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White Paper

Internet for All
An Investment Framework for Digital Adoption

Prepared in collaboration with The Boston Consulting Group

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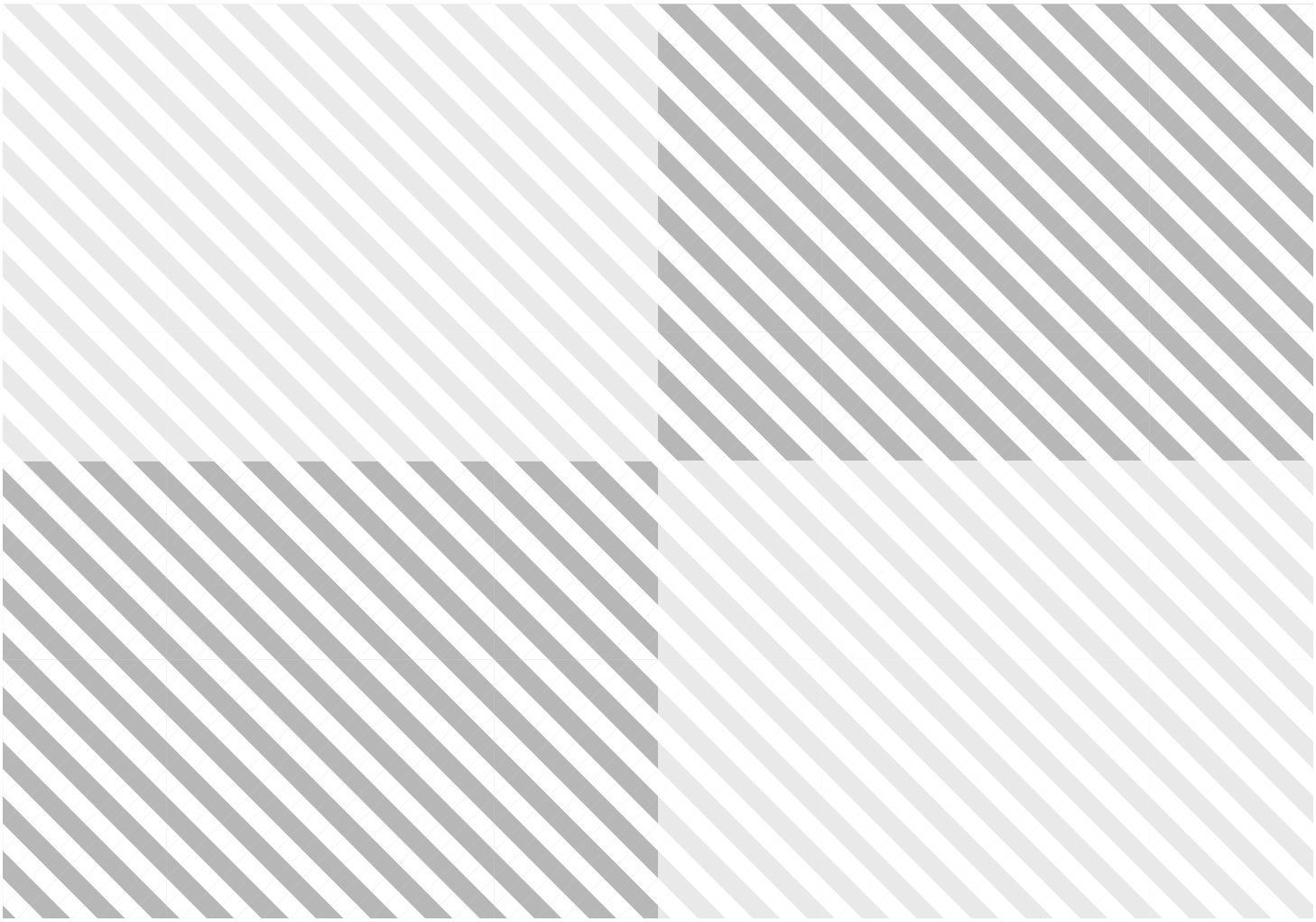


World Economic Forum
91-93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland
Tel.: +41 (0)22 869 1212
Fax: +41 (0)22 786 2744
Email: contact@weforum.org
www.weforum.org

REF 080517

Contents

Foreword

Alex Wong
Head of Global Challenge Partnerships
Member of the Executive Committee
World Economic Forum

Eric White
Project Lead, Internet for All
Global Leadership Fellow
World Economic Forum

This White Paper is the end result of a year-long effort that began with a raised hand and simple question. At an Internet for All workshop during the World Economic Forum on Africa in Kigali, Rwanda from 11-13 May 2016, participants were listening to a presentation on the project's "barriers framework". Developed as part of the first *Internet for All* publication, this framework is based on four barriers that must be overcome to achieve internet access for all: limited infrastructure, lack of affordability, poor digital skills and awareness, and an absence of relevant online content. At the end of the presentation, a minister of information and communications technology asked, "You've shown us a very nice framework, but how much is this going to cost?"

The Broadband Commission for Sustainable Development estimates that it will cost $450 billion to connect the next 1.5 billion people. While this figure well frames the global effort required, it does not provide much help to government leaders who must consider the specific needs, endowments and circumstances of their own country. When the Internet for All Steering Committee, a group of nearly 50 organizations representing every segment of the information and communication technology (ICT) industry as well as civil society, academia and international organizations, was asked if such a tool existed, they responded negatively and supported the suggestion to develop one.

This White Paper therefore presents a model that will help business and government understand what it takes, in dollar terms, to close the digital divide in a given national context. The methodology was applied to East Africa's Northern Corridor (Kenya, Uganda, Rwanda and South Sudan), where this project has been working for nearly a year. The results of this application yield much more than a single number. They show how the definition of "closing the digital divide" can have a tremendous impact on costs, illustrating a trade-off all governments must face. They show how the right policies can drastically reduce costs and turn a poor business case into a profitable investment opportunity. And they illustrate the challenge in Africa with device costs. Usually borne privately by consumers, in the Northern Corridor devices make up one of the biggest portions of the cost of bringing an individual online.

The model involves more than just this White Paper. To help with its application, it includes a compendium of spreadsheets that will allow readers to use the model. These can be applied to understand investment requirements and set goals in Internet for All country programmes, and can be used independently of this project as well.

As with any model, this one includes a set of assumptions, detailed in the Appendix at the end of this White Paper. The assumptions, particularly the focus on the extension of the current 3G/4G mobile broadband model, were made not necessarily as an endorsement but as a practicality based on data availability. The model will work as well with other assumptions, so individual users are encouraged to tailor it to their own needs.

We are extremely grateful to the Internet for All Steering Committee for their thoughtful and useful inputs at every step along the course of this White Paper's development. We would also like to thank the Boston Consulting Group (BCG) for its invaluable support as our project Knowledge Partner. In particular, Alykhan Vira (on secondment from BCG), who served as this effort's Project Manager, deserves special recognition.

Executive Summary

Background

Launched in 2015, the World Economic Forum Internet for All initiative aims to accelerate internet access and adoption for the world's 4 billion unconnected people through new models of public-private collaboration. The initiative provides multistakeholder platforms at the global, regional and national levels through which leaders from government, donor organizations, the private sector and civil society can collaborate to develop, deploy and scale innovative models and activities to close the digital divide. Over 50 global organizations from business, government and civil society as well as donors provide oversight as part of the Internet for All global Steering Committee. In 2016, the initiative developed a framework that identifies four principal barriers to internet inclusion: infrastructure gaps, limited affordability, poor digital skills (and awareness of why they are necessary) and a lack of relevant online content. Country programmes launched so far concern East Africa's Northern Corridor (Kenya, Rwanda, South Sudan and Uganda) and Argentina, and the Internet for All framework has been used as the basis for these programmes.

This White Paper illustrates an investment model that can be used to quantify the costs to achieve universal access and adoption. This allows multistakeholder groups, working together through Internet for All county programmes, to arrive at an objective estimate of the level of investment required to achieve internet for all through interventions that focus on each of the four barriers. The model has been developed and will be available as a series of spreadsheets on the Internet for All website. It is accompanied by information that explains the model and applies it to the case of the Northern Corridor countries.

The Internet for All investment model

The Internet for All model can be used for investment analysis using a four-step approach:

1. **Define the target**. As a starting point, countries need to quantify their ambitions in terms of new users to be brought online over a defined period of time.
2. **Select the interventions**. Stakeholders need to collectively identify the necessary interventions based both on their national broadband strategies and prevailing barriers in each country.
3. **Assess the investment**. Each intervention must be assessed in detail to determine the investments required to leverage the Internet for All model. Factors such as the impact of local policy and regulatory environment (e.g. tax policy) should be considered.
4. **Determine the business case**. It is necessary also to assess the financial feasibility and business case for investments, particularly with respect to infrastructure interventions. In most markets, investments in ICT infrastructure are made by private-sector players with the aim of generating a commercial return.

Of particular note is that the model includes detailed research into the assumptions necessary to arrive at an investment figure. This includes using geospatial information system data to determine the range of 3G/4G coverage based on topography, and interviews with educational groups to determine the cost of training one person on basic digital skills. All assumptions are detailed in the spreadsheets.

Applying the model to the Northern Corridor

Defining the target. The Internet for All project in the Northern Corridor, led by the governments of the respective countries and launched in 2016, has the goal of bringing 25 million new users online by the end of 2019. This would imply accelerating the current rate of growth of internet use by approximately 50%. The model was used to determine the level of investment required to meet this goal.

Selecting the interventions. Four specific interventions, one addressing each barrier, were chosen based on an understanding of the region. Achieving the target of accelerating internet access and adoption in the Northern Corridor requires that four main hurdles be addressed:

- Infrastructure: The intervention chosen was to expand 3G and 4G coverage. This was due in part to the realization that 42% of people in the Northern Corridor countries are not covered by a mobile broadband signal.
- Affordability: The intervention chosen was to increase access to smartphones. Smartphone adoption in the region is low, ranging from only 10% to 29% in the four countries, owing in part to the high cost of devices.
- Skills and awareness: Not only do people in these countries lack ICT skills, but basic literacy and numeracy are also widespread problems; for example, less than half of eligible youth are enrolled in secondary education. The intervention chosen was to train two people per family in digital skills and provide 10% of the population with advanced digital skills.
- Local content: Numerous studies have shown the importance of locally relevant content in encouraging local internet adoption and use. Local content is hard to find – in the Northern Corridor countries, only 0.1 internet domains are registered per 1,000 people, compared with the global average of 26 per 1,000 people. The intervention chosen was to develop a tech park to support the development of local content.

