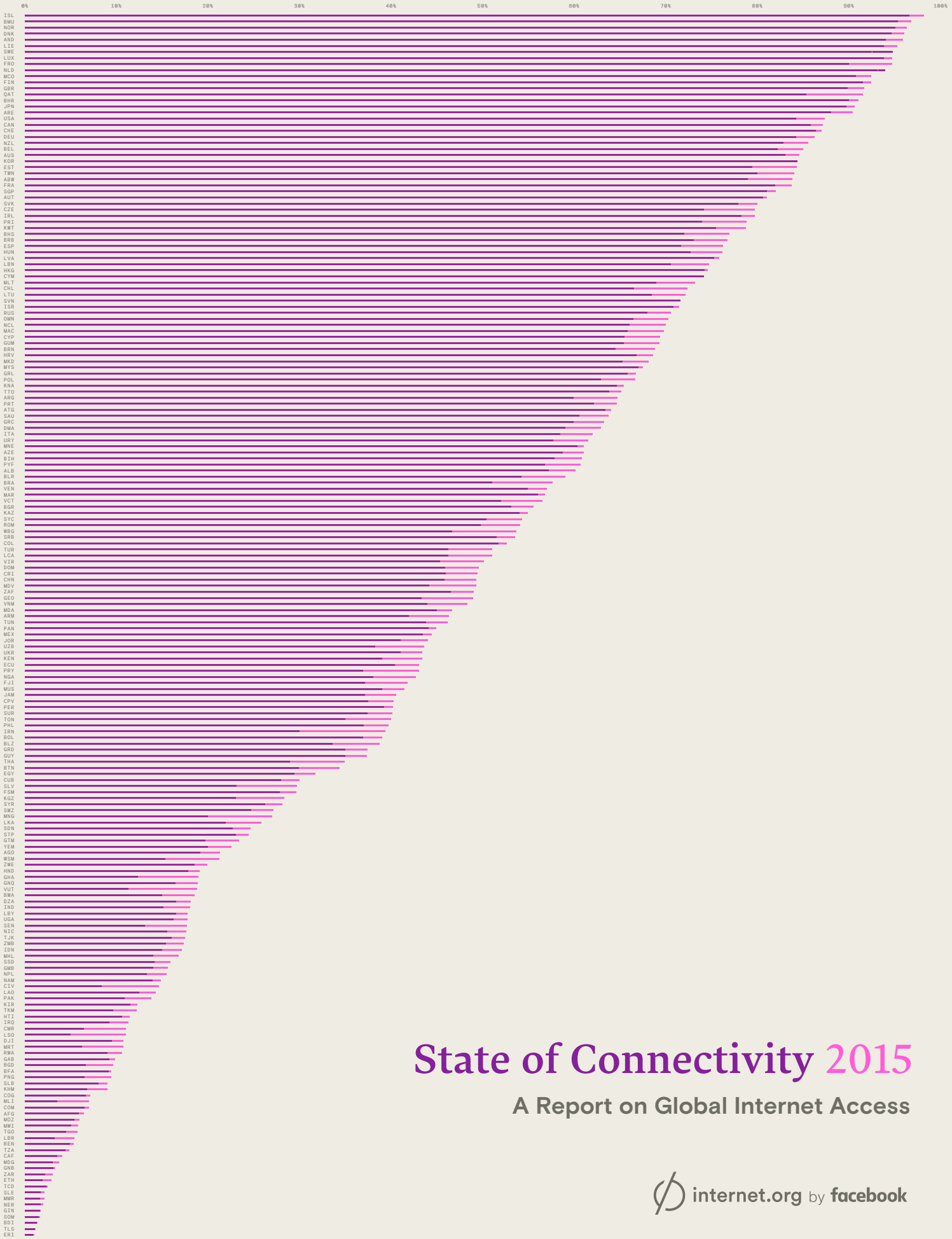


State of Connectivity 2015

A Report on Global Internet Access

internet.org by facebook

PERCENTAGE OF POPULATION ONLINE (International Telecommunication Union, World Telecommunication/ICT Indicators Database, 2015)

2013 2014

Facebook released the inaugural State of Connectivity report[1] last year, taking a close look at who was connected, who was not and why.

