February 2009.

[41] Katz, R., S. Vaterlaus, P. Zenhausern, S. Suter and P. Mahler (2009) "The Impact of Broadband on Jobs and the German Economy," *white paper prepared for Deutsche Telekom AG*, May 2009.

[42] For example, the EIU scores Egypt low at 4.21 out of 10 on e-Readiness, 57th in the list of countries ranked (see EIU (2010), "Digital economy rankings 2010 - Beyond e-readiness, a report from the Economist Intelligence Unit," report prepared in cooperation with IBM Institute for Business Value and the Economist, 2010).

[43] See Greenstein, Shane and Ryan C. McDevitt. 2009. "The Broadband Bonus: Accounting for Broadband Internet's Impact on U.S. GDP", Publication of Note, Technology Policy Institute, Washington, D.C., January

[44] See Jensen, R. (2007) "The Digital Provide: Information (Technology), Market Performance, and Welfare in the South Indian Fisheries Sector," *The Quarterly Journal of Economics*, 122(3), 879-924.

[45] This figure plots the level of ICT development as measured by the ITU's ICT Development Index (IDI) against Gross National Income (GNI) per capita. The IDI is a weighted index of ICT infrastructure, usage, and skill measures; and the GNI per capita is measured in terms of purchasing power parity $s. The positive correlation is readily apparent, as is the case for other measures of ICT infrastucture (e.g., fixed telephone lines per 100 population). (see ITU (2010), Measuring the Information Society, International Telecommunications Union (ITU-D), Geneva, Switzerland).

[46] See ITU (2010), "The World in 2010: ICT Facts and Figures," International Telecommunications Union, Geneva, Switzerland.

[47] See ITU (2010), "The World in 2010: ICT Facts and Figures," International Telecommunications Union, Geneva, Switzerland

[48] See OECD Broadband Portal, Penetration – Actual Lines, Exhibit 1d: Fixed and Wireless Broadband Subscriptions per 100 Inhabitants, June 2010 (available at: http://www.oecd.org/dataoecd/21/35/39574709.xls).

[49] ITU, Fixed Broadband Subscriptions per 100 inhabitants 2010, International Telecommunications Union, Geneva., available at: http://www.itu.int/ITU-D/ict/statistics/material/excel/2010/Fixed_bb_10.xls.

[50] ITU, Mobile Broadband Subscriptions per 100 inhabitants 2010, International Telecommunications Union, Geneva., available at: http://www.itu.int/ITU-D/ict/statistics/material/excel/2010/Mobile_bb_10.xls.

[51] For more comprehensive list see ICT Digital Literacy Portal at http://www.ictliteracy.info

[52] Rahgeb. M; "ICT in Education: Case of Egypt". Power point Presentation

[53] Most IT teachers are at preparatory; general secondary and technical secondary with rates under 500 students per IT teacher. General Secondary schools have one IT teacher per 277 students.

[54] Rahgeb, M. "ICT in Education: Case of Egypt". Power point Presentation

[55] Egypt Education Initiative -- http://www.eei.gov.eg

[56] http://www.eei.gov.eg/pages/03%20M_E/M_E.aspx#MEOutcomes

[57] This section is based on the analysis of the ICT in education policies of Finland, France, Ireland, Korea, Singapore and the United Kingdom

[58] Johnson, L. & Smith, R. (2009). The 2009, 2010 and 2011 Horizon Report.

[59] Broadband mobile devices like the iPhone have already begun to assume many tasks that were once the exclusive province of portable computers

[60] Clouds refer to large clusters of networked servers which offer inexpensive, simple solutions to offsite storage, multi-user application scaling, hosting, and multi-processor computing.

[61] Horizon report 2009

[62] See, for example, Salomon, G. (1990). The computer lab: A bad idea now sanctified. Educational Technology, 30(10), 50-52 or Fowler, G. (1990). The lab instructor: Success as obsolescence. Computing Teacher, 17, 7, 9-12.

[63] Air-conditioning is important equipment in an area where the temperature is high.

[64] This is the fundamental leitmotif within the ICT/education community. Evidence tends to support the notion that placing computers in computer labs does not change existing teaching practices in a fundamental way. At the classroom level, the evidence is more mixed, and depends on a multitude of factors, including teacher and school experience with utilizing computers for education purposes; availability of technical and pedagogical support; existence of sufficient digital learning resources; and enabling educational policies, incentives and administrative practices, to cite just some of the major considerations. See infoDev (2005) Knowledge Maps: ICT in Education and Balanskat, A., Blamire, R. and Kefala, S. (2005). A Review of Studies of ICT Impact on Schools in Europe.for an an entry point into general conclusions from the literature.

[65] See especially Silvernail, D. (2009). Research and Evaluation of the Maine Learning Technology Initiative (MLTI) Laptop Program. Other research documents are available on the MLTI web site, http://maine.gov/mlti/resources/research.shtml.