Assessing the investment and determining the business case. To implement the selected four interventions at a scale necessary to achieve the target would require an investment of $1.83 billion, or $64 per person, a financially unsustainable business case. Infrastructure costs are high, and current smartphone costs are well beyond the reach of many, if not most, potential users; prices today are equal to 50-100% of monthly GDP per capita. But by using

identifiable policy levers, Northern Corridor governments can reduce the cost of bringing new users online by 23%, or from $64 per person to $49 per person – a total investment of approximately $1.39 billion, which is a financially feasible business case for the three-year timeline of the Internet for All project. The levers include active and passive infrastructure sharing in unserved areas (a saving of more than $250 million); making low-frequency spectrum available for 3G and 4G coverage (saving $100 million); and removing value added tax (VAT) on low-end smartphones (saving $80 million).

Key insights

Defining the target and the interventions has a large impact on the viability of the business case. Although the scenario of bringing 25 million new users online is achievable given the right policy environment, the business case for the scenario of reaching 95% internet penetration in the region is not viable with the interventions selected.

Policy choices have a major impact on investment numbers. In the Northern Corridor, a few key interventions can reduce the total investment required by 23%. This makes the difference between a sustainable business case and the continued lack of investment.

Infrastructure is not always the biggest hurdle. To achieve 25 million new users in the Northern Corridor, the biggest barriers are device affordability and skills training – areas where private-sector-led investment models are not straightforward. However, to reach 95% internet access and adoption in the region, infrastructure does constitute the biggest constraint.

Innovative partnerships are key. The different cost components of expanding access and adoption are borne by various stakeholders – the public and private sectors, donors, civil society and even consumers. Partnerships that allow these investments to be coordinated and that bridge the gaps between the available funds and the investment required can shift the burden as appropriate to the different stakeholders. These partnerships are necessary to achieve Internet for All.

Introduction

In 2015, the World Economic Forum launched the Internet for All project with the mission of accelerating internet access and adoption for the 4 billion people globally who remain unconnected. As discussed in the Forum's 2016 report, *Internet for All: A Framework for Accelerating Internet Access and Adoption*, and as documented in numerous efforts related to digital connectivity, providing internet access and promoting internet use involves finding – and funding – solutions to a daunting series of challenges. These include the absence of connectivity infrastructure (and sometimes of basic electricity), the affordability of both devices and service for much of the world's poor, lack of literacy and digital skills, and a shortage of relevant (and local-language) content to encourage people to go online.

Internet for All provides a multistakeholder platform where leaders from government, the private sector, multilateral and bilateral organizations, academia and civil society can collaborate to develop and scale up new models of public-private collaboration on internet inclusion. This involves increasing coordination and collaboration around accelerating promising innovations, attracting investments, facilitating partnerships, and strengthening the policy and regulatory environment.

Internet for All has established such platforms at two levels. First, on the global level, the project increases collaboration on internet inclusion among major international actors, leading to greater impact at scale. Internet for All has a global Steering Committee with nearly 50 member organizations.

The second effort focuses on national-level platforms. The Internet for All project includes multiple in-country platforms to convene local stakeholders to implement internet inclusion activities through a government-led and Forum-supported process. Two initial country programmes were targeted for 2016 based on interest and an invitation from the respective governments: East Africa's Northern Corridor and Argentina. Further country programmes, including one in India, are planned for 2017 and beyond.

The slow growth of internet use

Despite improvements in technology, generally falling costs, the increasingly ubiquitous influence of digital technologies among those that use them, and the growing necessity of being connected to participate fully in today's digital economies and societies, global internet penetration has been consistently growing at only 2-3% a year over the last 15 years (Figure 1). A majority of the world's population – about 53% – is still not online and, if current growth rates persist, more than 3 billion people will remain unconnected by 2020. At the current pace, it will take almost 20 years before near-universal internet access (more than 95%) is realized.

Figure 1: Growth in Internet Penetration Has Remained Steady at 2-4 Percentage Points per Year over the Last 15 Years

Source: ITU, EIU population data, BCG analysis

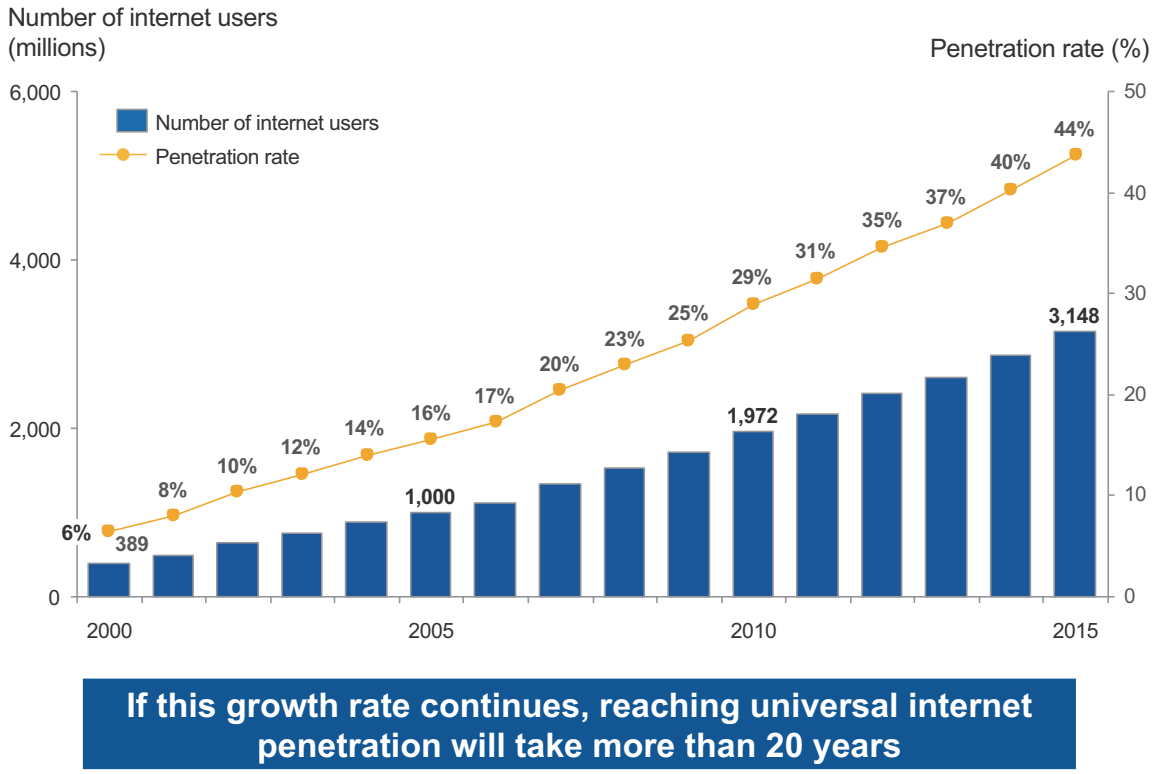


Figure 2: At Current Rates, Overall Connect 2020 Targets Will Just Be Reached...

1. Developing countries include least developed countries as per ITU definitions.
Note: Growth rate estimated as average percentage point increase per year based on the most recent linear three-year growth rate (2012-2015); Countries were classified into developed, developing and LDCs based on UN M49 classification as used by the ITU.
Source: ITU, World Bank, EIU, World Economic Forum; BCG analysis

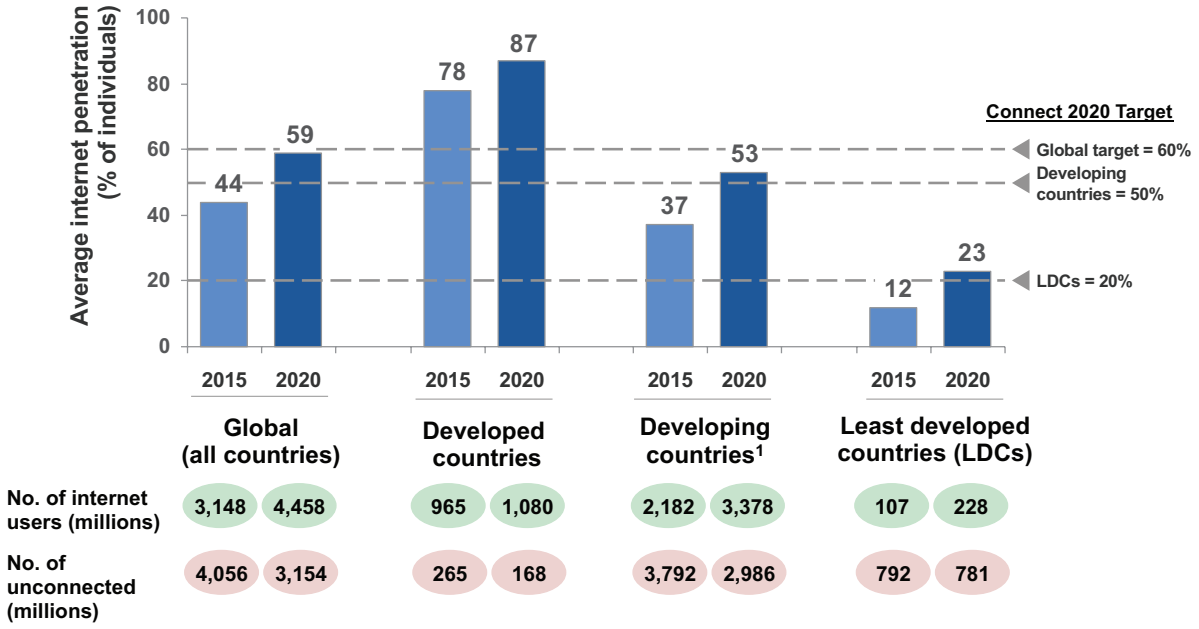
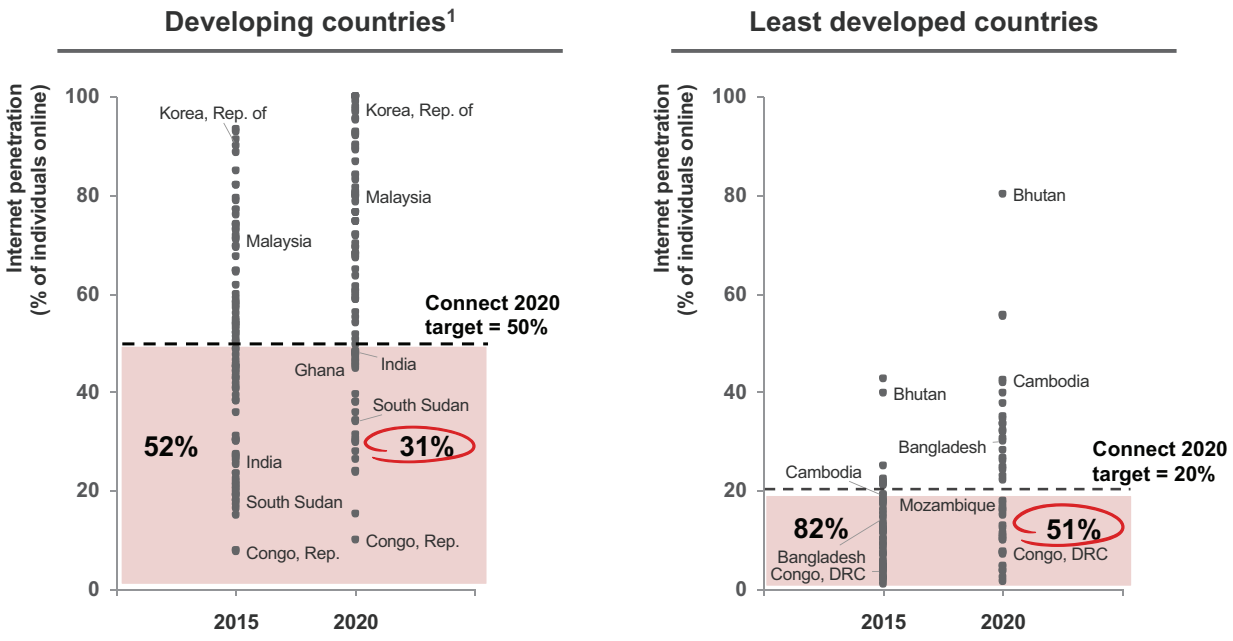