This year's report has been jointly authored by a team including Pat Wu and Molly Jackman at Facebook and David Abecassis, Richard Morgan, Hannah de Villiers and Declan Clancy at Analysys Mason. Graphical design and editorial was managed by Julie Bartram and Mark Hegarty at Analysys Mason, with cover design by Dan Zhou at Facebook.

The report has benefited from data, discussions and peer review from a number of teams within Facebook, with special thanks to Lauren Bachan, Benjamin Bartlett, Sean Chu, Curtiss Cobb, Dimitry Gershenson, Andreas Gros, Max Kamenetsky, Adam Li, Lyrica McTiernan, Matt Miller, Iris Oriss, and Chris Weasler.

This report calls for collaboration between stakeholders with an interest in connectivity, but is also a result of such collaboration. A number of organizations have supported the process, through discussions during the drafting phase and peer review of the report, resulting in invaluable feedback.

We are grateful for the help of: the Alliance for Affordable Internet (Sonia Jorge); Broadband Commission (Phillippa Biggs); Cisco (John Garrity); Google (Nnàmdi Abraham-Igwe, Mike Blanche, Vincent Chiu, Robindhra Mangtani, Patrick Ryan, Fred Xue); the GSMA (Matthew Bloxham, Kalvin Bahia, Pau Castells, Yasmina McCarty); the Internet Society (Michael Kende); ITU-D (Vanessa Gray, Esperanza Magpantay, Susan Teltscher, Ivan Vallejo); Telenor (Tom Varghese); the World Bank (Tim Kelly, Deepak Mishra); and the World Economic Forum (Rodrigo Arias, Michael Garabet, Anna Henry, Alex Wong).

A key theme of this report is the need to share data relating to connectivity more widely, and for different parties to use this data to generate new insights. This report releases original data and analysis from Facebook, however thanks go to those parties which have granted permission to use their country-level data as summary indicators or inputs to analyses, specifically: Google / Communications Chambers (Global Broadband Pricing Study), ITU (internet users, 2G coverage), GSMA Intelligence (3G coverage, unique mobile subscribers, unique mobile internet subscribers), and Gallup World Poll (median household income), and Ethnologue (primary and secondary languages speakers). Population statistics come from the United Nations Population Division (UNPD), and Gini coefficients are sourced from the World Bank.

Facebook is deeply committed to finding a path to connect everyone in the world, and believes this will only be possible through wide collaboration. A community of like-minded organizations is already working together towards this goal, and this report aims to add to the global discussion and encourage more parties to join the cause.

Contents

State of connectivity

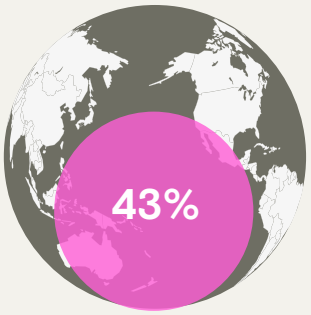
People using the internet

2014: 2.9 billion → 2015: 3.2 billion

People not using the internet

2014: 4.3 billion → 2015: 4.1 billion

People connected in 2015



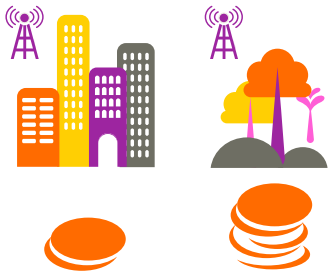
Availability

Share of population covered by mobile broadband networks

2014: 73% → 2015: 78%

People without mobile broadband coverage

2014: 1.9 billion → 2015: 1.6 billion

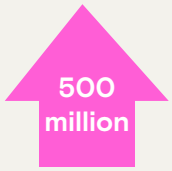


Remote mobile sites cost 2 to 3 times as much as urban sites, and can reach fewer people

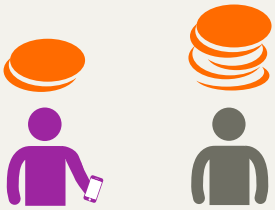
Affordability

People who can afford 500MB per month

At the end of 2014: 43%



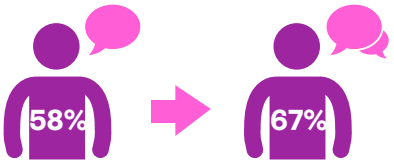
500M more people could afford mobile data services than at the end of 2013



