State of Connectivity: 2014

A Report on Global Internet Access

internet.org

The internet is a powerful tool for connecting people to information, ideas, resources, services, and other people.

It's driving the global economic engine, creating new jobs, transforming industries, and in some cases, creating entire new industries.

With the benefit of connected devices, people from all over the world are changing the way business is done, how governments relate to their people, and people relate to their governments.

And yet, while a lot of people have access to the internet, most people do not. The internet is still only accessible by a minority of people.

Moreover, even though the ecosystem of mobile data providers and device makers have brought a lot of people online in recent years, the internet's growth rate is — at present — slowing down.

With this in mind, internet.org is working to bring together technology leaders, nonprofits and, local communities to make the internet available to every person on earth.

The purpose of this report is to provide an overview of the state of connectivity — who's connected, who's not, and why.

The most recent estimates have predicted that, by the end of 2014, almost 3 billion people will have connected to the internet at some point within the previous year[1].

And yet, the divide between the people who are connected and the people who are not falls along familiar economic lines.

- Connectivity is concentrated in developed countries, and sparse in developing countries[2], where 78% of the population is online compared to 32%[3], respectively.

- Developing countries are home to 94% of the global offline population[4].

- The United States and Germany, for example, have connectivity rates as high as 84% while Ethiopia and Myanmar are connected at rates below 2%[5].

Moreover, the rate at which the world is connecting to the internet is slowing down and is estimated to decline for the fourth year in a row. In 2008, the number of people using the internet grew by 12.4%.

By 2014, the growth rate was down to 6.6%[6].

At present rates of decelerating growth, the internet won't reach 4 billion people until 2019[7].

Without the cooperation of industry, governments and NGOs working together to improve the global state of connectivity by addressing the underlying reasons people are not connected to the internet, connectivity may remain permanently out of reach for billions of people.

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Generally, there are three key reasons why people are not online.

These are:

- **Infrastructure**. People can't access the internet because they don't live within range of sufficient physical infrastructure that would allow it.

- **Affordability**. People cannot afford the cost of access.

- **Relevance**. People aren't using the internet because they're not aware of the internet, there is insufficient content available in their primary language, or they can't read or understand content that is.

These factors are interdependent, and can only be addressed in concert. Moreover this is not an exhaustive list, since all reasons why someone isn't online can vary from culture to region to individual.

Beginning with the state of connectivity as it relates to **infrastructure**.

- The International Telecommunications Union's (ITU) most recent coverage data estimates[8] that 91.7% of the world lives within range of a 2G signal (9.6 KBPS – 384 KBPS)[9] and 48.7% within 3G (384 KBPS – 10 MBPS)[10].

- There are no publically available estimates of the global coverage of subsets within 2G known as: 2G/GSM (9.6 KBPS), 2.5G/GPRS (35 KBPS – 171 KBPS), 2.75G/EDGE (120 KBPS – 384 KBPS), respectively.

- At less than a quarter the speed of a 56K dial-up modem, 2G/GSM (9.6 KBPS) is an insufficient speed for practical use of the internet. This is particularly true for the common internet-based activities of voice-over-IP, music and video, which are all inoperable at that speed[11].

- Thus, the percentage of people who live within range of the kind of infrastructure required for practical access has only a theoretical maximum of 91.6%, and is in practice far less[12].

Continuing with the state of connectivity as it relates to **affordability**:

- The Broadband Commission defines affordability as entry-level broadband services amounting to less than 5% of average income[13].

- By this standard, 34% of the world can afford at least 500 MB of mobile data per month, 55% can afford 250 MB per month and 80% can afford 100 MB per month.

- 100 MB is "entry-level" internet, sufficient for text-heavy applications. 500 MB is a "maturing" internet experience, sufficient for basic multimedia content. 2 GB and above represent a "fully connected" internet experience.

- In India, for example, market forces and competition have driven the cost of data to a price point at the bottom quartile of global prices, at $2.40 and $0.80 ($PPP), for prepaid data plans of 250 MB and 100 MB per month, respectively[14], which is affordable by 59% and 94% of the Indian population, respectively.

- There remain many places where even entry-level internet is out of reach.

- In Sub-Saharan Africa, where 69% of people live on less than $2 per day[15], only 53% could afford access of only 20 MB, sufficient for text-only messages and email.

Finally — regarding the state of connectivity as it relates to **relevancy**:

- Many people are not connected to the internet because it's irrelevant to their lives. That is, they're either unaware of it, there isn't sufficient online content in their primary language, or they lack the capacity to understand or access such content.

- Research in countries including Ghana[16], South Africa[17], India[18], and the United States[19] confirmed that lack of awareness, perception of lack of value or utility, or lack of ability are the primary reasons why people don't use the internet.

- There are no consistent, country-level metrics for internet relevance. In lieu of this, access to online "encyclopedic knowledge" in the form of at least 100,000 Wikipedia articles[20] is a useful proxy for assessing the availability of relevant, local language content across the broader internet.

- There are at present only 52 languages on Wikipedia, for which there are more than 100,000 articles, meaning only 53% of the world has access to "encyclopedic knowledge" in their primary language.

- In order to make the internet relevant to 80% of the world, it would require content in at least 92 languages[21].

These are significant challenges to overcome.

Moreover, the challenge to provide affordable, practical internet access to everyone on earth is neither independent of the world's other development challenges, nor is it in conflict them. It is one that requires the cooperation of many people, nations, NGOs, and industries.

Global

37.9%

Developed Countries	**76.2%**
Developing Countries	**29.8%**
East Asia & Pacific	**43.9%**
Europe & Central Asia	**65.4%**
Latin Am. & Caribbean	**46.7%**
Middle East & N. Africa	**39.0%**
North America	**84.4%**
South Asia	**13.7%**
Sub-Saharan Africa	**16.9%**
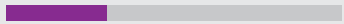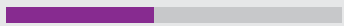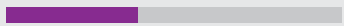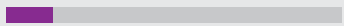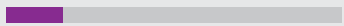
PART I:

The State of Connectivity

Internet access may feel ubiquitous, but for most people in the world, access is not the rule, it's the exception.

Most people have never connected to the internet.

According to the International Telecommunications Union (ITU), the specialized UN agency for information and communications technology, the latest confirmed count of the global online population is 2.7 billion people, or 37.9% of the earth's estimated population of 7.1 billion people[22] (Exhibit 1).

Subsequent as-yet-unconfirmed estimates by the ITU predicted that, by the end of 2014, the global online population would reach almost 3 billion people[23].

This is an incredible accomplishment, credit for which goes to the entire ecosystem of access-enabling stakeholders, from governments, operators, device and chipset makers, telecom equipment makers to developers, which made access affordable, by encouraging innovative competition.

How are the 2.7 billion measured?

The ITU collects statistics from governmental agencies (e.g., national statistics offices, national regulatory authorities) and the private sector (e.g., operators, ISPs). In most countries, ICT administrative statistics are solicited from operators, typically through questionnaires and the ITU harmonizes data from about 200 economies.

In the "Manual for Measuring ICT Access and Use by Households and Individuals," the ITU suggests the model survey question, "Have you used the internet in any location in the last 12 months?" and defines the internet as a "a world-wide public computer network [that] provides access to a number of communication services including the World Wide Web and carries e-mail, news, entertainment and data files" which "may be facilitated by any device enabling internet access (not only a computer). This includes a mobile phone, PDA, games machine and digital TV. Use can be via a fixed or mobile network."

Recently, the ITU recommended amending the connectivity survey question to focus on the last three months, instead of the past year. This should provide a more accurate answer to the question of access. Further improvements to this question would sharpen our understanding of global access even further.

And yet, despite how much progress has been made, the internet is still only accessible by a global minority of people.

Most people have never read the news online, shopped online, looked for a job online, never watched a TV show or movie, never downloaded anything, learned anything new online and never have done so much as a single online search.

From 2005 onward, the ITU recorded a steady increase in the global connected population, in both developing and developed countries.

In developing countries, for example, the number of internet users has doubled in the past five years, from 974 million in 2009 to 1.9 billion in 2014[24].

However, the rate at which the world is connecting to the internet is slowing down and is estimated to decline for the fourth year in a row[25] (Exhibit 2).

2014 saw only 6.6% growth, down from 12.4% in 2008, globally and 8.7% growth, down from 22.8% for developing countries.

Meaning, without significant, cooperative action among a multitude of stakeholders, at present rates of growth, the internet won't reach 4 billion until 2019[26], with an uncertain future after that.
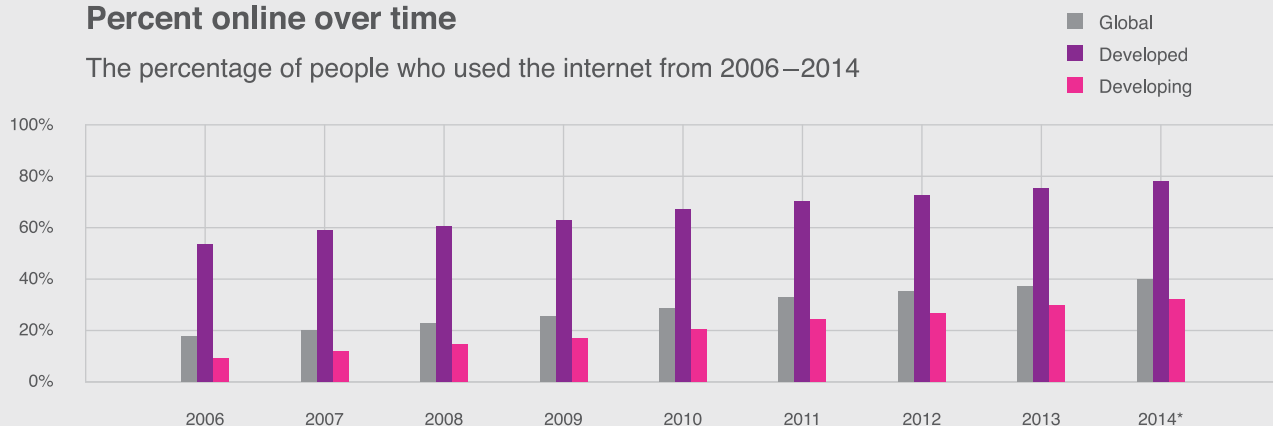
Exhibit 1
*Estimate
Source: ITU, *2005-2014 ICT data for the world, by geographic regions and by level of development.*