Figure 3: ...But One-Third of Developing Countries and More than Half of LDCs Will Not Reach Connect 2020 Targets

1. Excludes least developed countries (LDCs).
Note: Internet penetration in 2020 estimated using a growth rate calculated as average percentage point increase per year based on historical three-year growth rate (2012-2015); Countries were classified into developed, developing and LDCs based on UN M49 classification as used by the ITU.
Source: ITU, World Bank, EIU, World Economic Forum; BCG analysis



In addition, if current trends continue, the Connect 2020 targets set by the Broadband Commission for Sustainable Development of the United Nations and the International Telecommunication Union (ITU) will only just be met, particularly in developing and least developed countries (Figure 2). Broadband Commission targets are set at a combined country level, however; when looking at individual countries, almost one-third of developing nations and more than half of least developed countries will not reach these targets (Figure 3). The stagnant rate of internet penetration underscores the need for increased focus and effort on accelerating internet inclusion.

The need to do better

Accelerating internet inclusion is critical to ensuring that countries and their citizens can take advantage, sooner rather than later, of what the World Bank calls "digital dividends" – the economic and social benefits that digital technologies and connectivity confer on individuals, companies, countries, economies and societies. Much work has shown that the majority of the barriers to connectivity need to be addressed nationally and that interventions at a country level require participation and collaboration among a broad range of local stakeholders. The Internet for All project aims to bring together relevant national stakeholders under the stewardship of their respective governments so they can identify and implement interventions that accelerate internet access and adoption. But identifying and developing initiatives is only the first step towards the more crucial task of attracting the investments that will actually advance implementation. This White Paper highlights how the Internet for All framework can be put into action.

An Investment Model for Internet for All

In 2016, the World Economic Forum launched the first county-level implementation of the Internet for All model. Four countries in the Northern Corridor of East Africa – Kenya, Rwanda, South Sudan[1] and Uganda – agreed to ambitious goals to extend internet connectivity and use. By nature of being first, they were also establishing a model for other countries and regions to follow. This included being the first countries to which the investment model would be applied. The connectivity goal set in the Northern Corridor Internet for All project falls short of achieving near-universal internet coverage, but is more achievable given the lifespan of the project. The investment model therefore considers two scenarios: one of achieving the project goal (near-term) and the other of near-universal internet access (long-term). These scenarios are called Horizon 1 and Horizon 2 (Figure 4).

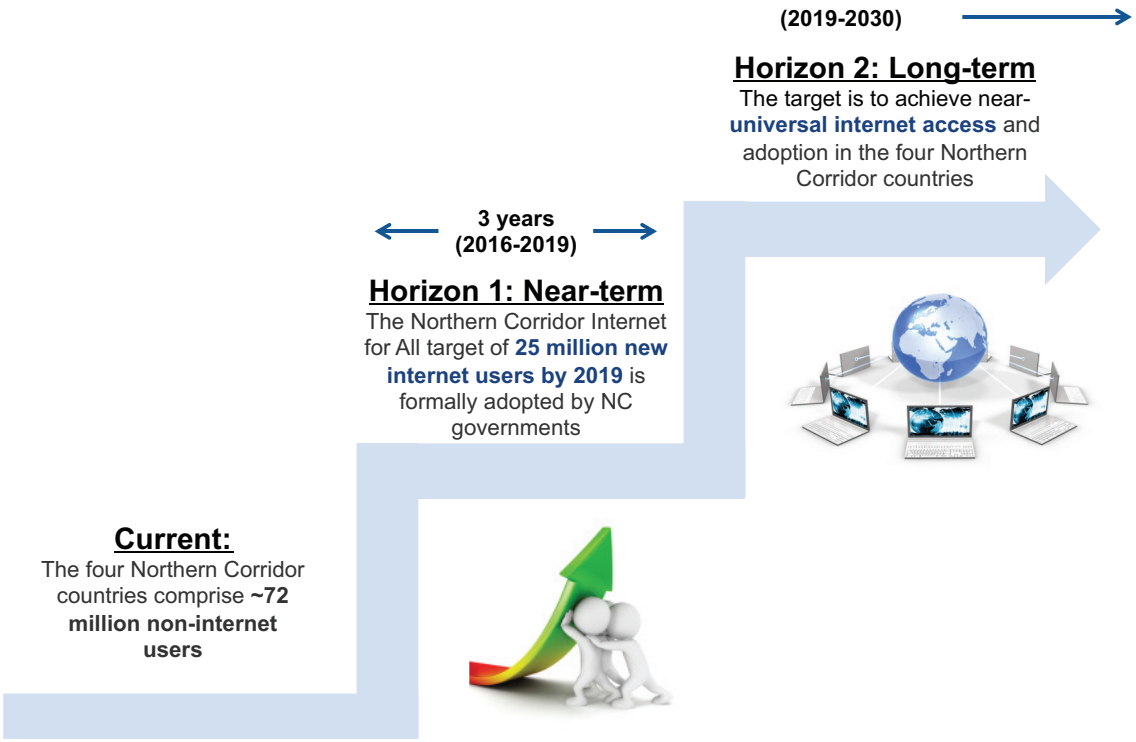
The Northern Corridor governments set a three-year goal of bringing 25 million new users online by the end of 2019, accelerating the current growth rate of internet use by approximately 50%. Achieving this target would increase collective internet penetration in the four countries to 50% from the current 33%, and add 15 million new users in Kenya, 10 million in Uganda, 2.5 million in Rwanda and 1 million in South Sudan.[2] This is Horizon 1. By comparison, achieving near-universal access and adoption requires bringing some 56 million new users online. This is Horizon 2.

Achieving the goals of either scenario involves overcoming the four barriers that the Internet for All project has identified as representing the biggest challenges to wider adoption and use. These include:

- Infrastructure: 42% of the population3 of the four Northern Corridor countries do not have access to mobile broadband (3G or better) coverage.
- Affordability: Smartphone adoption is low, ranging from only 10% to 29% in the four countries, owing in part to the high cost of devices (see box 1, “An Innovative Business Model Promotes Smartphone Use in Kenya”).
- Skills and awareness: Not only do people in these countries lack ICT skills, but basic literacy and numeracy are also widespread problems; for example, less than half of eligible youth are enrolled in secondary education.4
- Local content: Numerous studies have shown the importance of locally relevant content in encouraging local internet adoption and use. Local content is hard to find in eastern Africa. In the Northern Corridor countries, only 0.1 internet domains are registered per 1,000 people, compared with the global average of 26 per 1,000 people.5

Figure 4: Two Horizons Considered: A Near-Term Target of 25 Million New Users and a Long-Term Target of Near 100% Internet Access

Source: World Economic Forum



Box 1: An Innovative Business Model Promotes Smartphone Use in Kenya

The majority of Kenyans have incomes of less than 200 Kenyan shillings (KES) ($2) a day and no credit histories. Purchasing a smartphone to access the internet is beyond the reach of many.

The innovative business model pursued by M-Kopa (M stands for mobile, and Kopa means "borrow" in Swahili) is changing this situation. M-Kopa began in 2011 as a pay-as-you-go solar power provider. The company has brought affordable solar power to more than 400,000 homes in Kenya, Tanzania and Uganda. Customers buy the home-based solar power system on a payment plan, with a deposit followed by daily payments. In 2016, the company expanded its model to offer smartphones to customers that have already successfully paid off a home solar system.

Customers pay a daily fee of KES 50 ($0.50, the same as the solar home system instalment) until they have covered the total cost of the phone. The system uses mobile payment technology, and payments are managed through the control panel on the solar home system. If a customer fails to make regular payments, M-Kopa can deactivate the person's smartphone as well as the solar home system.