To get online, the 2.7 billion people who are not mobile phone users face costs three times higher than those who are

Relevance

Languages with high levels of relevant content online (at least 100,000 Wikipedia articles)



People speaking these as their primary language

People speaking these as primary or secondary languages

Readiness

Skills

1 billion people lack basic literacy skills

Awareness and understanding

Over two thirds* of the unconnected in developing countries do not understand what the internet is

Cultural and social acceptance

Women in developing countries are 25% less likely to be online than men

*based on surveys in 11 countries (see Readiness section for details)

Executive Summary

The state of connectivity has improved in the last year:

- At the end of 2014, there were 2.9 billion internet users globally. By the end of 2015, this figure was predicted to have reached 3.2 billion,[2] 43% of the world's population.
- During 2014, lower prices for data and rising global incomes have made mobile data packages of 500MB per month affordable to 500 million more people.
- The highest estimates of 3G and 4G coverage suggest that 1.6 billion people live outside mobile broadband coverage, an improvement compared to 2 billion at the end of 2014.
- Most people connect to the internet using mobile devices, which are the only way to get online in many parts of the world. An estimated 2.7 billion people did not have mobile phone subscriptions in 2015.[3]

Despite this progress, more must be done to address the challenges that remain: the developed world is largely online, but the developing world is a long way behind. Urban areas are connected, many rural areas are not. The less money you have, the less likely you are to be online. In many countries, women use the internet far less than men. And even if the entire world lived within range of the necessary infrastructure, nearly a billion people remain illiterate or otherwise unable to benefit from online content.

The internet is a catalyst for broader social and economic advances through access to education, economic and employment opportunities, and even healthcare. It is a critical tool for development and should be available to everyone. Acknowledging the importance of connectivity and the need to bring more people online faster, the United Nations (UN) General Assembly and the International Telecommunication Union (ITU) recently called on the international community to provide universal access to affordable internet by 2020.[4,5]

Achieving global connectivity will require action to address the four key barriers to internet access:

- **Availability:** Proximity of the necessary infrastructure required for access.
- **Affordability:** The cost of access relative to income.
- **Relevance:** A reason for access, such as attractive content in people's main language.
- **Readiness:** The capacity to access, including skills, awareness and cultural acceptance.

These barriers do not arise in isolation, nor can they be addressed in isolation. They function as a cluster, each one affecting the others. Unless corporations, government, NGOs and non-profits work together to address these chief barriers to access, the digital divide will persist and expand.

In order to improve connectivity, however, those parties who are committed to do that need better, more accurate data on the state of global connectivity. Further work is required to develop global standards for collecting, reporting, and distributing data related to connectivity. Currently, many indicators remain incomplete, inconsistent between sources, or are not sufficiently up to date.

The purpose of this report is to show how data can help assess the barriers to connectivity at the global, national and local levels and inform initiatives to reduce them.

Industry stakeholders must work together to share data more widely and apply this data to derive more sophisticated insights into how to expand connectivity. By measuring and sharing the outcomes of these applications it will be possible to improve data through ongoing collaboration and sharing.

The ITU has long championed broader and deeper sharing of connectivity data. It is now working with partners such as the World Bank and national governments to define and measure indicators,[6] while the GSMA is partnering with operators to standardize their reports.

In addition, Facebook is collaborating with the Center for International Earth Science Information Network at Columbia University to validate detailed maps of population distribution produced for 20 countries using new machine learning techniques. When released, these maps will be free to use by any government, operator, entrepreneur, or researcher, and will guide data-driven decision making.

While maintaining user privacy as a first principle, operators and technology companies should increase their efforts to release aggregate, globally consistent data as well.