Percent online over time

The percentage of people who used the internet from 2006−2014

Global
Developed
Developing

Growth of percent online

The rate of growth of percent online from 2006−2014
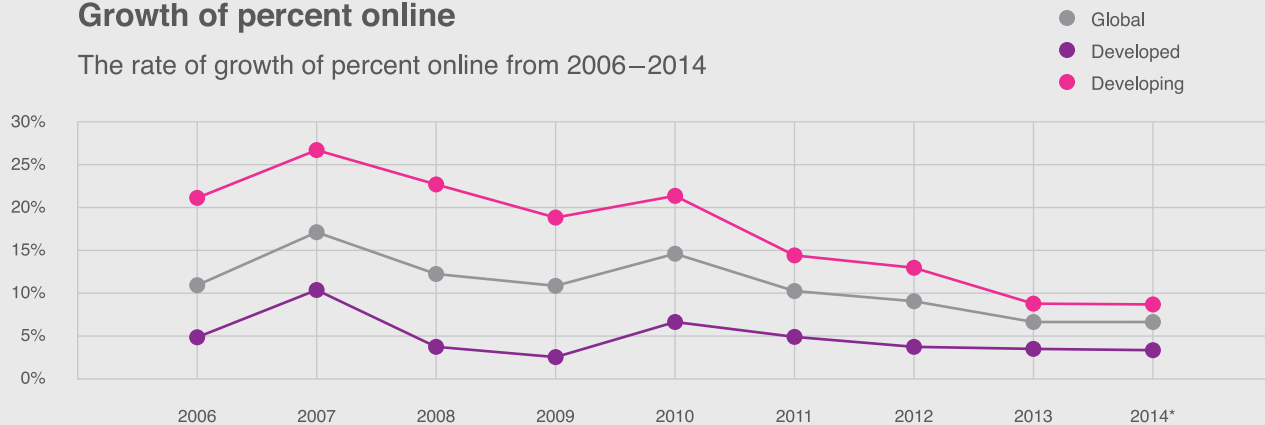
● Global
● Developed
● Developing

Exhibit 2
*Estimate
Source: ITU, *2005-2014 ICT data for the world, by geographic regions and by level of development.*

Mobile Is Driving Global Internet Adoption

Before the widespread existence of relatively affordable mobile connected devices, people could only access the internet by purchasing a desktop computer and maintaining a fixed landline connection, or via access to a computer through a friend, or a community-based connection point, such as a library, internet café, or similar public space.

For most of the histroy of the internet, the rate of adoption for fixed-line connections remained steady and growing.

And then, in the last decade, the number of people who could connect to the internet via a mobile device quickly overtook the number of people who were connected via a fixed-line (Exhibit 3).

There are a number of reasons for this: the advent of the smartphone, the emergence of mobile OS, the development of mobile apps, the increase of network coverage, the falling cost of data and affordability of prepaid plans, changing social norms towards mobile device ownership, the falling cost of devices, and overall increase in utility of the mobile internet, generally.

As a result of all of these reasons, internet adoption has seen an incredible upward trend in recent years, driven by mobile.

Mobile is the primary driver in bringing people online

Fixed vs. mobile subscriptions
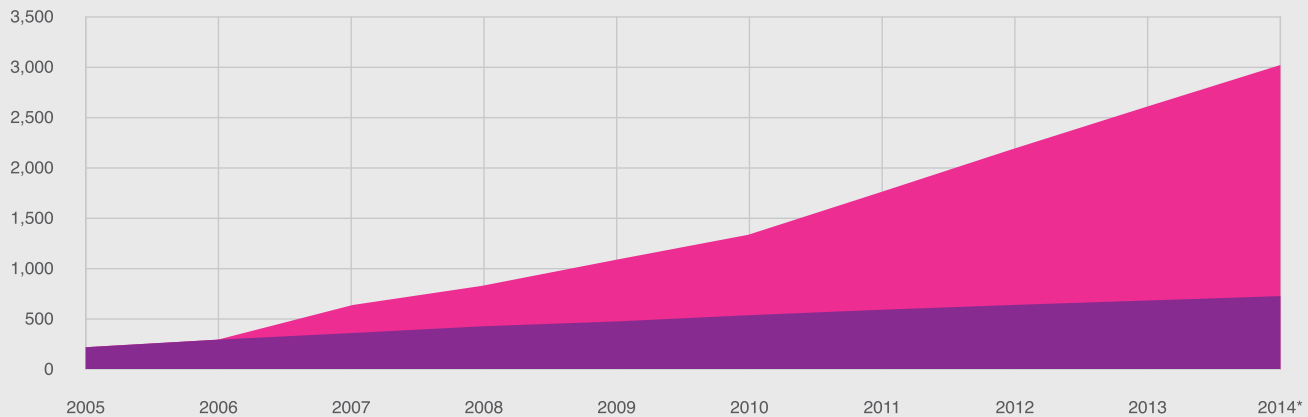
Broadband subscriptions (in millions)

■ Mobile subscriptions
■ Fixed subscriptions

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014* |

Exhibit 3
*Estimate
Source: ITU, *2005-2014 ICT data for the world, by geographic regions and by level of development.*

Who Are The Unconnected Billions?

While personal circumstances might vary for any individual without an internet connection, examining the best available data and research helps to inform us about the people who are still unconnected.

The three key factors affecting one's likelihood to be connected are location, income, and gender.

Principally, your location is an important factor in whether you're connected.

If you live in North America, for example, you're 84.4% likely to have connected to the internet[27], whereas if you live in South Asia or Sub-Saharan Africa, you're only 13.7% and 16.9% likely to connect, respectively[28]. The extremes of global connectivity rates range from 96.5% in Iceland to 0.9% in Eritrea.

The divide between the connected and non-connected world falls principally on the line between the developed and developing world. This divide has gotten smaller in recent years, but it remains significant.

While there has been some improvement in recent years, according to the ITU, mobile broadband in 2014 will reach 84% penetration in developed countries, and only 21% in developing countries.

The divide between the connected and non-connected world falls principally on the line between the developed and developing world.

Income also plays an important factor in determining whether someone is connected.

Even in well-connected nations like the United States, the rate of connectivity is coincident alongside income levels. So, for example, whereas 99% of American adults with incomes over $75,000 are connected to the internet, only 77% of those with incomes less than $30,000 are[29].

Similarly, in the developing world, only 30% of people are online, compared to 76% in the developed world (with estimates of 32% and 78% respectively, by end of 2014)[30].

Among countries in the top third of median per capital income, an average of 74% are online, compared to only 17% in the countries that make up the bottom third[31].

Finally, for a number of social and economic reasons, women are less likely to be connected to the internet than men.

According to a recent report by Intel & Dalberg:

- On average, across the world, nearly 25% fewer women than men have access to the internet.

- The connectivity gender gap is as high as 45% in some developing regions like Sub-Saharan Africa, 35% in South Asia, the Middle East and North Africa, and 30% in parts of Europe and Central Asia.

- By comparison, in "higher-income" countries, women's connectivity is nearly on par with men's[32].

Bridging this gap, according to Intel/Dalberg, will not only increase women's income and income-earning potential, it will increase their sense of empowerment and equity and improve their education[33].

Saudi women & the internet

The fact that women are, on average, less likely to connect to the internet is another argument in favor of the necessity of increasing global access for everyone.

Take, for example, the situation of women in Saudi Arabia: Certain cultural norms restrict the freedom of women to travel on their own and engage in traditionally male-dominated fields of commerce[34].

The internet breaks down some of those barriers by enabling both communication and e-commerce, and makes it possible for some Saudi women to work from home, with flexible hours, and at a low set-up cost.

It was personal ambition, combined with internet access that made it possible, for Saudi women to use Instagram, along with WhatsApp, to launch e-commerce businesses, such as T4Turban, Fancyboutique and Simplecious, which sell clothes, cosmetics, and food, respectively.

Saudi Women have also used the Internet to start up things like: GCON, an all-female gaming conference, "Mother & Child Guide," an advice and news blog for Saudi moms, Ohana, a beauty services and products booking platform, and Nujeed, a talent-identifying website.

An increase in internet access will similarly increase opportunities for women, not just in Saudi Arabia, but beyond.

The Global Barriers to Connection

At its most basic formulation — whether someone can, or does access the internet, is a function of three factors: Infrastructure, Affordability and Relevance.

That is, people can't get online because they don't live within range of sufficient physical infrastructure that would allow it, they cannot afford the cost of access, or they aren't using the internet because they're not aware of it, there is insufficient content available in their primary language, or they can't read or understand content that is.

Internet.org's principal mission is to bring together technology leaders, nonprofits, and local communities to connect everyone in the world that does not have internet access.

This mission begins by addressing these three barriers.

As much as the current state of global connectivity did not come about by one organization alone and was the result of a series of interested parties cooperating and competing with each other as the market and regulations allowed, the future of connectivity does not rest with any one actor in any one sector.

It will require the input of a variety of groups, many of whom have done much to bring connectivity to where it is today, and for whom much continued effort will be required.

Connectivity is an ecosystem

The barriers to connectivity cannot be addressed or understood in isolation. Improvement in any one area affects improvements in all areas.