The investment model methodology

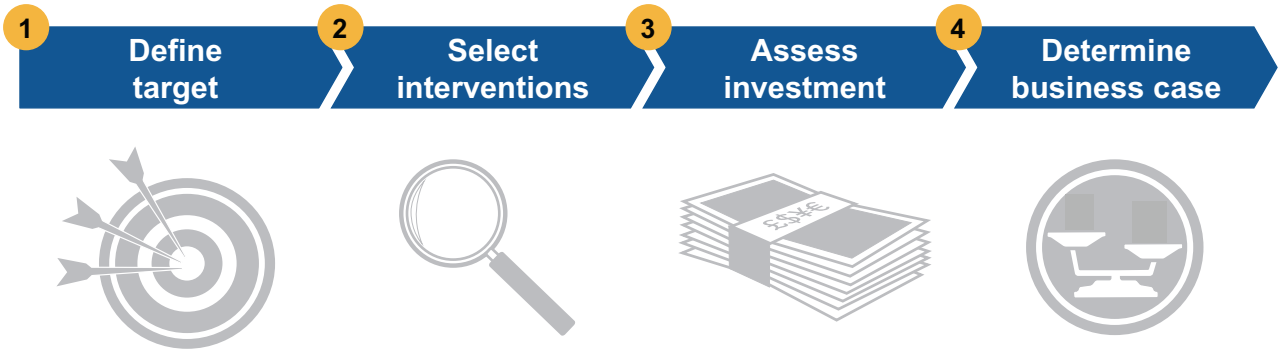
Overcoming these barriers will require significant investment. The Internet for All initiative has developed an investment model that can be used by governments, policy-makers, ICT companies and investors to quantify the financing requirements for increasing internet access and adoption. The model also allows policy-makers to assess the impact of their policy decisions on the cost and feasibility of increasing internet penetration. A four-step approach was used to develop the model (Figure 5).

1. Define the target. As a starting point, countries need to quantify their ambitions in terms of new users to be brought online over a defined period of time. As discussed, this White Paper uses two time horizons: a near-term horizon (25 million new users by 2019 in the Northern Corridor project) and a long-term horizon (internet penetration of more than 95%).

2. Select the interventions. Stakeholders need to collectively identify the necessary interventions based both on their national broadband strategies and prevailing barriers in each country. In this White Paper, four broad interventions are included, which each would generate progress on one of the four barriers of the Internet for All framework. Other potential interventions can also be used to address connectivity barriers, which can also be assessed with the help of this investment methodology. Some of them are described elsewhere in this paper. No specific approach is advocated, but a methodology and model to assess multiple potential interventions are provided. For example, the expansion of mobile broadband 3G coverage was selected as the intervention to model, although a number of alternative infrastructure models exist, which include (but are not limited to) models making use of unlicensed and/or dynamic spectrum, satellites, small-cell mobile towers, active infrastructure sharing, community networks and fibre to the premise (see box 2, "Innovations for Extending Internet Connectivity and Use"[6]). A country should ideally encourage a mix of different models, giving consumers the choice to select their preferred way of getting online.

Figure 5: Four-step Approach of the Investment Analysis for the Northern Corridor

Source: World Economic Forum



Define the high-level target for the Internet for All country programme
- Metric: no. of new internet users over time
- Multiple scenarios, e.g. short term and long term

Identify the interventions required
- Relevant barriers or government priorities
- Ideally, covers all four Internet for All barriers

Assess the investment value for each intervention
- Local policy and regulatory environment
- Total value and value per new user

Analyse the business case to determine the feasibility of interventions
- e.g. perform a net present value analysis
- Identify policy levers for a more attractive case

Box 2: Innovations for Extending Internet Connectivity and Use

The current 3G/4G mobile broadband model is only one of many business and technology models for internet connectivity. A recent report by USAID, Caribou Digital and the Digital Impact Alliance, *Closing the Access Gap: Innovation to Accelerate Universal Internet Adoption* (February 2017), presents eight alternative models. These are listed here, along with three more that should also be considered. While each model may or may not involve new technology, they all require different approaches to the business model of providing connectivity.

Rural internet service providers address unserved areas with an internet delivery model that uses Wi-Fi for last-mile connectivity and various technologies (including possibly TV White Space) for backhaul.

Mobile network operator partnerships (either revenue sharing or wholesaler) seek to address the high capex and opex costs of mobile network deployment through such approaches as "sharing of mobile network infrastructure and deployment of lower cost, 'white labeled,' networking equipment by nontraditional service providers [that] can reduce costs and facilitate network expansion."

Microteleco/community GSM providers offer small-scale network solutions to bring voice and SMS (and in some cases internet) services to remote, rural areas beyond the reach of mobile networks.

Paid commercial Wi-Fi are hotspots operated as commercial businesses using unlicensed Wi-Fi spectrum and selling pre-paid internet access. They are most economical in densely populated environments.

Public Wi-Fi (subsidized or free) is beginning to expand in emerging markets with public- and/or private-sector support. This model also works best in densely populated areas where people have Wi-Fi-enabled feature phones or smartphones.

Shared access centres (or telecentres) extend access to poorer communities by pooling the costs of devices and access. They are typically subsidized by a combination of governments, private donors and non-governmental organizations.

Zero-rating plans provide select content for "free" to users because the content is subsidized by mobile operators and/or content companies. (It should be noted that many believe that zero-rating runs the risk of violating the conventions of net neutrality and raises concerns of creating biased content and service silos.)

Sponsored or earned data models allow users to access the internet free of charge when they either accept advertisements or agree to test mobile applications. Additional innovative models are being explored under an "equal-rating" model.

Satellites play a crucial role in providing connectivity in rural and remote areas. They can either provide last-mile service to customers or be used to provide backhaul services to mobile network operators.

Small-cell mobile towers are low-cost mobile infrastructure designed for use in rural areas. They typically have low capital and operating costs, but limited range and bandwidth capacity can be constraints.

Publicly sponsored wholesale fibre networks can enable easy last-mile connections for homes and businesses. One example is the Andhra Pradesh Fibre Grid Project, where infrastructure sharing and innovations such as the aerial deployment of fibre have achieved substantial savings.

Beyond extending mobile broadband 3G coverage (infrastructure), the interventions used for the assessments in this White Paper include increasing smartphone adoption (affordability); providing basic as well as advanced digital literacy (skills and awareness); and developing a capability for producing local content. Keeping people online and deriving maximum benefits requires further investment. One of the most important ways to achieve this is helping to establish start-ups and small businesses that can develop locally relevant content and applications.

3. Assess the investment. Each of the four interventions were assessed in detail to determine the value of investment that will be needed. Factors such as the local policy and regulatory environment (tax policy, for example), which can influence the amount of investment needed, were considered. Assumptions and the calculation methodology are presented in detail in the Appendix.

4. Determine the business case. In addition to calculating the amount of investment required, a further step was to determine the financial feasibility and business case for investments, particularly with respect to infrastructure interventions. In most markets, investments in ICT infrastructure are made by private-sector players with the aim of generating a commercial return. In markets with inadequate or poor network coverage, private investors often find the business case less than compelling. Therefore, this paper also examines the kinds of policy levers that governments can employ to make business cases and investments more attractive (see box 3, "Infrastructure Sharing in Andhra Pradesh Lowers Costs and Time to Market").

Box 3: Infrastructure Sharing in Andhra Pradesh Lowers Costs and Time to Market

Innovative approaches to intervention can help get infrastructure projects off the ground – literally. In India, the government of Andhra Pradesh is determined to extend internet access to all of the state's 50 million residents, 70% of whom live in rural areas. The goal was to establish a highly scalable network infrastructure that could provide on-demand end-to-end broadband connectivity of 15 Mbps to all households and 1,000 Mbps to institutions and offices at an affordable cost.

The Indian government's initial BharatNet programme aims to lay 61,000 km of underground cable at an estimated cost of about $700 million, to be funded jointly by the central and state governments. The projected completion time is three to four years.

The government of Andhra Pradesh implemented a better idea. It pioneered an aerial route over existing electrical poles and established 2,445 points of presence at electrical substations. The network infrastructure was set up in a record nine months at a cost of about $50 million. The network delivers triple play services (data, TV, phone) and many value-added services at a monthly rate of 149 Indian rupees (about $2) for households and 999 rupees (about $14) for offices, as well as value-added services, such as education and health materials, videoconferencing, and movies on demand.

More than 90% of the 13,400 existing local cable operators and multisystem operators in the state joined as business partners with the government to integrate their networks and bundle services. The state government is gaining further value from its investment by establishing a state-wide cloud-based IP CCTV surveillance system, virtual classrooms, public Wi-Fi services and smart electrical meters, all of which make use of the new connectivity.

Investing in internet inclusion in the Northern Corridor

The application of the investment methodology and model to Horizon 1 in the Northern Corridor countries yields the results displayed in Figure 6. A total investment of $1.83 billion would be required, or $64 per person.[7]

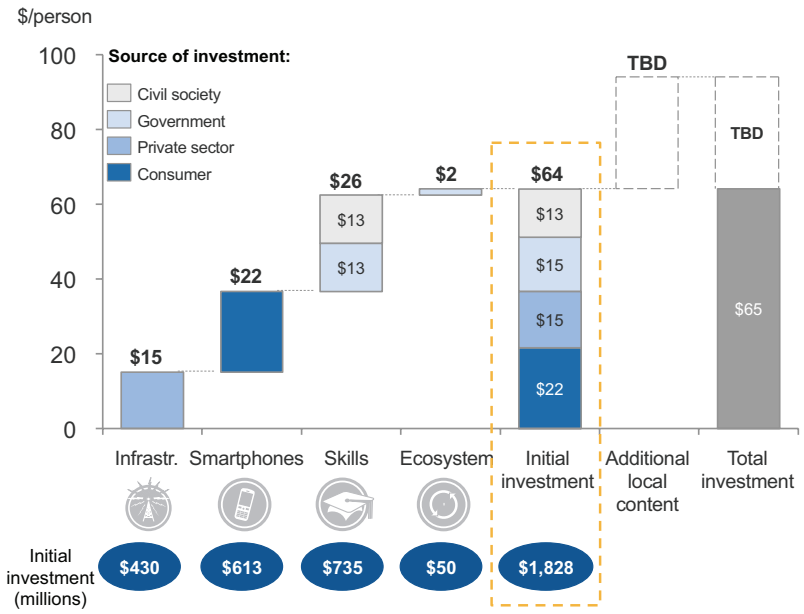
This investment would be split among the private sector, individual consumers, the government and civil society, and it breaks down as follows:

Infrastructure: 3G mobile broadband coverage. Infrastructure costs make up 23% of the total ($430 million or about $15 per person). To bring mobile broadband access to 25 million new users requires constructing or refurbishing approximately 6,100 3G towers and associated backhaul infrastructure. Population density[8] and current gaps in mobile broadband coverage (of at least 3G)[9] were used to determine the location and number of new or upgraded (2G to 3G) towers required. Capital expenditures and operating costs for the new towers were calculated using industry estimates. The calculation makes no provision for infrastructure sharing, such as multiple operators building tower networks with costs divided based on their respective market shares.