[66] One Laptop Per Child web site, http://laptop.org.

[67] Tabaré Vázquez (2009). Digital Democracy. America's Quarterly, spring 2009.

[68] Kennedy, S. Cheap PC for kids spinoff, Australian IT, July 28, 2009.

[69] Trucano (2009). What have we learned from OLPC pilots to date? http://blogs.worldbank.org/edutech/what-have-we-learned-from-olpc-pilots-to-date.

[70] Preliminary data cited here from a presentation by the head of Plan Ceibal at the Inter-american Development Bank, 15 September 2009. Brechner (2009), One Laptop per Child and per Teacher, available through http://events.iadb.org/calendar/eventDetail.aspx?lang=En&id=1444.

[71] See: http://www.ceibal.edu.uy/

[72] The two governing decress for Plan Ceibal are available at http://ceibal.edu.uy/portal/images/stories/decreto_ceibal_1.pdf and http://ceibal.edu.uy/portal/images/stories/decreto_ceibal_2.pdf.

[73] For a background on total cost of operation issues, please see Vital Wave Consulting (2008). Affordable Computing for Schools in Developing Countries: A Total Cost of Ownership (TCO) Model for Education Officials.

[74] America's Digital Schools Survey. 2006

[75] www.ocw.mit.edu

[76] Timmer J. "Open Source, digital textbooks coming to California schools" ARS Technia June 9, 2009 -- http://arstechnica.com/tech-policy/news/2009/06/open-source-digital-textbooks-coming-to-california-schools.ars

[77] Carlson, S., Gadio, C. (2002) Teacher Professional Development in the Use of Technology.

[78] "Key Technology Trends" 2006 -- http://www.techlearning.com/article/7568

[79] UNESCO (2008). Digital Competency Standards for Teachers.

[80] UNESCO – ICT Competency Standards Modules.

[81] ISTE (2002). Technology Standards for School Administrators: Framework, Standards, and Performance Indicators.

[82] http://www.education.gov.sk.ca/

[83] ISTE (2008). ISTE Educational Technology Standards and Performance Indicators for All Teachers.

[84] Macintosh, W "Toward Free Learning Opportunities for all Students Worldwide" The Edutech Debate -- https://edutechdebate.org/digital-learning-resources/towards-free-learning-opportunities-for-all-students-worldwide/

[85] Carey, K. The Chronicle of Higher Education, July 10, 2011 -- http://chronicle.com/article/A-College-Education-for-All/128162/

[86] Labi, A "New Network Seeks to Form a Meta-University to Link Engineering Schools" The Chronicle of Higher Education, July 10, 2011 -- http://chronicle.com/article/New-Network-Seeks-to-Form-a/128184/

[87] Atkinson mentioned that there are four kinds of broadband externalities; network externalities, investment externalities, competitiveness externalities, and regional externalities.

[88] The population in California is approximately 37 million (2009 Estimate), from http://quickfacts.census.gov/qfd/states/06000.html

[89] 2007 data. Obtained from http://www.capetown.gov.za/en/stats/CityReports/Documents/2007%20Community%20Survey%20Summary.pdf

[90] Fornefeld et al also pointed out that the long-term employment level after a process improvement could not be determined in advance.

[91] A. Vashistha. 2010. *Passing the Baton at Tholons Consulting to a Global Leadership Team*. Tholons Inc. http://www.tholons.com/nl_pdf/Press_Release2011.pdf; and H. Muthal. 2011. *Realizing Opportunities: The Global*

IT-BPO Sector and the Potential of Latin America & The Caribbean. Tholons Inc. http://www.outsource2lac.com/HarshMuthal.pdf

[92] R. Sudan, S. Ayers, P. Dongier, A. Mueute-Kunigami, C. Qiang. 2010. *The Global Opportunity in IT-Based Services: Assessing and Enhancing Country Competitiveness*. World Bank. Washington, D.C.

[93] Sakita Natu. *Rural BPO: Sustainability and a Better Life*. youthkiawaaz.com. http://www.youthkiawaaz.com/2011/05/bpo-in-rural-india/

[94] NASSCOM is the premier trade body and the chamber of commerce of the IT-BPO industries in India. NASSCOM is a global trade body with more than 1200 members, which include both Indian and multinational companies that have a presence in India.

[95] Kumar Parakala. 2011. *Rural BPOs in India: Are they over-hyped?* Global Services Media, March 2011 Newsletter. www.globalservicesmedia.com

[96] Microwork write-up extracted significantly from infoDev report: infoDev 2011. "Knowledge Map of the Virtual Economy". Available at: http://www.infodev.org/en/Publication.1076.html

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[98] A.T. Kearney. 2011. *Offshoring Opportunities Amid Economic Turbulence: The A.T. Kearney Global Services Location Index, 2011*.