Compare, for example, the ecosystem required to get someone to drive a car. (Like the internet, a car is a method of connecting people to other people and their ideas. It facilitates an exchange of cultures and knowledge. It helps to build communities, and democratizes information by facilitating its movement.)

If someone does not drive, there might be a few inter-dependent reasons why: Someone might not live within an area with **1** roads that are good enough to support car travel to anywhere they might want to go ("infrastructure"), they might live near good roads but can't afford a **2** car or the cost of **3** gas ("affordability"), others might live near good roads, and can afford a car and gas, but have no **4** destinations to drive to, and still others might be able to afford a car and gas, have the roads and the destination, but **5** don't know how to drive ("relevance.")

If you want to answer the question, "How do we get more people to drive cars?" You have to tackle these problems together, from a holistic perspective, with an eye towards their interplay.

The problem of internet access is similarly complex.

Increasing access cannot be the work of any one company, government, or organization. It can only be done with the broad cooperation of an entire ecosystem of interested actors, working together, to advance a set of common development goals and sharing with each other the important foundational information relating to access. It's only when everyone works together, from operators to content providers, device manufacturers, to governments, corporations and NGOs that we can adequately address this challenge.

4 Destinations

3 Gas

2 Car

1 Roads

5 Ability to Drive
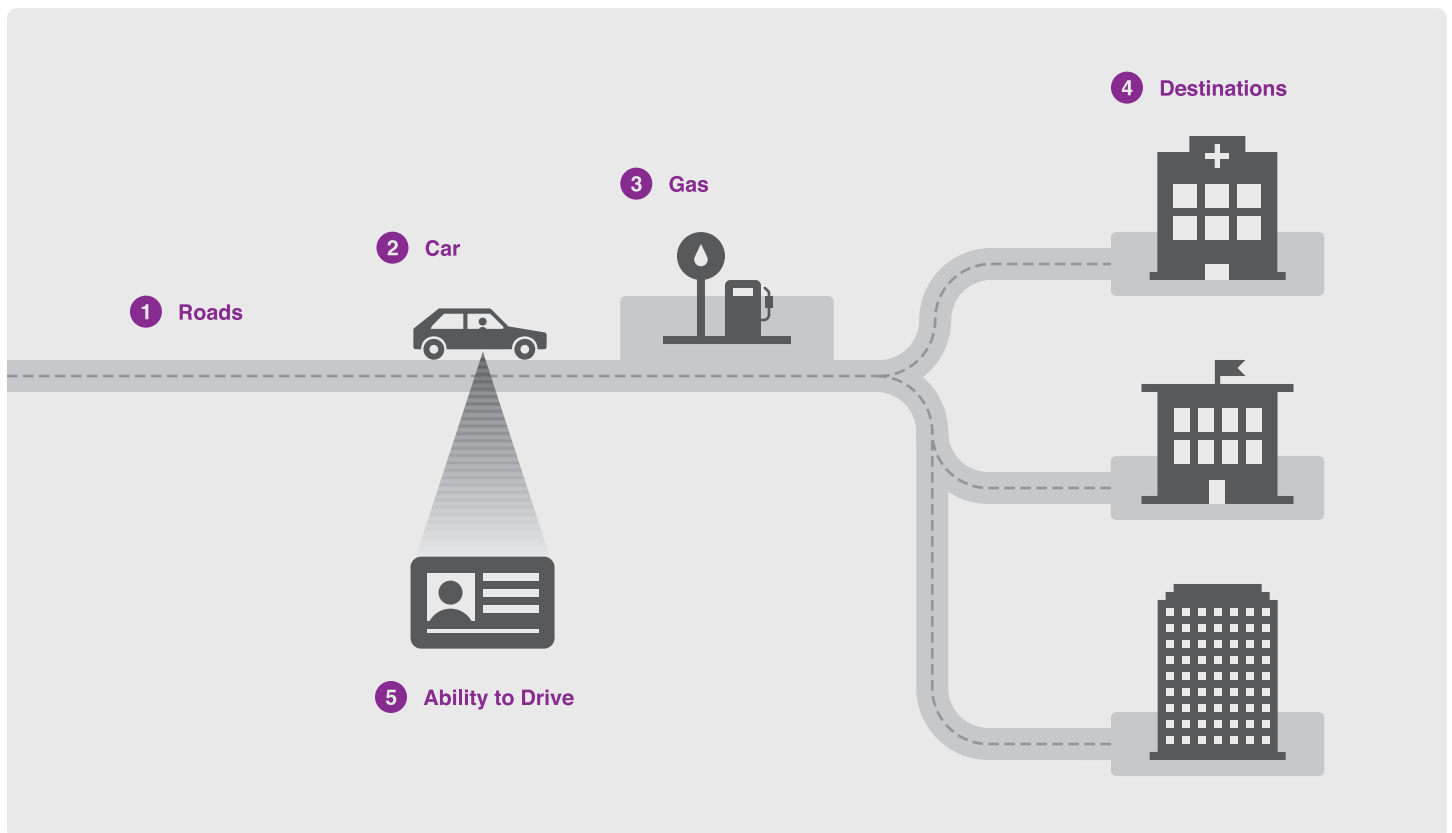
Infrastructure

The percentage of the population who live within range of mobile network

Global ■ 2G ■ 3G

91.7% / 48.7%

Developed Countries 99.1%
91.5%

Developing Countries 90.1%
32.0%

East Asia & Pacific 95.8%
86.4%

Europe & Central Asia 97.9%
81.9%

Latin Am. & Caribbean 97.5%
82.5%

Middle East & N. Africa 93.2%
70.3%

North America 99.8%
99.5%

South Asia 85.0%
1.61%

Sub-Saharan Africa 80.0%
36.0%

INFRASTRUCTURE

In order to physically access the internet, you need a device that can connect to the internet and a data connection.

Notwithstanding the issue of affordability or relevance, there are many people who cannot access the internet because they simply do not live within an area where access is possible; they don't live close enough to the kind of physical infrastructure that would permit basic, practical use of the internet.

The answer to this question begins by examining the definition of "Access."

Identifying Basic, "Practical" Network Speed

Below a certain speed, the internet becomes impractical to use.

However, like any meeting point between technology and human experience, there isn't a bright line, or specific data point that delineates a "practical" connection. "Practicality" is as much a function of what's possible as it is what's available.

But we can make some basic recommendations based on current expectations of usage, with reference to the experience of people around the globe.

Historically, mobile data transmission speeds have been classified by reference to a series of mobile network technology "generations," or "G's"[35].

These classifications are[36]:

- 2G (GSM) refers to network speeds of up to 9.6 KBPS, and can support voice calls and SMS (Short Message Service).

- 2.5G (GPRS) typically refers to speeds of 40 KBPS, and can support mobile online services at a similar speed to a dial-up modem, along with advanced, feature-rich data services, such as

e-mail, multimedia messages, social networking, and location-based services.

- 2.75G (EDGE) refers to speeds between 120 KBPS & 384 KBPS, and can support the delivery of more demanding mobile services, such as the downloading of video and music clips, multimedia messaging, full web browsing, and email.

- 3G (UMTS) refers to speeds 384 KBPS & 2 MBPS, which include the recommended minimum speeds for streaming media, including VOIP calls, and music and video.

- 3.5G (HSPA) refers to speeds between 600 KBPS & 14.4 MBPS, and can support sustained streaming media.

- 4G (LTE) refers to speeds between 3 MBPS & 100 MBPS, and can support high-definition streaming media.

In practice, 2G/GSM, which operates at 9.6 KBPS, would require 2 minutes to download a webpage[37] and 11 minutes to download 1 song, but does not support voice, music, or video streaming.

Those download times drop significantly as the generations progress.

At 2.5G/GPRS, which operates around 40 KBPS, a user could download a webpage in 25 seconds and a song in 2.5 minutes.

At 2.75G/EDGE, which operates around at 120 KBPS, the same tasks would take only 8 seconds and 51 seconds respectively.

Beyond browsing webpages, a lot of people use the internet to make phone calls, listen to music, or watch videos.

The theoretical capacity to make use of streaming-related services begins to emerge at 2.5G/GPRS, and is sustained at 2.75G/EDGE.

Skype[38] for example, recommends speeds of 100kbps, but will be functional, at minimum, at 30 KBPS.

Spotify, a music streaming service, specifics the need for at least a 3G connection[39] and streams at bitrates of 160 KBPS[40], but will function at 96 KBPS[41].
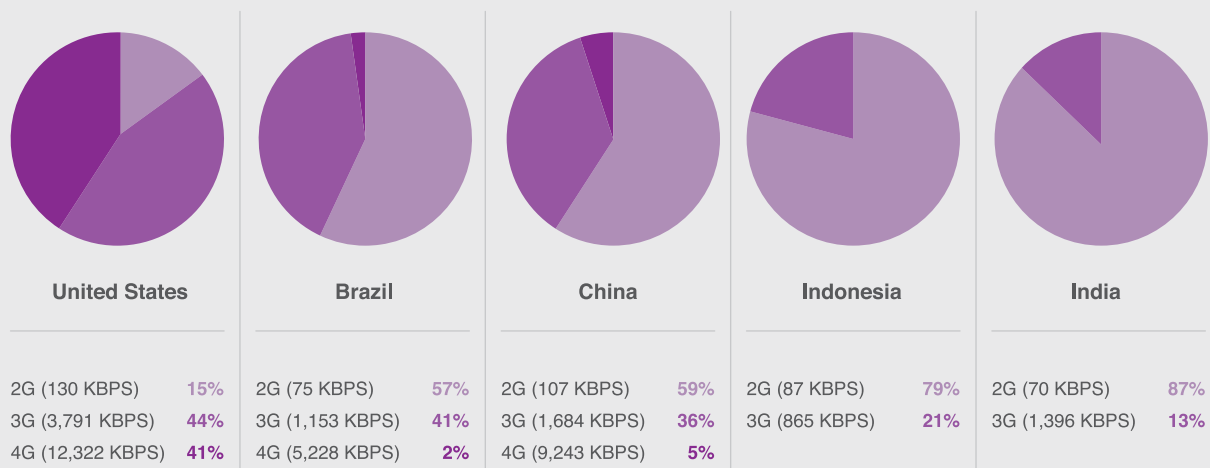
By way of comparison, both YouTube[42] and Netflix[43] recommend speeds of 500 KBPS and over, that is — 3G. Below that, video compression algorithms make watching video possible, with limitations.