In the investment model, extending the mobile broadband coverage was selected as the intervention that enables more people to access the internet. For the purposes of the model, sufficient cost data also exist to measure this, which is not the case for many alternative models. As already pointed out, a number of alternative models exist, each of which has its strengths and may represent a preferred approach in certain circumstances. Countries should ideally encourage a mix of different models, giving consumers the choice to select their preferred way of getting online.

Figure 6: Investment Required to Add 25 Million1 New Internet Users in the Northern Corridor

Note: Assumes limited infrastructure sharing between operators, two smartphones per household at $47, one person per household with basic digital literacy training, 10% of youth labour force given advanced ICT training (in line with figures for selected OECD countries) for South Sudan, Uganda, Rwanda and 4% for Kenya (given the already high ICT employment rate) and a lower cost of capital at 15%.
1. Based on collective country targets totalling 28.5 million new users in the Northern Corridor; 2. $47 before value added tax.
Source: World Economic Forum; BCG analysis. Note that the numbers may not add up precisely due to rounding.



Affordability: Smartphone penetration. People need to own or have access to a smartphone or other connected device to get online. The model assumes two smartphones per family as a measure of adequate device penetration. New users in the Northern Corridor would need 11 million more smartphones than are currently projected to be in service from natural rates of increase, which at current prices represents 34% of the total ($613 million or about $22 per person). This cost is principally borne by the consumer in this model. The affordability of the connection is also an issue currently under discussion (see box 4, "Affordability of Internet Connectivity").

Box 4: Affordability of Internet Connectivity

The debate continues regarding the definition of affordable internet. The Broadband Commission for Sustainable Development has defined affordability as entry-level broadband services for less than 5% of monthly income. However, the Alliance for Affordable Internet (A4AI) argues that this cost is still too expensive for at least the bottom 20% of income earners in many countries. It affirms that when prices drop to 2% or less of monthly gross national income per capita, all levels of income earners, including the bottom 20%, are more likely to afford a basic broadband connection.

A4AI also believes that the 500MB definition of entry-level broadband is too low. It allows a user to watch just two minutes of high-quality video, not enough to enable regular use of health, education and other valuable online tools and information sources. Combining these two arguments, A4AI proposes setting and working towards a new affordability target: 1GB of mobile broadband data priced at 2% or less of average monthly income. This target is being debated at global levels for possible adoption.

Skills and awareness: Basic and advanced digital skills. A prerequisite for increasing usage is basic digital literacy. The model assumes digital literacy training for at least one person per family, which equates to more than 6 million people. More advanced skills training is also necessary to satisfy demand for ICT employment in the future. The model assumes advanced ICT training for up to 10% of the youth population based on OECD estimates and expert recommendations. Basic and advanced digital skills training accounts for 40% of the total cost ($735 million or about $26 per person). One idea being put into practice as part of the Northern Corridor Internet for All initiative is Rwanda's Digital Ambassador Program, which aims to provide basic digital literacy to more than 5 million people (see box 5, "Building Basic Digital Literacy with Digital Ambassadors"). This cost is assumed to be shared between the government and civil society.

Box 5: Building Basic Digital Literacy with Digital Ambassadors

The Digital Ambassador Program (DAP) is championed by the Ministry of Youth and ICT in Rwanda, the Digital Opportunity Trust (DOT) and the Mozilla Foundation. It directly contributes to Rwanda's Digital Talent Policy, which aims to increase digital literacy and skills for all Rwandans. The DAP will foster digital literacy, create jobs and empower communities. The programme will train 5,000 Digital Ambassadors (made up of social innovators, and un- and underemployed young men and women) who will train others in digital skills in order to access and benefit from financial, e-government and e-business services, and to help create social enterprises, self-employment and jobs in the digital economy. The DAP is an excellent example of local and international collaboration, bringing together key stakeholders from both the public and private sectors to provide investment, support and assistance with implementation. A key component of the programme is empowering women. Half of the Digital Ambassadors will be young women, and the programme includes specific metrics to ensure gender balance and inclusion.

Local content: Technology hubs. Studies indicate that technology hubs are being established in many emerging markets and have a significant impact.[10] The model assumes that the creation of a digital content ecosystem includes investing in at least one ICT hub in the Northern Corridor region that can nurture local ICT companies. This cost is estimated at about 3% of the total (or $50 million or about $2 per person) (see the sidebar, "Building a Tech Park in Cape Verde").

Box 6: Building a Tech Park in Cape Verde

Cape Verde is a lower middle-income nation with a development vision of becoming an emerging economy. In 2013 it applied for, and was granted, a loan from the African Development Bank to build a tech park at an estimated cost of $48 million. The purpose of this park is to foster entrepreneurship, create jobs and continue progress towards the country's goal of becoming an ICT hub. The park's components include a data centre and business continuity plan or disaster recovery site; a business and common facilities centre; open spaces for offices; an incubation centre; open space for equipment; and a training and qualification centre.

Of the total project cost, the government provided $5.8 million, and the African Development Bank financed $42 million. The project was forecast to take 48 months to complete, with operating costs expected to be covered by revenues from the data centre's services, which include cloud-based services, hosting and housing.

The data centre opened in July 2015. The rest of the tech park is still under construction but, once completed, its expected impact includes:

- Boosting ICT's share of GDP from 0.7% to 2.1% by 2020
- Increasing the number of start-ups and new businesses from 95 to 186 by 2017

– Generating more than 1,000 direct jobs and more than 1,200 additional jobs through companies located in the park by 2017
– Improving the country's internet penetration from 38% to 50% and average connection speeds from 1 Gbps to 10 Gbps by 2017
– Increasing the number of people in Cape Verde trained and certified in advanced ICT from 22 to 100

Based on these analyses, the model calculated the return on the infrastructure investment that would be necessary to add 25 million new users in the Northern Corridor. The analysis assumes the current regulatory environment and, as will be demonstrated later, changes substantially with policy intervention. Under current conditions, the business case for this level of infrastructure investment will not be financially sustainable (Figure 7).

Of equal concern is that the current costs of smartphones in the region puts them well beyond the reach of many, if not most, potential users. Prices today are equal to 50-100% of monthly GDP per capita (Figure 7).

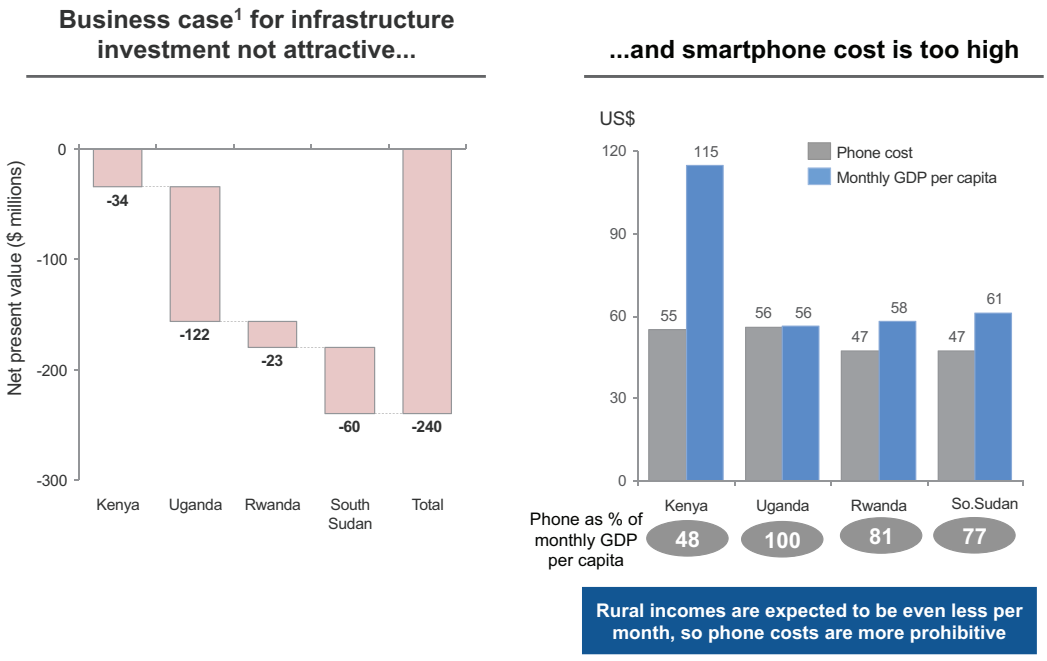
Assessing policy implications using the Internet for All model

The Internet for All investment model has been set up to quantitatively assess the impact of policy measures on the investment requirement and business case going forward. The model can therefore also be applied to test the impact of implementing policy changes. Three are presented here. Analyses showed that these levers would result in a financially sustainable business case to invest in expanding the 3G broadband network in all four Northern Corridor countries. It will also result in lower smartphone prices and significant cost savings for end consumers. For this assessment, the policy levers assessed were:

– Active and passive infrastructure sharing in unserved areas, which saves more than $250 million. A majority of the savings were derived from passive infrastructure sharing. It should also be noted that active infrastructure sharing can potentially result in lower quality of service and reduced incentives for investing in innovation if not implemented correctly.[11,12] This can be mitigated, however, by ensuring quality of service and investments in the latest technologies as part of licensing conditions.
– Making low frequency (700-800 MHz range) available for 3G and 4G coverage by using spectrum freed up from the digital migration of TV and/or by refarming spectrum currently committed to 2G networks, which together would save more than $100 million. The cost of spectrum has not been included in the analysis, and any savings from this policy lever are likely to be offset by spectrum acquisition costs. High costs of spectrum will therefore impact the investment decisions to expand mobile broadband connectivity (see box 7, "Spectrum Policy and Its Impact").
– Removing value added tax (VAT) on low-end smartphones would save consumers $80 million. For example, removing VAT would lower prices by 16% in Kenya and 18% in Uganda, making it more affordable to purchase these phones. A report by Deloitte and GSMA shows that handset purchases increased by more than 200% after VAT was removed in Kenya in 2009.[13] VAT on mobile phones was reintroduced in 2013. Overall, inefficient tax regimes related to connectivity serve to raise the end-user costs, and these inefficiencies need to be periodically assessed by governments.