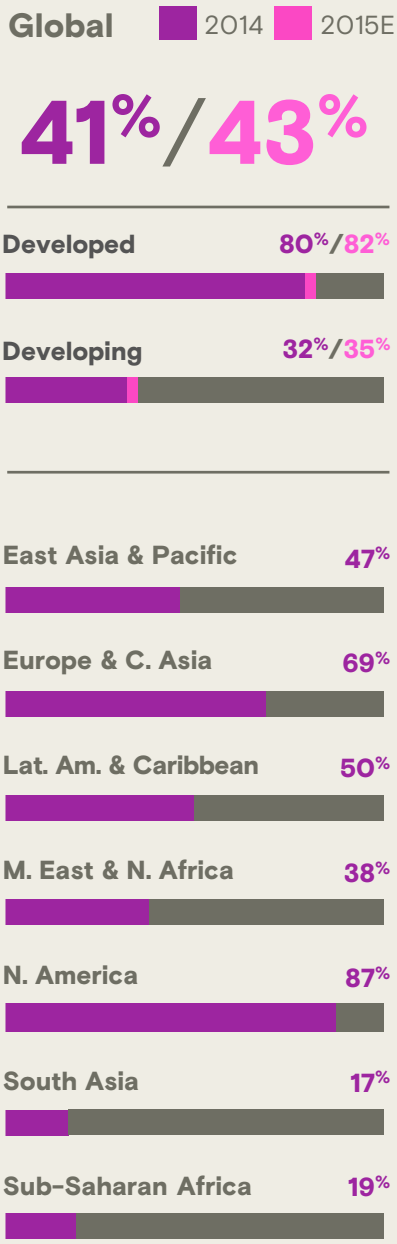
The internet produces content to meet the needs of those already connected. In the absence of intervention, people who already use the internet will be the ones to shape its destiny, and the gap between the connected and unconnected will only grow deeper.

Everyone, everywhere should be able to access the internet. And the world has to work together to make it happen.

The State of Connectivity

Percent online

Percentage of the population using the Internet in the last three months



Source: ITU

At the end of 2015, 4.1 billion people were not internet users, down from 4.3 billion in 2014.[7] Without a step change to current trends, over 3 billion people will remain offline by 2020, nearly all in developing countries.

Studies suggest that a 10% increase in broadband penetration in developing countries is correlated with a 1.35% increase in GDP.[8] People in rural areas and with low incomes have most to gain from the broad social and economic benefits the internet can bring, which include:[9, 10]

- greater economic opportunities, reducing poverty and hunger[11]
- improved access to healthcare and education services[12]
- increased empowerment and opportunities for women[13]

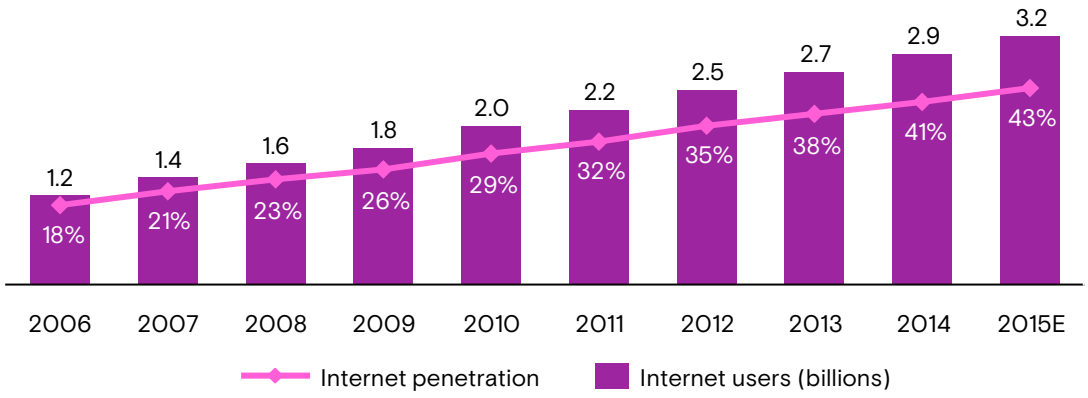
Achieving universal connectivity is a major challenge that will require the cooperation of many stakeholders through innovation and investment. For any collaborative solution to be planned and executed effectively, rich, reliable and accessible data must be widely available.

Over 3 billion people are connected to the internet and nearly all newly connected people use mobile devices

According to ITU estimates, at the end of 2015, 3.2 billion people had used the internet within the previous three months (2014: 2.9 billion). This represents 43% of the world's total population.[14] Growth in internet users has been steady over the last ten years, with a net increase of 200 to 300 million people every year.