When load times are too slow, pages get timed out, images fail to load, and overall the experience becomes an exercise more in futility than utility.

Connections and connection speed by mobile network type

Percent of total mobile connections and average connections speed by network type

- 2G
- 3G
- 4G

United States		Brazil		China		Indonesia		India	
2G (130 KBPS)	15%	2G (75 KBPS)	57%	2G (107 KBPS)	59%	2G (87 KBPS)	79%	2G (70 KBPS)	87%
3G (3,791 KBPS)	44%	3G (1,153 KBPS)	41%	3G (1,684 KBPS)	36%	3G (865 KBPS)	21%	3G (1,396 KBPS)	13%
4G (12,322 KBPS)	41%	4G (5,228 KBPS)	2%	4G (9,243 KBPS)	5%				

Cisco's Visual Networking Index highlights the gap in connection speed between developed and developing countries. The majority of mobile connections in North America (85%) and Western Europe (66%) have average 3G speeds at or above 3 MBPS. Whereas Middle East & Africa (80%) and Asia Pacific (66%) are primarily on 2G with average 2G speeds at or below 93 KBPS, with India at 87% and Indonesia at 79%.

Source: Cisco, *Visual Networking Index* (Feb 2015)

What is the Global State of Internet Infrastructure?

Given this standard of connectivity, how "connected" is the world to the internet?

At present, there are no publically available estimates of the global population coverage of 2.5G/2.75G.

The only publically available country-level data comes from the ITU[44] and consists of 2G and 3G population coverage, inclusive of the interim "G's".

Between the two:

- 91.7% of the world lives within 2G coverage, with 90.1% coverage in the developing world, and 99.1% in the developed world.

- 48.7% of the world lives within 3G coverage, with 32% coverage in the developing world and 91.5% coverage in the developed world.

Even within "developing" countries, the connection rate can vary widely.

For example, in Chad, 2G coverage is only at 36.1%[45], whereas in nearby Nigeria, also a developing country, it's 96.1%.

2G coverage may reach 92% globally, but, unless this 2G coverage footprint is upgraded to support average actual throughput speeds of 100 KBPS[46], or higher, the global population of potential internet users will remain constrained.

If the promise of global connectivity is to be achieved, the internet has to get faster, for more people, everywhere.

Connecting rural and remote areas

42% of the world's population lives in rural areas (defined as less than 1,000 people per square kilometer).

Internet access can make significant impact in remote and rural areas since these are places where infrastructure, public services for education, healthcare and emergency services, and commerce are frequently lacking.

Globally, rural household internet access trails behind urban household access, ranging from a disparity of 4% in highly developed countries, to 35% in developing countries.

Current business models and technologies make commercial viability in rural areas particularly challenging due to low population density,

difficult geography, lower income levels, and a lack of basic infrastructure (including electricity).

Accordingly, regulators, Industry and NGOs must identify both market and non-market innovations to address rural internet access.

Population vs. land size

Percentage of of population vs. percentage of land

■ Population
■ Land size
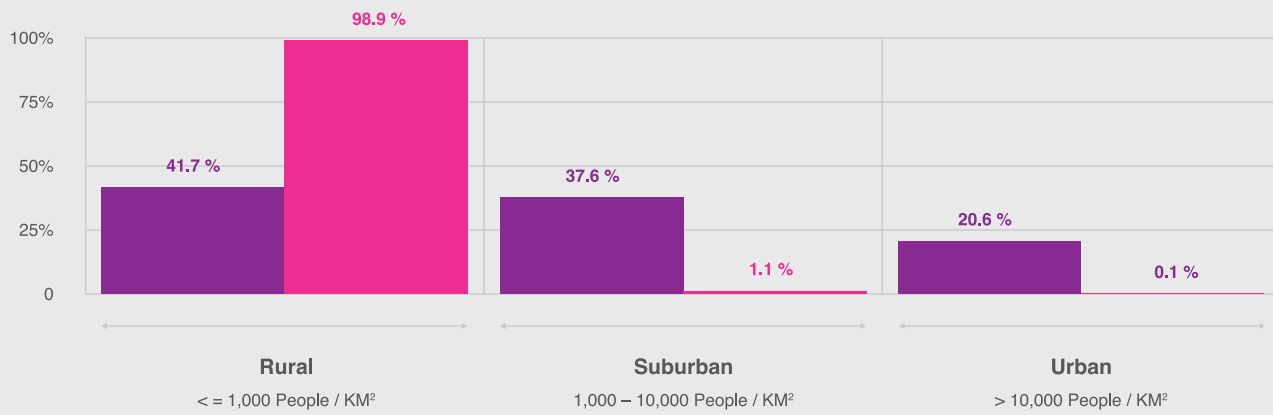
Source: Facebook (2015). ITU, *Measuring the Information Society Report* (Nov 2014). Broadband Commission, *The State of Broadband* (Sep 2014). Center for International Earth Science Information Network, *Gridded Population of the World v3.*

Affordability

The percentage of population who can afford the Internet

Global   ■ 100 MB   ■ 250 MB

79.6% / 54.9%

Developed Countries	99.7% 99.3%

Developing Countries	75.5% 45.9%

East Asia & Pacific	80.2% 39.0%

Europe & Central Asia	97.2% 94.5%

Latin Am. & Caribbean	88.0% 71.0%

Middle East & N. Africa	66.7% 44.6%

North America	99.8% 99.5%

South Asia	91.5% 61.7%

Sub-Saharan Africa	18.6% 5.1%

AFFORDABILITY

Access isn't determined by speed alone, or the mere fact of access.

Practical use of the internet requires access to a sufficient amount of mobile data.

Mobile data networks have both fixed and variable cost components that an operator needs to recover via pricing models.

At present, however, many of those pricing models exclude the possibility for much of the world to connect to the internet.

And as a result, people with lower incomes connect at a much lower rate.

As McKinsey identified in their Barriers report, among the countries with the 20 largest offline populations, 50% of these offline populations are "low income" (defined as "below the average between the national poverty line and the median") whereas ~0% of the online population is[47].

Even as global incomes improve, the cost of access will still be a significant challenge.

According to Gallup, as of December 2013[48]:

- 22% of people worldwide live on $1.25 or less per day — the definition of extreme poverty (54% in Sub-Saharan Africa, 38% in South Asia, and 33% in South East Asia).

- 34% live on no more than $2 per day (69% in Sub-Saharan Africa, 60% in South Asia, and 50% in South East Asia).

Improving internet access in low-income areas is important because the internet is a driver of economic progress.

By democratizing access to information and knowledge resources, the internet eliminates longstanding barriers to economic activity, and unlocks

the vast reserves of human potential that remain confined by their particular geographical, cultural, or linguistic circumstances.

Defining Affordability — Data Use Cases

When answering the question "Who can afford the internet?" you have to start with the question, "How much data do you need to practically use the internet?" the answer to which depends on how the internet is accessed and what it's used for.

There are some complications regarding the creation of quantitative metrics out of a qualitative, person-dependent state of mind like "affordable."

Because what is "affordable" is a function not just of how much something costs, but also how valuable it is to a given person.

Expensive internet access may be "affordable" to a person who draws a significant amount of use from it, and underpriced access may be "unaffordable" for someone who can get no use out of it.

And yet — we can begin with some generalizations about the relative affordability of the internet, based on some basic assumptions about how much people are willing to pay for a practical amount of internet access.

For basic text-only internet-based activities, like email, chat, and some basic social media, data consumption is low. Messages without attachments are 10 – 20 KB.

Data requirements increase as use-cases diversify (Exhibit 4):

- The data load of websites range from 100 – 200 KB for pages without multimedia (e.g., images, video, interactivity) and 300 KB – 1 MB for multi-media rich pages.

- An hour of listening to streaming music ranges from 30 – 60 MB depending music quality.

- One 5-minute video can range from 1.5 – 5 MB across standard definition and considerably higher for high definition video.

Data usage by mobile services

Estimated data usage per activity (i.e., browsing 1 webpage) by type of usage

Types of Usage	Data used / activity	100 MB / month	250 MB / month
Web Browsing (text only)	100 – 200 KB	~ **500** webpages *or*	~ **1,250** webpages *or*
Web Browsing (multimedia)	300 KB – 1 MB	~ **100** webpages *or*	~ **250** webpages *or*
Emailing (text only)	10 – 20 KB	~ **5,000** emails *or*	~ **12,500** emails *or*
Emailing (with attachments)	300 – 500 KB	~ **200** emails *or*	~ **500** emails *or*
Streaming (music in 96 – 192 KBPS quality)	500 KB – 1 MB	~ **100** minutes *or*	~ **250** minutes *or*
Streaming (video in standard definition)	1.5 – 5 MB	~ **20** minutes *or*	~ **50** minutes *or*
Social Media (with non-high res. photo or link)	350 – 400 KB	~ **250** posts	~ **650** posts

Exhibit 4
Source: Based a comparison of data calculators from Airtel Sierra Leone, Vodafone Uganda, Tigo Ghana, AT&T, Verizon, and Sprint. Estimate of number of activities per month for a 100 MB and 250 MB is based on the higher end of the range of data used per activity.