Figure 7: The Infrastructure Business Case and Smartphone Costs in Horizon 1 Are Not Financially Feasible

1. The business case only considers revenues from the newly covered population; includes selling, general and administrative (SG&A) expenses in cost based on a benchmark of 14% SG&A cost of revenue. Note: Net present value 2017-2025.
Source: World Economic Forum; BCG analysis



Box 7: Spectrum Policy and Its Impact

Spectrum access policies have considerable impact on infrastructure and investment more broadly. In particular, regulatory policy and decisions affect infrastructure investment with regard to both scarce mobile spectrum and fixed-line networks. Removing entry barriers and facilitating competition puts downward pressure on prices. Colombia, for example, lowered barriers for new broadband market entrants in 2009. Today, five network operators and six virtual network operators compete against each other. Prices decreased for entry-level broadband plans from 5.8% of per capita average income in 2013 to just 3.3%. In a number of countries, the Alliance for Affordable Internet has found that the shift to a unified licensing regime, which facilitates the move from vertical (technology-based) to horizontal (services-based) licences, can help reduce the administrative and formal requirements for new competitors to enter the market.

Some countries are using spectrum policy to advance connectivity. For example, the Brazilian Agency of Telecommunications, Anatel, included specific coverage obligations to a spectrum auction in 2012, such as connecting 30% of Brazilian cities by June 2014, 60% by December 2014 and 100% by December 2015. The criteria for determining the buyer included bringing the lowest costs to consumers.

Too many governments consider spectrum as an asset whose full financial value to the seller should be realized immediately, rather than used as a powerful means of expanding coverage and use. Empirical evidence shows that high auction prices can result in successful bidders lacking the resources to make the capital investments required to put their newly acquired purchases to use, thus turning a scarce resource into a wasted one. The primary goal for policy-makers and regulators should be to maximize the use of spectrum rather than its short-term value. Governments should also be clear on whether they are using spectrum policy to address coverage or capacity challenges, and establish their rules with this in mind.

It is possible that by using identifiable policy levers, Northern Corridor governments can change the game – reducing the cost of bringing new users online by 23%, or from $64 per person to $49 per person. This would mean a total investment of approximately $1,391 million (Figure 8) for the three-year timeline of the Internet for All project. These policy levers also ensure a financially feasible business case[14] for infrastructure investment.

Achieving universal internet penetration: A tougher long-term challenge

The long-term vision of the Internet for All project is for countries to achieve universal internet access and adoption. Therefore the investment model was also applied to assess the cost of providing access to more than 95% of the Northern Corridor population.

This ambition is a far tougher challenge. The model shows a total cost of $6.3 billion, or $115 per person, to connect the remaining 56 million people in the Northern Corridor countries. The higher costs are substantially the result of additional infrastructure that needs to be built in more remote areas with lower population densities. If the same 3G/4G model is assumed, infrastructure costs comprise $67 of the $115 per person cost (Figure 9). Similar assumptions were used in the other three areas (affordability, skills and content) and those costs are similar to those for the near-term horizon.

Once again, however, applying a similar set of policy levers can reduce costs significantly – by 50% – and improve the business case in all countries. Infrastructure sharing and refarming spectrum would save approximately $3 billion, or $54 per person. Estimates suggest that the resulting business case would be sustainable in Uganda, marginal in Rwanda, but still not sustainable in Kenya and South Sudan. Further interventions would therefore be necessary (perhaps including government subsidies) to achieve a sustainable business model in these countries.

Figure 8: Targeted Government Policy Levers Can Reduce This Cost by 23% to $49/Person with Savings of about $440 million...

1. Media articles. 2. GSMA and Deloitte, Digital Inclusion and Mobile Sector Taxation, 2015.

Source: World Economic Forum; BCG analysis

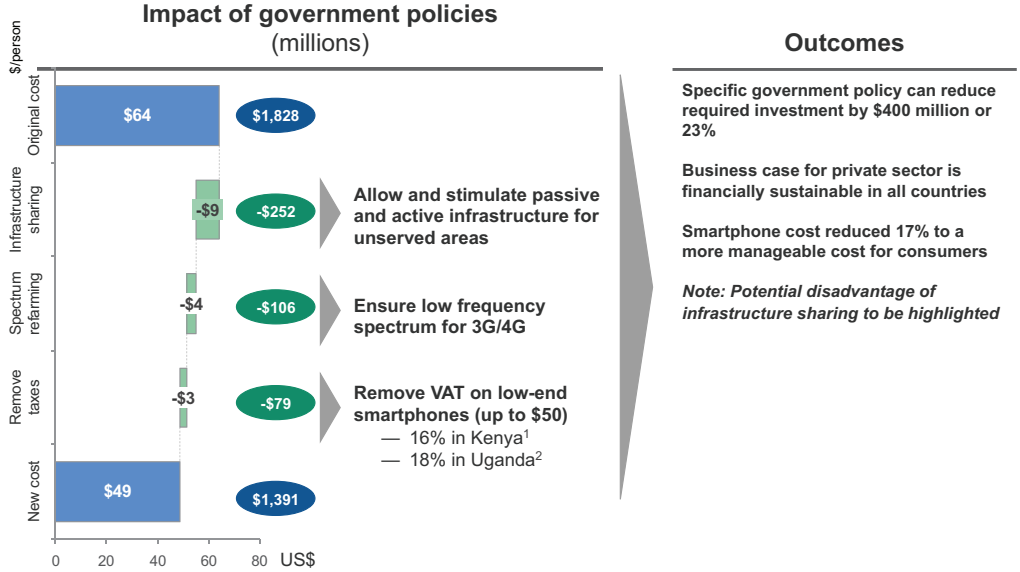
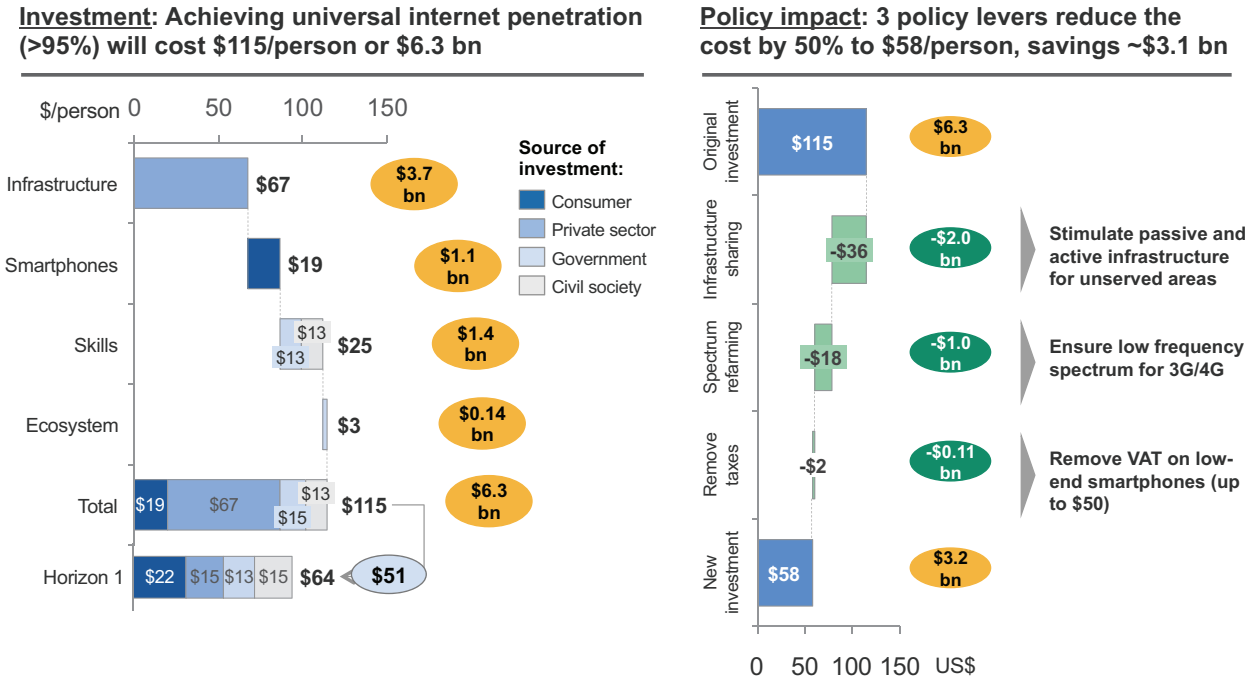


Figure 9: Investment Required to Reach Universal Internet Penetration

Note: Assumes limited infrastructure sharing between operators, two smartphones per household at $471, one person per household with basic digital literacy training, 10% of youth labour force given advanced ICT training (slightly above OECD average of 3.62%) and a lower cost of capital at 15%.
1. $47 before value added tax.
Source: World Economic Forum; BCG analysis



Going beyond basic access to meaningful use

As pointed out in the 2016 *Internet for All* publication, helping people acquire the skills to go online and to spread awareness of the internet's value often involves addressing issues of cultural acceptance. A sharp understanding of local conditions and customs needs to underpin these efforts, especially on how families and communities influence teaching and exposure to new ideas. Thus, these influencers can be used to ease communication, circumvent cultural barriers and encourage a good understanding of what it means to be web-literate.

The initial investments described above will provide the basic infrastructure, devices and skills that people need to go online. Keeping people online and ensuring that individuals and companies derive the maximum socio-economic benefit also require a ready supply of locally relevant digital products and services. This creates a chicken-and-egg situation. A content creation ecosystem is unlikely to take root and grow until there is a sufficient user base to serve and, without the local content, people have little reason to become users. Countries can help sidestep this conundrum by investing (or providing incentives for investments) in the local small technology companies that can form the foundation of a vibrant ecosystem.