Global internet users and internet penetration

Source: ITU, 2015



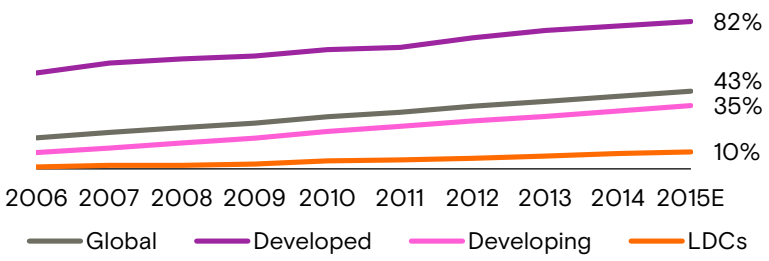
Most people now connect to the internet using mobile devices such as smartphones and internet-enabled feature phones, rather than desktop computers with fixed-line connections. The GSMA's latest numbers suggest that there were 3.2 billion unique mobile internet subscribers in 2015, very close to the ITU's estimate for total internet users.[15]

The predominance of mobile access is partly explained by the fact that mobile broadband networks are much more widely available than fixed broadband networks, which have limited coverage in developing countries where most of the world's unconnected population lives. Mobile networks will continue to play a leading role in getting more people online in the future: of the 4.6 billion people estimated by the GSMA to have a mobile phone subscription at the end of 2015, 1.4 billion are not mobile internet users. A further 2.7 billion people in the world do not have their own mobile subscription.[16]

On current trends, international targets for connectivity will not be achieved, with a projected shortfall of 500 million people globally

Over 90% of the world's unconnected people live in developing countries, primarily in South Asia (1.4 billion in 2014), East Asia and the Pacific (1.2 billion) and sub-Saharan Africa (800 million).[17] In least developed countries (LDCs), a sub-set of developing

countries with a population of over 900 million, only 10% of people use the internet. Furthermore, people in rural areas of developing countries are 70% less likely to be connected than those in urban areas,[18] and the majority of the unconnected are women.



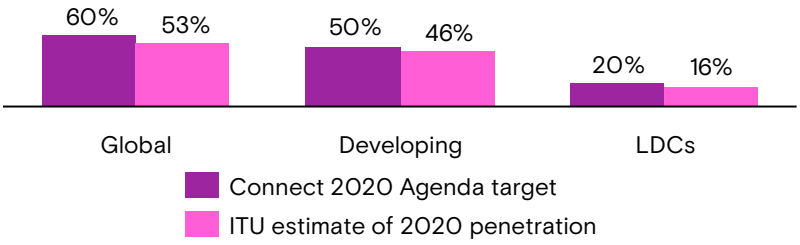
Percentage of individuals using the internet

Source: ITU[19]

The last two years have been pivotal for bringing the issue of universal connectivity to the fore. In September 2015, the United Nations (UN) Member States unanimously adopted the post-2015 development agenda and the Sustainable Development Goals (SDGs). SDG 9c recognizes the importance of removing barriers to internet adoption by making connectivity universally available and affordable, and emphasizing the role of the internet in combating inequalities and promoting development.[20]

The ICT components of the SDGs complement the ITU's Connect 2020 Agenda, which sets measurable targets for broadband coverage and internet adoption. Published in November 2014, the Agenda acknowledges the role of connectivity in enabling inclusive and sustainable growth.[21]

Despite the steadily increasing number of people connected over the past decade, current trends suggest at least 3 billion people will remain unconnected by 2020, nearly all of them in the developing world.[22] The ITU's own projections suggest that connectivity will fall short of the 2020 targets by 500 million people (7% of global population), emphasizing the need for concerted action to address the barriers to connectivity.



Projected internet adoption in 2020 compared with Connect 2020 Agenda targets

Source: ITU Measuring the Information Society Report 2015

These clear targets, set and monitored by the UN, are essential in aligning government policies towards the goal of universal connectivity. They complement a growing body of private-sector initiatives to bring about the technology and business models needed to accelerate global internet penetration.