[99] ITIDA. *Brochures and Reports*. http://www.itida.gov.eg/En/Media/Reports/Pages/default.aspx

[100] ITIDA. 2010. *Destination Egypt: BPO Value Proposition – March 2011*. http://www.nvtc.org/documents/enews/Combined_ITO_BPO_Proposition_March_2011.pdf

[101] Dr. Tarek Kamal. 2010. *Dr. Kamal Receives Parliamentary Delegation at Smart Village*. Ministry of Communications and Information Technology. http://www.mcit.gov.eg/MediaPressSer_Details.aspx?ID=720&TypeID=3

[102] In January 2008, when two submarine fibre-optic cables snapped along the coast of Egypt, the country was able to utilize the third cable as emergency back-up for critical telecommunications. Such emergency preparedness is an important factor in the success of any BPO destination (from http://nextfrontier.wordpress.com/2009/08/31/outsourcing-to-africa-egypt-%E2%80%93-the-great-sphinx-is-rising/)

[103] Abhishek Anand. 2008. *HDFC Bank sets up Rural BPO in Tirupati*. mydigitalfc.com. http://m.mydigitalfc.com/hdfc-bank-sets-rural-bpo-tirupati-649

[104] World Bank. 2009. *Economic and Fiscal Impact of Introducing Broadband Networks and Services in Lebanon*. World Bank, Washington, D.C.

[105] Christine Qiang and Carlo M. Rossotto. 2009. *Economic Benefits of Broadband, and chapter 3 in Information and Communications for Development 2009: Extending Reach and Increasing Impact*. World Bank, Washington D.C.

[106] World Bank. 2009.

[107] Dr. Raúl L. Katz et al. 2009. *The Impact of Broadband on Jobs and the German Economy*. Columbia Institute of Teleinformation. http://www.teleadvs.com/images/NYU_Katz.pdf

[108] Crandall, Lehr & Litan. 2007. *The Effects of Broadband Deployment on Output and Employment: A Cross-sectional Analysis of U.S. Data.* The Brookings Institution. http://benton.org/node/6568

[109] Telegeography. 2009. *Egyptian government aims for 20% broadband penetration in four years*. http://www.telegeography.com/products/commsupdate/articles/2009/12/16/egyptian-government-aims-for-20-broadband-penetration-in-four-years/

[110] Dr. Ranee Jayamaha, Deputy Governor of the Central bank or Sri Lanka, January 2008 – " Impact of IT in the banking sector", BIS Review

[111] Update on regulation of branchless banking in Brazil, CGAP, 2010

[112] CBE – Annual report 2008-2009

[113] Except Katz R. and al for Germany

[114] Other studies have also shown a positive impact of broadband penetration and GDP growth, although the impact of such growth varies. A 10 percentage points increase in broadband penetration could have an impact on GDP growth from 0.26 percentage points to 1.50 percentage points in GDP growth; see Katz (2010) The Impact of Broadband in the Economy: Research to Data and Policy Issues, available at: http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR10/documents/GSR10-ppt1.pdf, Analysis Mason (2010) Assessment of Economic Impact of Wireless Broadband in India, available at: http://www.gsmamobilebroadband.com/upload/resources/files/AM_India_Final_Full_Report.pdf, and Czernich et al. (2009) Broadband Infrastructure and Economic Growth, available at: http://www.cesifo-group.de/portal/page/portal/DocBase_Content/WP/WP-CESifo_Working_Papers/wp-cesifo-2009/wp-cesifo-2009-12/cesifo1_wp2861.pdf.

[115] Based on a study of 27 developed countries and 66 developing countries. See Clarke, G. and Wallsten, S. (2006), Has the Internet Increased Trade? Evidence for Industrial and Developing Countries, Economic Inquiry 44 (3): 465-84.

[116] Telegeography (2010)

[117] In addition, NTRA installed Mobile Number Portability (MNP) in April 2008, which aims at spurring the mobile market and enhance subscribers' usability.

[118] Telegeography 2010.

[119] See MCIT indicators at: http://www.mcit.gov.eg/Indicators/Indicators.aspx

[120] Data from Telegeography 2010. Population data from World Bank database.

[121] See MCIT indicators at: http://www.mcit.gov.eg/Indicators/Indicators.aspx

[122] Telegeography (2010), GlobalComms Database.

[123] Calculated from data from Telecom Egypt, Annual Report 2009, available at: http://ir.telecomegypt.com.eg/admin/uploads/annual-report-2009/FINAL%20ANNUAL%20web.pdf

[124] ITU Database

[125] A few countries (like Greece), adopted this Directive with a few years of delay. EU accession countries from Eastern Europe also all adopted this Directive as one of the conditions to enter the European Union.

[126] See, for instance, Tekbas, Erdinc, Liberalization Process of Electronic Communications Services Market in Turkey, UNCTAD (2011), available at: http://unctad.org/sections/wcmu/docs/cImem3_3rd_Country_Paper_Turkey_3.pdf

[127] Qiang (2010)