The specific extent and focus of the investment required depends on each country's ambition to grow its ICT sector and the local small and medium-sized technology enterprises that will go on to create local digital content. Financial support for new companies is required at all stages of development, from the idea or "seed" stage to the early business start-up stage, to the fully developed business that is ready for expansion stage. Sources of financing also differ based on the development stage. They can include the government or angel investors at seed stage, venture capital firms and "impact investors" at the early business stage, and more traditional funding sources, such as banks and microfinance institutions, private equity firms and larger companies, at the growth and expansion stage.

Technology platforms, through which digital services are accessed and businesses can provide products and services, are key to the development of local ecosystems. By providing technology services, these platforms eliminate the need for businesses to make upfront investments in technology that are often prohibitive. But many countries have barriers to the deployment of platform business models, such as restrictions on advertising or the free flow of data or no access to digital financial services. Removing such barriers is critical to the development of local ecosystems.

Conclusion

The Northern Corridor is one region of one continent, but its nations face many of the obstacles to extending internet penetration and use that are common to developing countries worldwide. One clear lesson derived from the Northern Corridor is that while the barriers are high, and business cases can be tough to justify, targeted, intelligent interventions can make a huge difference, potentially swinging a negative case into positive territory. A collaborative, multistakeholder approach is essential, and thoughtful planning and cooperation can have a big impact on the effectiveness of implementation.

The World Economic Forum is only at the beginning of its implementation of the Internet for All initiative. However, with a strong working model that has demonstrated its effectiveness, and with subsequent projects in Argentina and India that will provide new lessons, there is significant room for optimism about the future.

Appendix: Investment Model Research Methodology and Assumptions

The World Economic Forum and BCG developed an investment model to assess the investment costs involved in individual initiatives designed to help achieve internet access for all. This model was applied to the Northern Corridor pilot project. The methodology and assumptions are described in detail in this section to enable others to make use of this approach to perform their own investment analyses in other countries or to adapt these assessments to help evaluate alternative interventions.

The investment model was developed using a four-step approach:

1. Define the target
Two horizons, or scenarios, were selected for assessment. Horizon 1 involved 25 million new users, with gender parity, in the Northern Corridor by 2019, which represents an acceleration of approximately 50% in the current growth rates. Horizon 2 covers an additional 56 million new users (on top of the initial Horizon 1 target), which encompasses the remaining unconnected population, to achieve near-universal access and adoption (defined as at least 95%).

2. Select the interventions
Four interventions were identified, one for each of the four major barriers to internet access and adoption. These include expanding 3G mobile broadband (infrastructure); increasing smartphone penetration (affordability); providing basic and advanced digital literacy (skills and awareness); and developing relevant local content though local technology hubs and ecosystems (technology hubs). The interventions selected represent one possible set, although many other alternative interventions that were not assessed could also be implemented.

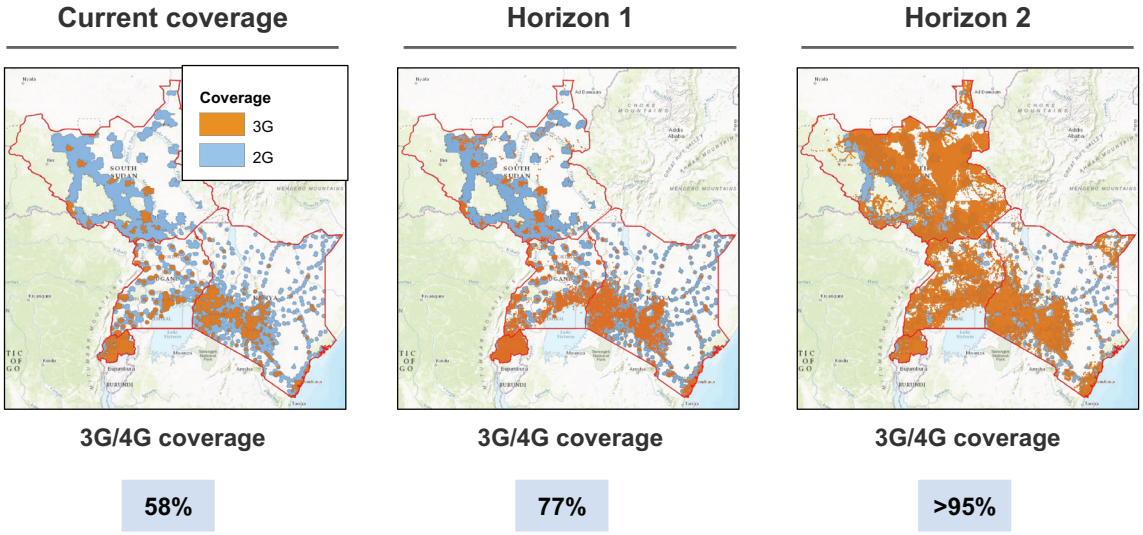
3. Assess the investment
A number of data sources and assumptions were used to calculate the investments required for each of the four interventions assessed:

3G mobile broadband. *Intervention:* Expand existing mobile 3G broadband infrastructure to add 25 million new internet users (Horizon 1) and the remaining unconnected population to reach at least 95% coverage with 3G (Horizon 2).

Methodology: The number of new and upgraded (2G to 3G) towers required was determined using geospatial mapping of population density and existing 2G and 3G coverage. A constant average value was used for the range per tower at 2100 MHz. Assumptions included no infrastructure sharing and each of the multiple operators (the top three) building its own tower infrastructure based on its existing market shares. To determine the number of towers, a tower multiplier figure derived from the market shares of the top three operators per country was used, multiplied by the lowest number of towers required for the desired coverage. The final investment of $430 million or $15/person (Horizon 1) and $3.7 billion or $67/person (Horizon 2) are capital expenditure (capex) costs only. Regarding the last step (**4. Determine the business case**), an additional business case analysis (on a net present value basis), including capex and operating expenses (opex) compared with revenues, determined the feasibility of the intervention. Assumptions for costs (capital and operating), revenues and policy are detailed in Figure 11. The detailed model with a compendium of spreadsheets will be provided at https://www.weforum.org/projects/internet-for-all.

Figure 10: Geoanalytical Modelling Determined Optimal Expansion of 3G/4G Coverage for Horizons 1 and 2

Source: LandScan™ database, published local telecom operator coverage maps



Smartphone penetration. *Intervention:* Increase device penetration to at least two smartphones per household for new users (to ensure gender parity).

Methodology: The cost of smartphones required for new users was calculated based on the number of households (new users only) multiplied by two smartphones per user, multiplied by the price per smartphone. The organic increase in penetration, based on current sales forecasts, was excluded from total new smartphones required. The cost of a new smartphone was assumed to be $55 (including VAT), based on an analysis of the distribution of low-cost smartphones under $100 available in the local markets. The current assumption is that the full cost of the smartphone is borne by the end-consumer as is common in the region of focus.

Skills training. *Intervention:* Provide basic digital literacy training to at least one person per household and advanced digital literacy training to a significant portion of the youth population.

Methodology: The cost of basic literacy training was estimated by multiplying the number of households times one person/household times the cost of basic training. The cost of advanced training was estimated by multiplying the number of youth (aged 15 to 34) times the percentage to be provided advanced training, times the cost of advanced training.

Basic digital literacy training was defined as short one-on-one or group training sessions in which new users are provided the skills necessary to navigate the internet and to use commonly available local applications. Advanced digital literacy training involves the provision of ICT skills necessary to prepare youth to perform jobs in the digital economy. For this assessment, advanced training was considered outside of formal tertiary (university) education, as capacity in tertiary education can be difficult to scale in a short time period. Examples of advanced digital training includes (but is not limited to) web and software development, network engineering and IT systems administration. An example of a programme delivering technical ICT skills is the Cisco Networking Academy, which has trained more than 5.5 million people globally over the last 20 years.

Technology hubs. *Intervention:* Create a technology hub that systematically identifies, develops and supports local technology companies that in turn develop the local content and applications that will drive adoption.

Methodology: Interviews were used to derive the investment required for a typical technology hub, based on large, recently established technology hubs in Africa. Components of a typical hub include a data centre; business facilities, such as office space, and training facilities for incubated companies (business and technical training); and early-stage funding.

Figure 11: Summary of the Main Assumptions for the Northern Corridor Investment Model

Notes: RAN = Radio Access Network; SG&A = selling, general and administrative expenses; ARPU = average revenue per unit; VAT = value added tax.
Sources: 1. GeoAnalytics analysis. 2. GSMA data on market shares. 3. GeoAnalytics analysis. 4. Interviews. 5. Interviews. 6. Based on higher World Bank estimate for social projects (10-15%). 7. GSMA. 8. Interviews. 9. Regulator websites. 10. Desktop research. 11. World Bank, National Census. 12. Euromonitor, e-retail website, interviews, Pyramid, Ovum. 13. Desktop research. 14. For advanced skills, assume 4% for Kenya in Horizon 1, given an already strong ICT skills base and 1% for South Sudan, Rwanda and Uganda; Assume 4% across all countries for Horizon 2. 15. Interviews. 16. Interviews, African Development Bank.