Availability

Supply-side barrier

- Mobile access networks
- Access innovation
- Adjacent infrastructure

Nearly 2 billion people are outside the range of broadband networks

Affordability

Supply / demand-side barrier

- Ability to pay
- Cost of data packages
- Device-related costs

Over 3 billion people cannot readily afford mobile broadband packages

Relevance

Supply / demand-side barrier

- Useful
- Relatable
- Accessible

Over 2 billion people do not have access to enough content in their language

Readiness

Demand-side barrier

- Literacy, digital skills
- Awareness and understanding
- Social and cultural acceptance

1 billion people are illiterate, nearly **3 billion** are not mobile subscribers

The Global Barriers to Connectivity

Progress toward universal connectivity requires an understanding of why people remain offline. There is growing consensus on the primary barriers to connectivity, which relate to **availability, affordability, relevance** and **readiness.**[23] These barriers affect both demand- and supply-side factors.

Demand for internet connectivity is limited by a lack of affordability, perceived relevance, and readiness: if people cannot pay for services, do not have the skills to access the internet, or are not aware of its benefits, they simply will not get connected.

If there is not enough demand, **supply** may be unsustainable: an operator will not be able to deploy the infrastructure needed to make broadband services available in an area with little demand, and relevant local content is less likely to emerge in communities where most people are unconnected.

This overlap between the barriers is linked by a number of common factors, shown below. They are much more prevalent in the developing world, leading to an accelerating divide between connected and unconnected communities.

Factors that affect multiple barriers

Source: Analysys Mason

	Rurality and remoteness	Low incomes	Lack of education	Low connectivity among peers
Availability	✓	✓		
Affordability	✓	✓	✓	
Relevance	✓			✓
Readiness	✓		✓	✓

Connecting the next 4 billion requires a cohesive, coordinated and data-driven approach deployed by many stakeholders

Success in improving connectivity will depend on the ability of many stakeholders to work together, through innovation and investment to improve connectivity, supported by well-designed policy interventions. Coordinating projects, initiatives, and support by both the private and public sectors is therefore essential. This is one of the roles of national broadband plans (NBPs), which are widespread but often suffer from a lack of resources, information, buy-in and funding, as discussed in the Availability section below.

All these initiatives imply a degree of risk, which can be mitigated through careful planning and research. In addition, stakeholders need to prioritize their efforts. This requires a good understanding of where the barriers to connectivity are greatest (e.g. what countries, regions or segments of the population), and the challenges to address these barriers.

Rich, reliable and accessible data is essential to achieve these objectives. Yet many indicators remain incomplete, inconsistent between sources, or insufficiently up to date. The ITU has long championed broader and deeper sharing of connectivity data,[24] and others are working on responding to this call.[25]

This report brings new data, analyses and insights on each barrier

This State of Connectivity 2015 report contributes to these efforts by showcasing original data and new insights, as well as providing original perspectives on the barriers.

- In the **Availability** section, new maps show the mobile technology used by people to connect to Facebook using the Android Facebook app. Population distribution and density data, based on the processing of high-resolution satellite images, facilitates greater understanding of the distribution of population in India. This type of data can be used to support planning for network roll-out.

- The **Affordability** section provides insight into how prices for mobile data bundles compare with people's incomes, by analyzing income distributions and pricing data made available by Google and ITU.[26] A key new perspective explored in the report relates to how affordability constraints differ for the many people who do not yet use mobile phones.

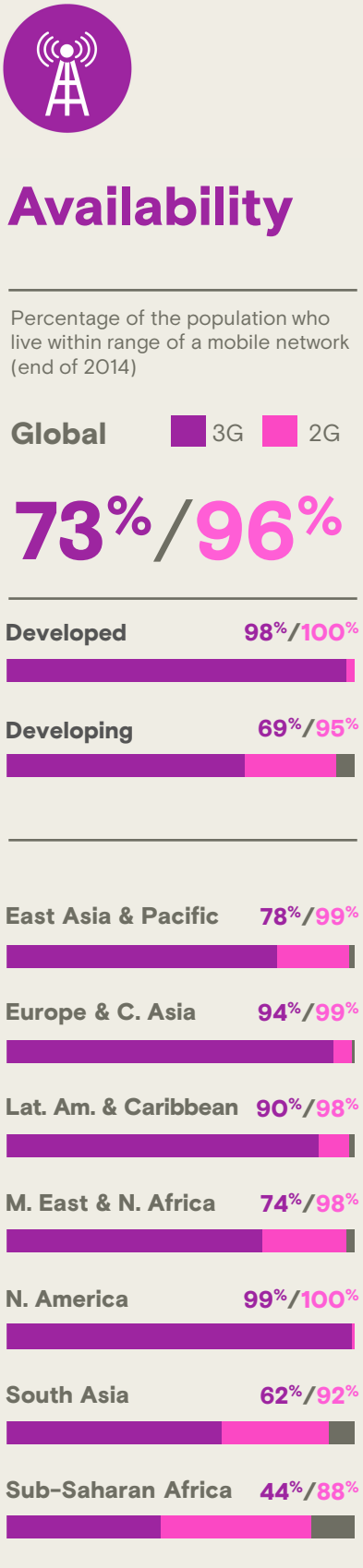
- The **Relevance** section proposes a definition of 'relevant content' centered around 'usefulness' and how people can relate to online content. Language is a major constraint to relevance: the report explores the breadth of content accessible to people in their primary and secondary languages, supported by major mobile OS and