Accordingly, at 20 MB per month, someone could send around 35 text-only messages or emails a day or browse around 25 web pages without multimedia (i.e., no images, videos, or interactivity) a week.

By way of comparison, at 250 MB per month, someone could send over 30 text-only messages a day and browse over 40 non-multimedia webpages a day.

Video and audio remain high-end use cases. Combining streaming music or downloading videos with less-data intensive services (e.g., web browsing, messaging, email, social media) substantially increases data consumption.

- Streaming around 10 minutes of music a day or 12 minutes of video a week would require around 250 MB per month.

- At 500 MB per month, an internet user could access video and educational content such as 10-minute Khan Academy educational videos two to three times a week[49].

The amount of data one needs to use the internet is also impacted by type of mobile network and type of device used to access the internet. (Exhibit 5):

- Faster networks allow users to consume data at higher rates and take advantage of more advanced, feature rich data services.

- Combining streaming music or downloading videos with less-data intensive services (e.g., web browsing, messaging, email, social media) substantially increases data consumption.

- Upgrading to smartphones with larger screens to browse multimedia webpages, advanced cameras to share higher resolution photos, and a wider selection of apps also correlates with higher data usage.

Exhibit 5
Source: Cisco, *Visual Networking Index* (Feb 2015). "Other Data" traffic by application includes file sharing, web, and other traffic.

Mobile data traffic

	Mobile traffic per user per month	% of connections by network type		% of mobile data traffic by application		% of device connections	
		2G	3G/4G	Steaming audio & video	Other data	Smartphones	Other devices
Global	**585 MB**	**62%**	**38%**	**63%**	**36%**	**28.5%**	**36%**
North America	1,893 MB	15%	85%	67%	32%	57.3%	32%
Middle East & Africa	353 MB	80%	20%	58%	40%	16.4%	40%
Latin America	466 MB	66%	33%	61%	38%	26.5%	38%
Central & E. Europe	627 MB	60%	40%	58%	40%	24.1%	40%
Western Europe	916 MB	34%	66%	63%	35%	43.5%	35%
Asia Pacific	431 MB	66%	34%	62%	37%	27.8%	37%
India	149 MB	87%	13%	47%	51%	15.3%	51%
Brazil	416 MB	57%	43%	61%	38%	31.5%	38%
United States	1,960 MB	15%	85%	67%	32%	56.6%	32%

Accordingly, because the data requirements of individuals will vary with demand, it is best to speak of the "minimum" amount of data required to use the internet as a spectrum, rather than a bright line.

Some people will need more data, some people will need less. Generally, however, the amount of data required to make practical use of the internet can be categorized as:

- **Entry-level** (below 100 MB per month): Countries such as India are indicative of entry-level data use. Based on Cisco's 2014 VNI Mobile Forecast, India is at the lower-end of global use, in that mobile users average 149 MB per month. Assuming the top 20% of users generate 85% of traffic, the bottom 80% average less than 30 MB per month. This data average is reflective of conditions where, 13% of Indian connections are on 3G/4G networks, 47% of network capacity is driven by streaming audio and video, and 15.3% of connections are via smartphones.

- **Maturing** (approximately 500 MB per month): Countries such as Brazil are indicative of maturing data use, in that mobile users average 416 MB per month. This data average is reflective of conditions where 43% of Brazillian connections are 3G/4G, 61% of network capacity is driven by streaming audio and video, and 31.5% of connections are via smartphones.

- **Fully connected** (above 2 GB per month): High data use countries like the United States inform the definition of fully connected. American users average 1,960 MB per month. This data average is reflective of conditions where 85% of connections via 3G/4G, 67% of network capacity driven by audio and video, and 56.6% of connections via smartphones.

As underlying "home" networks get upgraded and offer more capacity that can support streaming audio and video, for example, and as the demonstrated viability of the internet increases with use generally, operators can expect entry-level users to migrate to maturing users, and beyond.

Who can afford the Internet?

The question of affordability is as much a question of cost as it is demand.

As a powerful communications platform, the internet is useful to everyone across all income levels.

However, since basic needs take up such a preponderance of income in low-income areas, we adopted the standard of <5% of monthly income as the affordability threshold. This, by way of comparison, is the same percentage used by the Broadband Commission, which assumes that broadband internet access is "affordable" at that level[50].

Exhibit 6
Source: Gallup, *World Survey.* Google, *Global Broadband Pricing* (Dec 2013). ITU, *World Telecommunications/ICT Indicators.*

We then measured this threshold against the global cost of a mobile pre-paid data plan[51]. There are other ways to access the internet, including Wi-Fi, but prepaid on mobile is the area with the highest and most immediate growth potential.

Income vs. prices

Comparison of median per-capita income and prepaid data prices

	Gallup's 2014 median per-capita annual household income	Google's 2013 500 MB prepaid (PPP$)	Google's 2013 500 MB / Gallup's 2014 annual income
Nigeria	$309	$21.39	**84.8%**
India	$642	$11.29	**6.9%**
United States	$15,000	$65.33	**0.8%**

Moreover, this analysis has focused on the cost of access rather than the cost of a device because overall cost of the device is much less a factor than the cost of data[52].

Accordingly, to determine the population who could afford a given amount of data at <5% of monthly income, we worked with Strategy& (formerly Booz & Company) to determine income distribution across households in a

country by using the Gini coefficient "G" from the World Bank and median per capita household income from Gallup. (See, Appendix "B" for more details.)

For the internet to be affordable to over 50% of the world, data consumption would need to be limited to 250 MB per month

The percentage of the world that can afford the internet varies with reference to the median income of a given country (Exhibit 7):
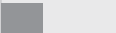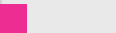
- At the benchmark of 500 MB per month, only 34.0% of the world can afford internet access.

- For the internet to be affordable to over 50% of the world, data consumption would need to be limited to 250 MB per month. Reducing consumption to 100 MB makes the internet affordable to 80% of the world.

- In India, for example, where the cost of data is $2.40 and $0.80 ($PPP) for 250 MB and 100 MB, respectively, the internet is affordable to 58.9% and 94.1% of the population, respectively.

- In Sub-Saharan African, where 69% of people live on less than $2 per day[53], even at 20 MB per month, only 53% of the population can afford the internet.
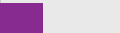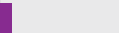
Exhibit 7
Source: Strategy& (2015). Gallup, *World Survey.* Google, *Global Broadband Pricing* (Dec 2013). ITU, *World Telecommunication/ ICT Indicators.*

Percent affordability

Percentage of population that can afford internet access at pre-paid data plan caps of 20 MB to 500 MB per month

	20 MB	50 MB	150 MB	500 MB
Global	92.34%	86.97%	66.17%	34.01%
Developed	99.85%	99.72%	99.56%	96.15%
Developing	90.80%	84.36%	59.32%	21.20%

	20 MB		50 MB		150 MB		500 MB	
East Asia & Pacific		99.26%		93.87%		61.49%		14.73%
Europe & Central Asia		99.30%		98.70%		96.45%		89.25%
Latin Am. & Caribbean		92.70%		91.35%		83.03%		38.49%
Middle East & N. Africa		83.10%		82.51%		46.62%		44.08%
North America		99.84%		99.84%		99.52%		99.07%
South Asia		97.54%		92.25%		71.12%		24.50%
Sub-Saharan Africa		53.22%		34.35%		9.87%		2.82%

Access impacts affordability

As noted, studies have demonstrated that an increase in connectivity carries with it a corresponding increase in economic activity[54].

Access to the internet helps improve commerce for the simple reason that communication costs are built into the cost of doing business, both for the consumers and producers of information, and when that cost is lowered, and information can travel more easily, income increases across.

In practical terms, when people have internet access, they can post jobs and look for jobs. They can write resumes and send them out. They can search for ways to improve their skills and information, and share methods for improving the same.

With the benefit of a data connection, people can look up prices for similar goods in neighboring towns, they adjust their future-expectations of prices based on historical performance, or even changes in the weather report.

With e-commerce, they can buy and sell goods and services, without the need to be physically near their customers, etc.

In turn, greater access to the internet creates greater economic opportunities.

This is particularly true in developing countries that are new to the internet.

As noted by the Juniper Networks, Global Bandwidth Index from Dec 2014, a survey of 5,500 adults from nine countries:

• People in developing countries tended to use connectivity for personal advancement, more so than people in developed countries, who used it for convenience.

• For example, 40% of respondents in emerging markets said connectivity had "improved their earning power," compared with just 17% in developed markets.

• In addition, 39% of respondents in developing nations experienced a "significant transformation in their access to education" because of connectivity"[55].

These survey results bear out in practice. As a result of internet.org's ongoing efforts to extend global internet access, we've seen:

• A chicken farmer in Zambia named Matthew use the internet to find information that improved the health of his livestock, and as a result, improved his business and local economy.

• Young mothers in Colombia use the internet to access health information from the Mobile Alliance for Maternal Action (MAMA), and improved their lives and the lives of their children.

• People looking for work in India use the internet to browse job listings, weather, government services information and news in seven languages.

Moments like these, and others like online searches, social media posting, and ecommerce may sound commonplace, but they represent a new era of economic opportunity, made possible by many generations of better, faster, less expensive and more reliable communications technology and information retrieval and distribution systems.

Models of Affordability

Innovative pricing plans such as prepaid have been a real catalyst for bringing the most recent billion people online. These kind of plans allow people more control over their spending, a particularly useful feature in low-affordability markets[56].

A few innovative pricing models, for example, were highlighted in GSMA's study *Mobile Broadband at the Bottom of the Pyramid in Latin America*,

- In Argentina, there are plans that provide access for the cost of A$5 a day that would be affordable for everyone in the country 8 days out of a month.

- In Ecuador, 20 MB plans are available for as little as $1.11.