3G Mobile broadband infrastructure	3G population coverage[1]	20 million (Horizon 1) Additional 19 million (Horizon 2) - 95%
	Tower multipliers[2]	Kenya (2.1x), Rwanda (1.9x), South Sudan (3x), Uganda (3x)
	Number of towers[3]	6,100 (4,420 upgraded) (Horizon 1) 23,500 (15,900 upgraded) (Horizon 2)
	Capex[4]	Includes passive tower equipment, RAN equipment, backhaul, power
	Opex[5]	Includes rent, maintenance, overhead, power (electricity & diesel), bandwidth, SG&A
	Upgraded towers	**Capex:** Only cost of upgrade (30-50% of new tower) **Opex:** Difference between 2G and 3G opex costs (~10%) **Revenue:** Only data ARPU considered
	Discount factor[6]	15%
	Revenue (ARPU)[7]	80% data ARPU (GSMA) figures to account for rural area
	Depreciation[8]	7-year depreciation
	3G spectrum frequency[9]	2100 MHz
	Taxes[10]	Country corporate tax and additional telco sector tax
Smartphone	Household size[11]	Kenya - 4.4, Rwanda - 4.4, Uganda - 4.7, S. Sudan - 6.0
	No. of smartphones	2 per household - adjusted for natural increase in penetration
	Cost per smartphone[12]	$55 (with VAT), $47 (less VAT)
	VAT[13]	Kenya - 16%, Uganda - 18% Rwanda - 0% on smartphones
Skills	No. of people trained[14]	Basic training - 1 per household Advanced - 10% of youth population (between 18 and 35)
	Cost[15]	Basic training - $30/person Advanced - $1,000/person Based on local interviews
Tech. hub	No. of hubs	Horizon 1: One regional hub Horizon 2: One hub in each NC country (additional 3 hubs)
	Cost[16]	~$50 million/hub

Contributors

Internet for All Steering Committee

Alliance for Affordable Internet
Omobola Johnson, Honorary Chairperson
Sonia Jorge, Executive Director

AT&T
Karim Lesina, Vice-President, International External Affairs, EU, Caribbean, Central and Latin America, Trans-Atlantic Relations

Berkman Center (Harvard)
Urs Gasser, Executive Director

BT Group
Niall Dunne, Chief Sustainability Officer
Anna Easton, Director, Sustainable Business

Cisco
Tae Yoo, Senior Vice-President
Laura Quintana, Vice President, Corporate Affairs,Global Field Operations

Cloudflare
Michael Nelson, Head of Public Policy

Cornell University
Soumitra Dutta, Dean, College of Business

Cyberspace Administration of China
Zhong Shilong, Deputy Director-General
Wang Jianchao, Deputy Director-General

Digital Impact Alliance
Kate Wilson, Chief Executive Officer
Beth Gertz, Interim Leadership Team

Digital Opportunity Trust
Janet Longmore, Founder and Chief Executive Officer
Jane Jamieson, Vice President, Strategic Alliances
Elizabeth Holland, Manager, Development and Grants

Ericsson
Mats Nilsson, Director, GF Technology

Elaine Weidman Grunewald, Senior Vice-President and Chief Sustainability Officer
Rajib Bhattacharjee, Head of Solution Area Engineering IT & Tools

Facebook
Robert Pepper, Head, Global Connectivity and Technology Policy
Flavia Alves, Manager, Global Policy, International Institutions

Federal Department of the Environment, Transport, Energy and Communications (DETEC)
Thomas Schneider, Deputy Director, International Affairs; Coordinator, International Information Society, Federal Office of Communication

Google
Will Hudson, Senior Advisor for International Policy
Hibah Hussain, Global policy analyst

GSMA
John Giusti, Chief Regulatory Officer
Alix Jagueneau, Senior Director Regional Advocacy

Hewlett-Packard Enterprise
Lara Birkes, Vice President, Chief Sustainability Officer

Huawei
Adam Lane, Program Manager of Corporate Sustainability Development

INSEAD
Bruno Lanvin, Executive Director, European Competitiveness Initiative (IECI)

Institute of Electrical and Electronics Engineers (IEEE)
Konstantinos Karachalios, Managing Director
Karen McCabe, Senior Director, Technology Policy and International Affairs

Intel
Rosalind Hudnell, President, Intel Foundation
Martina Roth, Senior Director Global Strategy and Alliances, Corporate Affairs Group

Inter-American Development Bank
Antonio Garcia Zaballos, Lead Specialist, Technology

International Telecommunication Union (ITU)
Doreen Bogdan-Martin, Chief, Strategic Planning and Membership Department
Preetam Maloor, Strategy and Policy Adviser & Acting Head, Corporate Strategy Division
Vaggelis Igglesis, Strategy and Policy Advisor

International Telecommunications Satellite Organization
José Toscano, Director General
Renata Brazil David, Director of Legal Affairs

Internet Corporation for Assigned Names and Numbers (ICANN)
Nigel Hickson, Vice-President, Europe Partnership
Tarek Kamel, Senior Adviser to the President and Chief Executive Officer

Internet Governance Forum (IGF)

Lynn St Amour, Chair, Multistakeholder Advisory Group
Chengetai Masango, Programme and Technology Manager
Brian Gutterman, Associate Programme Officer, Secretariat of the Internet Governance Forum

Internet Society
Constance Bommelaer, Director of Public Policy
Raul Echeberria, Vice President of Global Engagement
Michael Kende, Senior Fellow

Japan International Cooperation Agency
Tomoyuki Naito, Senior Adviser, Information and Communication Technologies and Development

Mastercard
Manu Bhardwaj, Vice President for Research and Insights, Mastercard Center for Inclusive Growth

Microsoft
Frank McCosker, General Manager, Affordable Access and Smart Financing 4Afrika
Paul Garnett, Director, Technology Policy
Paul Mitchell, General Manager, Technology Policy
Carolyn Nguyen, Director, Technology Policy Group

Millicom
Rachel Samrén, Executive Vice-President and Chief External Affairs Officer

Ministry of Youth and Information Communication Technology of Rwanda
Didier Nkurikiyimfura, Director of Youth and Information Communication Technology
Jean Philbert Nsengimana, Minister of Youth and Information Communication Technology

Mozilla Foundation
Mitchell Baker, Executive Chairwoman
Mark Surman, Executive Director
Cathleen Berger, Global Engagement Lead

MTN Group
Stephen van Coller, Vice-President, Digital Services, Data Analytics and Business Development

NEPAD Planning and Coordinating Agency
Towela Nyirenda-Jere, Programme Manager

NetHope
Lauren Woodman, Chief Executive Officer

Pearson
Adrian Godfrey, Vice-President, Strategic Partnerships and Investments

People Centered Internet
Mei-Lin Fung, Co-Founder; Organizer
John Ryan, Organizer

Qualcomm
Ryan Gorostiza, Senior Director, Industry Relations and Marketing
Anne-Lise Thieblemont, Senior Director, Global Technology Policy and Industry Relations

Royal Holloway, University of London
Tim Unwin, UNESCO Chair in ICT4D, Emeritus Professor of Geography

Tata Consultancy Services
Santosh Mohanty, Vice-President
Ameet Nivsarkar, Vice-President, Corporate Affairs

Telkom
Jabu Mabuza, Chairman

UK Department for International Development
Lauren Kahn, Head, Digital Policy and Programmes
Charlotte Smart, Executive Assistant
Kitty von Bertele, Digital Adviser, Emerging Policy, Innovation and Capability

UNESCO
Indrajit Banerjee, Director Knowledge Societies Division (KSD) Communication and Information Sector (CI)

University of Pennsylvania
Christopher Yoo, John H. Chestnut Professor of Law, Communication and Computer and Information Science; Director, Center for Technology, Innovation and Competition

US Agency for International Development (USAID)
John Garrity, Senior Connectivity Advisor
Thomas Koutsky, Senior Connectivity Advisor
Jonathan Dolan, Acting Team Lead, Digital Inclusion

US Government State Department
John Spilsbury , Senior Coordinator, Global Connect Bureau of Economic and Business Affairs

Veon
Tomas Lamanauskas, Group Director, Public Policy

World Bank
Boutheina Guermazi, Practice Manager, Transport and ICT Global Practice
Samia Melhem, Lead Policy Specialist, Transport and ICT; Global Lead, Digital Development CoP
Doyle Gallegos, Lead ICT Policy Specialist

World Wide Web Foundation
Anne Jellema, Chief Executive Officer

Zain Group
Jennifer Suleiman, Head of Corporate Sustainability

The Boston Consulting Group (Adviser and Knowledge Partner)

Wolfgang Bock, Senior Partner and Managing Director

Hans Kuipers, Partner and Managing Director

Maikel Wilms, Director

Alykhan Vira, Project Leader

We are grateful to the following individuals for their assistance in the preparation of this report: David Duffy, Katherine Hudak, Benjamin Jung, Kurt Schulze, and Arseniy Semenov.

World Economic Forum Project Team

Eric White, Project Lead, Internet for All and Global Leadership Fellow

Alex Wong, Head, Global Challenge Partnerships and Member of the Executive Committee

Anna Henry, Community Specialist, Internet for All

Endnotes

1. Limited progress was made in South Sudan due to the ongoing political instability there, such that only the other three countries are discussed in detail in this White Paper.
2. These numbers total 28.5 million people rather than 25 million. The overall programme target is 25 million, but national governments individually requested to commit to higher numbers.
3. GSMA Intelligence, “Rwanda”, “South Sudan”, “Kenya”, “Uganda” (four separate databases), published 30 March 2016. Purchased via www.gsmaintelligence.com, 20 September 2016. Note: Data reference Q4 2015.
4. The World Bank, World Bank Open Data, “Gross enrolment ratio, secondary, both sexes (%)”, aggregated from UNESCO Institute for Statistics (Open license). Accessed via http://data.worldbank.org/indicator/SE.SEC.ENRR.
5. Webhosting.info, “Hosting Stats by Country: Distribution of Hosted Domains by Country”. Accessed via https://www.webhosting.info/web-hosting-statistics.
6. See the solutions presented in the recent Equal Rating Innovation Challenge championed by Mozilla. Available at https://equalrating.com/.
7. The calculations were made on the basis of 28.5 million people, which is the sum of the individual country targets, although the formal regional target announced was 25 million people.
8. Based on LandScan™ Dataset from Oak Ridge National Laboratory. Available at http://web.ornl.gov/sci/landscan/landscan_data_avail.shtml.
9. Data published by: the Communications Authority of Kenya, “ICT Access Gap Study”. Available at http://www.ca.go.ke/index.php/ict-access-gap-study; MTN Rwanda, “Coverage”. Available at http://www.mtn.co.rw/Content/Coverage/Coverage; MTN Uganda, “Coverage & Services”. Available at https://www.mtn.co.ug/internet/Coverage_Services/Pages/default.aspx; MTN South Sudan, “MTN Coverage”. Available at http://www.mtn-ssd.com/coverageLanding.html. The coverage was translated onto the GeoAnalytics mapping software and the percentage coverage was correlated with data published by GSMA.
10. See, for example, Sambuli, N. and J. P. Whitt, Technology innovation hubs and policy engagement, Making All Voices Count Research Report, Brighton: Institute of Development Studies, 2017. Available at https://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/12860/RReport_TechHub_Online.pdf.
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World Economic Forum
91–93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland

Tel.: +41 (0) 22 869 1212
Fax: +41 (0) 22 786 2744

contact@weforum.org
www.weforum.org