At these entry-levels, use cases are limited, but people will still have access to basic text-heavy resources, including educational and occupational information, as well as basic communications tools.

For places where entry-level access is still out of reach, the effort to bridge the digital divide must necessarily include other economic models.

Internet.org is working with mobile operators and internet service providers to provide affordable basic services to people who aren't yet connected to the internet, as an initial step in increasing connectivity rates in those countries.

In Zambia, Tanzania, Kenya, Colombia, Ghana, and India, for example, Internet.org has partnered with operators to make available, via the internet. org app, basic access to weather, search, social information, health information, messaging, Wikipedia, women's rights information, and so on.

These efforts are having an impact not only on the connectivity rates of these countries, but in the lives of people who now have access.

Relevance

The percentage of population who have sufficient relevant content online

Global

53.0%

Developed Countries   92.2%

Developing Countries   44.6%
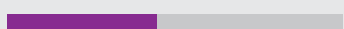
East Asia & Pacific   64.3%

Europe & Central Asia   86.3%

Latin Am. & Caribbean   91.9%

Middle East & N. Africa   70.2%

North America   96.6%

South Asia   19.2%
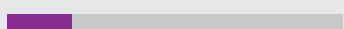
Sub-Saharan Africa   5.1%
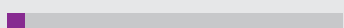
RELEVANCE

Beyond a lack of viable infrastructure and the inability to afford access, the third reason people aren't using the internet is because it is not relevant to their lives.

Most often, this is because people are not aware of the internet, or if they are, they don't use the internet because there isn't enough content in their primary language or because they lack the literacy required to use a connected device to understand relevant content, even when it is available.

Relevance is a major, if unappreciated barrier to access.

Even if people live within range of the infrastructure required to go online, and even if they can afford the cost of a device and data access, they won't go online if they are unaware that the internet exists, or can't make use of it.

Although it may seem that knowledge of the internet is ubiquitous, it's not. A lack of awareness about the internet is still a major barrier to access.

Evidence of this fact is reflected by surveys which find, consistently, that the people who don't use the internet are also unaware of it, or unfamiliar with it (Exhibit 8).

Efforts to increase awareness of the internet are a necessary step towards increasing access.

The majority of non-internet users are not aware of the internet

% Non-internet users who are not aware of the internet

Select Countries, 2012-2013
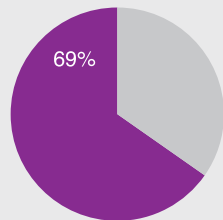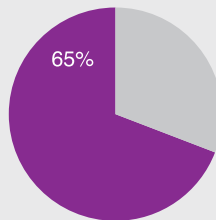
69%	65%	50%
India[1]	**Ghana**	**South Africa**
69% unaware of the Internet	65% don't know of / not familiar with the Internet	50% don't know what the Internet is
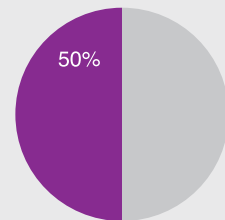
Exhibit 8
1. Rural non-internet users
Source: IAMAI, *Internet in India 2013* (June 2013). USAID, *Study of the Digital Divide in Ghana* (Oct 2013). South Africa Network Society Project, *The New Wave* (2012).

Why is the internet irrelevant to so many non-internet users?

There are many people for whom the internet is irrelevant, not because they're unaware of it, but because the internet has insufficient content in their primary language,

According to the World Bank, about 80% of all content online is in one of ten languages: English, Chinese, Spanish, Japanese, Portuguese, German, Arabic, French, Russian or Korean[57].

If everyone is to connect, the internet has to be relevant to everyone's lives. There has to be content available in languages people can read.

As noted, 94% of the over 4 billion people who are not currently connected to the internet are in the developing world, a place with almost twice the language diversity of the developed world.

In India alone, for example, people speak in about 425 primary languages[58], of which only English and 22 others are designated as "official"[59].

If the goal of global connectivity is to be reached, the problem of relevance as it relates to awareness and language will have to be addressed. Addressing this problem begins by identifying just how prevalent the language barrier is.

What about machine translation?

While the technology is improving[60], machine translation, whether by websites or translating apps, is at best a temporary solution to the availability problem. As any translator knows, the art of translation is as much about interpretation as it is mere substitution of words. At least, at present, without human input, machine translated information on the internet may be legible, but it isn't quite good enough[61].

Moreover, while machine translation may improve to the point where it solves the language problem, there still will persist a cultural gap between translated language and useful, meaningful content.

Take, for example, the question of maternal health. Even though human biology is the same across cultures, the way people receive and use information isn't. Information, especially in the style of an encyclopedia, isn't sufficient to ensure maternal health, particularly because information needs a cultural context for it to be meaningful.

For example, some cultures use doctors to deliver babies, and some use midwives, some perform deliveries in hospitals, and some at home, and even pre-natal care changes from culture to culture. As MAMA, the Mobile Alliance for Maternal Action, an organization that encour-

ages mothers' health through timely and relevant text messages has pointed out – information by itself is not sufficient. It has to be presented in a way that is both "trusted and accepted"[62], that is, within the proper social context.

Looking ahead, machine translation of the internet will improve. Until then, it cannot be relied upon to make the internet more widely relevant in peoples' lives. Efforts at creating relevant content in the primary languages of more people should take precedent over the reliance on machine-translated information.

Page Distribution by Language on Wikipedia (2014)

Number of Articles	Number of Languages
4M+	1
1 – 4M	11
500K – 1M	4
100K – 500K	36
50K – 100K	20
20K – 50K	30
10K – 20K	26
5K – 10K	25
1K – 5K	81
0 – 1K	54
0	7,002

Exhibit 9
Source: WikiMedia, *List of Wikipedias* (Dec 2014).

It's not enough to simply take a linguistic survey of every webpage on the internet and compare that to the languages spoken by the unconnected populations. In order to gauge the scope of the relevance problem, you also need to identify the value of the internet, for any given language group.

Since value is a qualitative measurement, short of asking everyone how useful they find the content on the internet, it's possible to gauge the relative value of the internet with reference to the functional value of the Wikipedia in any given language.

Wikipedia is an excellent proxy for identifying the existence of local and primary language internet ecosystems because it's a universally useful tool, created by dedicated editors in every language for which the internet is a prevalent part of daily life.

Globally, there are about 7,100 languages spoken, with 99.7% spoken by less than 1% of people. (By way of comparison, 54.5% of the world speaks just 20 languages, collectively).

On Wikipedia, there are articles in 288 languages (which can be read by the speakers of about 477 languages[63]), which in turn correspond to the primary languages of approximately 87% of people on earth.

The remaining 13%, or about 936 million people, use a total of about 7,000 languages[64], all of which are unaccounted for by the Wikipedia.

And yet, not all Wikipedias are equal.

Among the 288 languages on Wikipedia, only 52 of them have at least 100,000 articles (Exhibit 9), a number approximately equivalent to the most recent edition of the English-language Encyclopedia Britannica, which is our reference point for "encyclopedic knowledge"[65] and by extension, a basic threshold for the broader availability of primary language content online.

In order to make the internet relevant to 80% of the world, it would require content in at least 92 languages.

With reference to the 100,000 Wikipedia article mark:

- Only 53% of the world has access to online encyclopedic knowledge in their primary language and by extension, online content in their primary language.

- By this same standard, developed countries have 92% primary language-compatible content, whereas developing countries have only 44%.

- In order to make the internet relevant to 80% of the world, it would require content in at least 92 languages.

The content divide between the developed and developing world is lessoned as the standard for encyclopedic knowledge decreases.

- At 50,000 pages, developed countries have 93% primary language compatibility, and developing countries have 50%.

- At 10,000 pages, those numbers rise to 98% and 68%, respectively.

The content divide between developed and developing countries does not exist because there are significantly less *facts* in the primary languages of developing countries, but rather because the size of primary-language Wikipedias tend to increase as the people who speak that language make general use of the internet.

Of course, the Wikipedia is not the entire internet. People use the internet for a lot more than to look up or write about facts.

The availability of primary language content on the Wikipedia is just the leading indicator of what's necessary to bring the world online.

If the relevancy issue is to be addressed, people will need content and services in their primary language across a variety of categories, including:

- Entertainment, *e.g.*, books, games, music, and movies

- Information services, *e.g.*, news, research, and search

- Public services *e.g.*, education, healthcare, and government

- Business services *e.g.*, shopping, payment, and employment

- Sharing platforms, *e.g.*, social media, photo sharing

- Communications, *e.g.*, email, messaging, and voice & video calls

Moreover, there's an additional technical barrier to overcome, since any language displayed on the internet has to be compatible with both font-based display technology and input technology in form of compatible keyboarding or keystroke combinations, particularly for the many languages that use non-alphabetic characters.

Capacity also affects Relevance

A major contributor to the irrelevance of the internet is a person's inability to make use of it, whether because they lack the technical capacity to operate a connected device, or they cannot read and therefore cannot make use of any potentially relevant information that is online.

Any attempt to improve the relevance of the internet for the people who have not connected to it will also require a corresponding effort to increase peoples' technical capacity by increasing their proximity and access to connected devices. This access can be informal – as in, a person lives within a family that has a phone or computer, or it can be through formal, governmental or NGO channels, specifically designed to improve peoples' familiarity with computers and digital mobile devices.

Moreover, the technical capacity gap is highest in areas that are less developed. So, for example, according to recent data, in South Africa, 78% of non-internet users say they believe they don't know how to use the internet, whereas in the United States, only 32% say the same thing.[66]

Illiteracy, as well, is a major barrier to relevance.

According to some recent estimates, the number of illiterate adults in the world varies between 773.5 million[67] and 954 million[68].

And while the world's literacy rate is improving, it remains higher in countries with "very high human development" compared to countries with "low human development," with an adult literacy of 97.2% in the former, and 58.2% in the latter.[69]

Meaning, even if the other barriers to access were systematically addressed, unless and until literacy is no longer a necessary skill for interfacing with the internet, the global connectivity rate will still lag behind the literacy rate.

The Internet Matters Because Information Matters

What we understand about the world and how we navigate the challenges within it, is and always has been a function of what we know and what we can know.

From the agricultural revolution, to the industrial revolution, to the communications revolution that followed the invention of the telegraph, much of the history of human progress has been the story of using tools to do things more efficiently.

The internet is the latest manifestation of this trend. It's simply the latest tool. Only, an incredibly powerful one that should be within reach of everyone, everywhere, without regard to or despite their particular circumstances.

With internet access, people can quickly and easily find and publish information about almost everything, from information relevant to employment, healthcare, education, government services, commerce and, in times of natural disaster or emergency, vital assistance[70].

And as use of the internet continues to expand, it will exert a powerful effect on the global economy, particularly in the developing world[71].

A more connected world is a world of more opportunity, freer expression, and greater innovation. By eliminating barriers to the publication and dissemination of information and knowledge, the internet increases opportunities for everyone.

The internet isn't a guarantor of economic progress, but it is an enabler.

In recent years, people using the internet have "disrupted" some industries, and in a few instances, created entirely new industries.

Connecting the world is not an easy task. There are many social, cultural, political, technical, and economic barriers that will have to be overcome before universal access is a reality.

By encouraging global internet development, internet.org is working towards a future where the power of connectivity is available for everyone, everywhere, and the innovative energy of the billions who cannot now connect is unleashed on the world.

East Asia & Pacific
American Samoa
Australia
Brunei Darussalam
Cambodia
China
Fiji
French Polynesia
Guam
Hong Kong SAR, China
Indonesia
Japan
Kiribati
Korea, Dem. Rep.
Korea, Rep.
Lao PDR
Macao SAR, China
Malaysia
Marshall Islands
Micronesia, Fed. Sts.
Mongolia
Myanmar
New Caledonia
New Zealand
Northern Mariana Islands
Palau
Papua New Guinea
Philippines
Samoa
Singapore
Solomon Islands
Thailand
Timor-Leste
Tonga
Tuvalu
Vanuatu
Vietnam

Europe & Central Asia
Albania
Andorra
Armenia
Austria
Azerbaijan
Belarus
Belgium
Bosnia and Herzegovina
Bulgaria
Channel Islands
Croatia
Cyprus
Czech Republic
Denmark
Estonia
Faeroe Islands
Finland
France
Georgia
Germany
Greece
Greenland

Hungary
Iceland
Ireland
Isle of Man
Italy
Kazakhstan
Kosovo
Kyrgyz Republic
Latvia
Liechtenstein
Lithuania
Luxembourg
Macedonia, FYR
Moldova
Monaco
Montenegro
Netherlands
Norway
Poland
Portugal
Romania
Russian Federation
San Marino
Serbia
Slovak Republic
Slovenia
Spain
Sweden
Switzerland
Tajikistan
Turkey
Turkmenistan
Ukraine
United Kingdom
Uzbekistan

Latin America & Caribbean
Antigua and Barbuda
Argentina
Aruba
Bahamas,The
Barbados
Belize
Bolivia
Brazil
Cayman Islands
Chile
Colombia
Costa Rica
Cuba
Curaçao
Dominica
Dominican Republic
Ecuador
El Salvador
Grenada
Guatemala
Guyana
Haiti
Honduras
Jamaica

Mexico
Nicaragua
Panama
Paraguay
Peru
Puerto Rico
Sint Maarten (Dutch part)
St. Kitts and Nevis
St. Lucia
St. Martin (French part)
St. Vincent and the Grenadines
Suriname
Trinidad and Tobago
Turks and Caicos Islands
Uruguay
Venezuela, RB
Virgin Islands (U.S.)

Middle East & North Africa
Algeria
Bahrain
Djibouti
Egypt, Arab Rep.
Iran, Islamic Rep.
Iraq
Israel
Jordan
Kuwait
Lebanon
Libya
Malta
Morocco
Oman
Qatar
Saudi Arabia
Syrian Arab Republic
Tunisia
United Arab Emirates
West Bank and Gaza
Yemen, Rep.

North America
Bermuda
Canada
United States

South Asia
Afghanistan
Bangladesh
Bhutan
India
Maldives
Nepal
Pakistan
Sri Lanka

Sub-Saharan Africa
Angola
Benin
Botswana
Burkina Faso

Burundi
Cabo Verde
Cameroon
Central African Republic
Chad
Comoros
Congo, Dem. Rep.
Congo, Rep.
Côte d'Ivoire
Equatorial Guinea
Eritrea
Ethiopia
Gabon
Gambia, The
Ghana
Guinea
Guinea-Bissau
Kenya
Lesotho
Liberia
Madagascar
Malawi
Mali
Mauritania
Mauritius
Mozambique
Namibia
Niger
Nigeria
Rwanda
São Tomé and Principe
Senegal
Seychelles
Sierra Leone
Somalia
South Africa
South Sudan
Sudan
Swaziland
Tanzania
Togo
Uganda
Zambia
Zimbabwe

Bold italicized indicates development
classification of developing based on
the ITU grouping

This annex outlines the definitions, data sources, and methodology used by Strategy& (formerly Booz & Company) to determine and measure the indicators for the infrastructure, affordability, and relevance.

Infrastructure

The percentage of the population who live within range of a mobile network is based on the population covered by a 2G or 3G mobile cellular network.

Country-level 2G and 3G population coverage is from the ITU World Telecommunications / ICT Indicators database.

Coverage for global, regional, and development status group is a weighted average of the most recent 2G or 3G country-level population coverage and 2013 population from the World Bank. Countries without 2G or 3G coverage where excluded from the calculation.

Affordability

Affordability is the percentage of the population who can purchase a 500MB prepaid data plan for less than 5% of their household income.

Price of prepaid data plans is from the December 2013 edition of Google's Broadband Pricing Data database and affordability was based on the lowest priced plan that fulfills the data cap requirement within the given country. For example, to determine the price for 250 MB, the lowest price of the following was selected: 250 MB plan, 300 MB plan (if lower than the lowest priced 250 MB plan), two 15 0MB plans (if lower than the lowest priced 250 MB or 300 MB plan), etc. Price data from ITU World Telecommunications / ICT Indicators database was used when pricing data from Google's database was not available.

Household income is based on Gallup's median per capita household income distributed over the population based on the GINI index reported by the World Bank. Median per capita household income was selected based on the assumption that GNI per capita is less representative of household income levels, especially in countries with higher levels of income inequity. For example, India's median per capita household income is $642 vs GNI per capita of $5,350, Indonesia's is $800 vs $9,275, and the United States is $15,000 vs $53,470.

Country specific household income distribution curves were determined by using the GINI index "G" and the mean household income per capita "GNI/Cap".

The formula of the curve is:

$$f(x) = \frac{1}{\sigma x \sqrt{2\pi}} e^{-\frac{(\ln x - \mu)^2}{2\sigma^2}}$$

in which,

$$\sigma = \Phi^{-1}\left(\frac{(G+1)}{2}\right)\sqrt{2}$$

and,

$$\mu = \ln(GNI/Cap) - \frac{\sigma^2}{2}$$

Using the income distribution curve, the percentage of population for whom the 500MB plan does not exceed 5% of their monthly income is determined as the population who can afford to be online.

Affordability for global, regional, and development status group is a weighted average of the country-level affordability and 2014 population from the World Bank. Countries without data plan prices or income data were excluded from the calculation.

Relevance

Relevance is the percentage of the population that has more than 100,000 Wikipedia articles (a proxy for encyclopedic knowledge) in their primary language.

Count of Wikipedia articles is from the list of Wikipedias classified by language (as of December 9, 2014).

Primary languages and speakers per country based on the Ethnologue Global Database (http://www.ethonologue.com), an SIL brand (http://www.sil.org)

Wikipedia languages are mapped to Ethnologue languages based on ISO 639-3 codes. The 100K threshold for Wikipedia articles is derived from the reference point of availability of encyclopedic knowledge in one's primary language (for example, Encyclopedia Britannica covers 100 K topics).

Relevance for global, regional, and development status group is a weighted average of the country-level relevance and 2014 population from the World Bank.

1. International Telecommunications Union, *Measuring the Information Society Report 2014*.
2. For a list of developing and developed countries based on ITU group, see Annex A.
3. *Measuring the Information Society Report 2014*.
4. International Telecommunications Union, *2005-2014 ICT data for the world, by geographic regions and by level of development*
5. *Measuring the Information Society Report 2014*.
6. *2005-2014 ICT data*.
7. The estimate of 4 billion by 2019 is based on applying the 6.6% growth rate in 2014.
8. ITU, *World Telecommunications/ICT Indicators Database.* (see Annex B for methodology)
9. Range of 2G throughput rates is based on 2G/GSM, 2.5G/GPRS, and 2.75/EDGE and range of 3G is based on UMTS and HSPA.
10. 4G/EDGE (theoretically up to 100mbps) coverage data is not currently tracked by the ITU.
11. The recommended minimum speed for streaming voice, music and video is at least 100kbps.
12. For example, the Telecom Regulatory Authority of India (TRAI) monitored the 'minimum download speed' across 12 service providers and found the average 2G speed to be 65.81Kbps, with a range of 21.42 kbps to 97.06 kbps.
13. Broadband Commission, *The State of Broadband 2014: Broadband for All.*
14. Google, *Global Broadband Pricing database* (Dec 2013),
15. Gallup, *More than One in Five Worldwide Living in Extreme Poverty, Dec 2013*.
16. USAID*, Study of the Digital Divide in Ghana: Analysis and Recommendations, figures are from 2013*. Specific findings include "Almost 65% responded that they did not know of, were not familiar with, the Internet at all" (p14) and "For those Ghanaians who indicated that they do know about the Internet, but who do not use it, by far the most significant reason (over 50%) given for not using the Internet was that respondents didn't know or understand how to use such services. The second strongest concern specified was that potential users didn't see any value in Internet service" (p15).
17. South African Network Society Project, *The New Wave*, 2012. Specific findings include results from responses to "What are the most important factors that prevent or inhibit this 66% from going online?" where 76% answered "I don't know how to use it," 50% "I don't know what it is, and 42% "no interest / not useful" (p20).
18. IAMAI, Internet in India 2013. Specific findings include "Internet unawareness continues to be the primary reason why people do not access Internet in Rural India" with 69% "unaware of the internet" and 33% "PC illiterate" (p16).
19. Pew Research Center, *Who's Not Online and Why*, http://www.pewinternet.org/2013/09/25/whos-not-online-and-why/, Sep 2013. Specific findings include "34% of non-internet users think the internet is just not relevant to them, saying they are not interested, do not want to use it, or have no need for it" and "32% of non-internet users cite reasons tied to their sense that the internet is not very easy to use."
20. Encyclopedia Britannica Store, *Britannica 2013 Ultimate DVD*, http://store.britannica.com/collections/software/products/04211380jcas, Feb 2015. The Britannica store lists that the *2013 Ultimate DVD of the Britannica* features over 100,000 articles from the 32-volume print set.
21. Ethnologue, *Ethnologue Global Dataset – 17th Edition*, 2014.
22. 2005-2014 ICT data.
23. *Measuring the Information Society Report 2014.*
24. *2005-2014 ICT data.*
25. ITU*, Measuring the Information Society 2011 Report.* The report noted that the uptick in internet growth rate reflected a surge in mobile broadband subscriptions, particularly in developing countries.
26. ITU ICT 2005-2014 data.
27. According to a 2013 Pew survey, among the people who are not connected to the internet in the US: 34% say the internet is irrelevant and they're not interested, do not want to use it, or have no need for it. 32% say the internet is difficult or frustrating to use, they are physically unable, or they are worried about other issues such as spam, spyware, and hackers. 19% cited the costs and 7% cited a physical lack of access . See "Who's Not Online and Why," Pew, 2013 at http://www.pewinternet.org/2013/09/25/whos-not-online-and-why/
28. World Telecommunications/ICT Indicators Database 2014.
29. Pew Research Center, *Who's not online and why*, Sep 25, 2013, 5.
30. ITU ICT 2005-2014 data.
31. Analysis based on comparing median household income, population, and percent using the internet. *Gallup, World Poll. The World Bank, World Development Indicators. ITU, World Telecommunications/ICT Indicators database.*
32. Intel and Dalberg, Women and the Web, 2013.
33. *Women and the Web.*

34. The World Economic Forum *2013 Global Gender Gap Report* ranked Saudi Arabia 127th out of 132 countries in terms of gender equality. In 2013, women represented 42.9% of the Saudi population but comprised only 14.8% of the total labor force (http://www.arabnews.com/news/451262)

35. CDMA, though not listed, includes 2G/CDMA at 14.4-60 kbps, 2.5G/CDMA 1xRTTT at 64-144 kbps, and 3G/CDMA EV-DO at 600 kbps-3.1 mbps

36. GSMA, *GSM Mobile Technology*, http://www.gsma.com/aboutus/gsm-technology.

37. Vodafone, Data Calculator, http://www.vodafone.co.ug/data-calculator, Feb 2015.

38. Skype, *How much bandwidth does Skype need?*, https://support.skype.com/en/faq/fa1417/how-much-bandwidth-does-skype-need, Feb 2015.

39. Spotify, *What connection do I need to stream music on my mobile phone?*, https://support.spotify.com/us/learn-more/faq/#!/article/What-connection-do-I-need-to-stream-music-on-mobile, Feb 2015.

40. Spotify, *What bitrate does Spotify use for streaming?*, https://support.spotify.com/us/learn-more/faq/#!/article/What-bitrate-doesSpotify-use-for-streaming, Feb 2015.

41. Saavn, a streaming music service, offers options to stream music at bitrates across quality levels: low (32 kbps), medium (64 kbps), high (128 kbps), and premium (320 kbps). http://help.saavn.com/customer/portal/articles/1006069-at-what-bitrate-does-saavn-pro-stream-music

42. Google YouTube, *System requirements*, https://support.google.com/youtube/answer/78358?hl=en-GB, Feb 2015. (note: YouTube supports 56K dial-up modem speeds but provides guidance on buffering to enable viewing ("Start the video and then click Pause button immediately. Wait for the grey video progress bar to load a bit before clicking Play"),

43. Netflix, *Internet Connection Speed Recommendations*, https://help.netflix.com/en/node/306, Feb 2015.

44. ITU, *World Telecommunications/ICT Indicators Database.*

45. Population coverage of Chad and Nigeria is based on 2012 data from the ITU, *World Telecommunications/ICT Indicators Database.*

46. Actual speeds can vary in practice. For example, the Telecom Regulatory Authority of India (TRAI) monitored the 'minimum download speed' across 12 service providers and found the average 2G speed to be 65.81Kbps, with a range of 21.42 kbps to 97.06 kbps

47. McKinsey, *Offline and Falling Behind*, 2014.

48. Gallup, *More than One in Five Worldwide Living in Extreme Poverty,* http://www.gallup.com/poll/166565/one-five-worldwide-living-extreme-poverty.aspx, Dec 2013.

49. Airtel, *airtel 3G Data Bundle Calculator | Calculate Internet Usage | Sierra Leone*, http://africa.airtel.com/wps/wcm/connect/africarevamp/sierra/3g/home/calculator, Feb 2015.

50. Broadband Commission, The State of Broadband 2014: *Broadband for All*, Sep 2014.

51. The ITU's *Measuring the Information Society Report 2014* report notes that prepaid plans are more available than postpaid plans in developing countries. The Broadband Commission's *State of Broadband 2014* report noted that "prepaid based services nearly another one billion users to come online, for whom long-term broadband subscriptions were not easily affordable."

52. Based of the average selling price of an android phone of $320 in 2012 (based on IDC's assessment of average selling price for smartphones by operating system Q4 2013 - http://www.idc.com/getdoc.jsp?containerId=prUS24676414), device tax rate of 23.29% (based on GSMA's Global Tax Review 2011), and at 500 MB of monthly data prices of $19.50USD (based on ITU's MIS2014), data is 69% of the undiscounted cost for a device lifetime of 2-years and 77% for a device lifetime of 3-years. More generally, device prices continue to fall as a result of increasingly efficient economies of scale on chipsets, handsets and the broader mobile hardware ecosystem.

53. *More than One in Five Worldwide Living in Extreme Poverty*.

54. "The Value of Connectivity," Deloitte, 2014. (http://www2.deloitte.com/ie/en/pages/technology-media-and-telecommunications/articles/value-of-connectivity.html); "Sizing the Internet Economy," McKinsey, 2014. (http://www.mckinsey.com/features/sizing_the_Internet_economy)

55. Juniper Networks, *Global Bandwidth Index*, Dec 2014.

56. WEF and Intel Corporation, *The Global Information Technology Report 2012.*

57. The World Bank, *Internet Access, Yes, But in my Mother Language*, http://www.worldbank.org/en/news/feature/2014/07/03/Internet-access-yes-but-in-my-mother-language, Jul 2014.

58. Ethnologue , Ethnologue *Global Dataset – 17th Edition*, 2014.

59. European Commission, *EU, India, both with 23 official languages, sign joint declaration on multilingualism*, http://europa.eu/rapid/press-release_IP-09-362_en.htm?locale=en.

60. New York Times, *Language Translation Tech Starts to Deliver on Its Promise*, http://bits.blogs.nytimes.com/2015/01/11/language-translation-tech-starting-to-deliver-on-its-promise/

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62. Mobile Alliance for Maternal Action, *The Power of Health in Every Mama's Hand*, http://www.mobilemamaalliance.org/evidence.

63. Wikimedia Foundation, *List of Wikipedias*, http://meta.wikimedia.org/wiki/List_of_Wikipedias, Dec 9, 2014. Ethnologue, *Ethnologue Global Dataset – 17th Edition*, 2014.

64. *Ethnologue*, 2014.

65. Encyclopedia Britannica Store.

66. South African Network Society Project, 2012. Pew Research Internet Project, *Who's not online and why*, Sep 2014. Intel & Dalberg, *Women and the Web*.

67. UNESCO*, Adult and Youth Literacy*, http://www.uis.unesco.org/Education/Documents/fs26-2013-literacy-en.pdf, Sep 2013.

68. *Adult and Youth Literacy. CIA, The World Factbook*.

69. UNDP, Human Development Report 2014.

70. For example, when the Ebola virus began to affect people in West Africa, internet access was seen a critical tool for health officials, medical professionals and the public, both for coordinating medical relief and distributing information on prevention. NetHope, *Partnership Expands ICT Support for Ebola Fight in West Africa*, http://nethope.org/media/press-room/partnership-expands-ict-support-for-ebola-fight-in-west-africa, Jan 2015.

71. In its greatest formulation, internet access makes it possible for people to participate in the global "knowledge economy." See, Walter W. Powell, Kaisa Snellman. Annual Review of Sociology. August 2004, Vol. 30, Pages 199-220, which defines the "knowledge economy" as "production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence." The key component of which is "a greater reliance on intellectual capabilities than on physical inputs or natural resources."

72. ITU, *Country Classifications by Region and Development Status*, http://www.itu.int/ITU-D/ict/definitions/regions/, Feb 2015.

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