platforms. Using data on people who use Facebook in Tanzania, it shows how support for local languages can act as a powerful incentive for people to connect.

- **Readiness** is characterized in the last section as a combination of skills, awareness, and social and cultural acceptance. Data from recent surveys carried out by Facebook in eleven developing countries confirms the lack of awareness of the internet amongst unconnected people, and highlights gender differences in internet use in some parts of the world.

Availability

Percentage of the population who live within range of a mobile network (end of 2014)



Source: ITU, GSMA Intelligence

Availability of internet services depends on individuals living within range of physical infrastructure that enables them to access the internet. This infrastructure can be:

- **Wired fixed** networks, using copper telephone lines, cable TV networks or fiber-optic cables.
- **Wireless** networks (fixed or mobile), which offer internet access direct to end-user devices, either through traditional cellular networks or using technologies such as Wi-Fi.
- **Satellite** broadband networks, which are ubiquitous[27] but expensive for access (but do play a key role as a 'backhaul' technology for land-based wireless networks in remote areas, as discussed below).

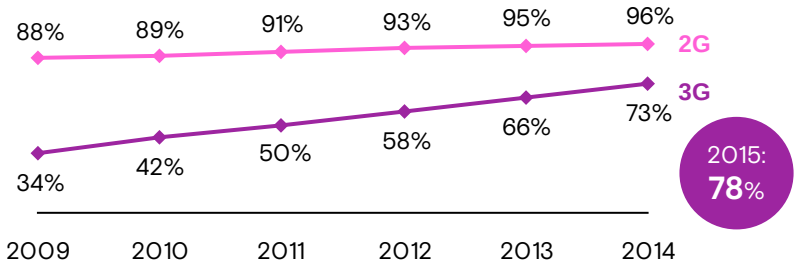
Mobile network connections are by far the most prevalent, particularly in the developing world. Although 2G mobile networks cover up to 96% of people globally and are used for telephony and basic data connectivity by over half the world's population, at least 1.6 billion people still live in places where mobile broadband networks (3G and 4G) are not available.

The barriers to availability are essentially economic, as current technology does not enable ubiquitous coverage at a reasonable cost. Better data is needed to support the development of innovative solutions that significantly bring down the cost of extending broadband networks to cover more people.

As a step in this direction, this report showcases new data from Facebook that is consistent across countries and operators, and shows the mobile technology people use to access Facebook.

Operators have made good progress in extending the availability of broadband networks to over 5 billion people worldwide

Basic 2G mobile networks are available to 96% of the world's population according to ITU country-level data. However these 2G networks offer at best very basic connectivity, and cannot support most internet services. More advanced services (e.g. accessing media-rich web pages or video content),[28] require broadband access. On mobile networks, this is delivered through 3G and 4G technology, the availability of which has increased strongly in recent years to reach 73% population coverage in 2014 and 78% by the end of 2015.



Global 2G and 3G population coverage

Source: ITU (2G, based on data for 134 countries) and GSMA (3G, based on data for 218 countries), 2015

Estimates of network coverage vary, and more consistent and reliable data is required to better understand the availability barrier. For example, Ericsson estimates global 2G and 3G population coverage in 2014 to be lower than ITU and GSMA estimates, at 90% and 65% respectively.[29]

Quality of user experience is important to consider as well as network coverage

Network quality is about more than just peak data speeds. Other factors – such as reliability (e.g. drop rate) and latency (delay) – are important to the user experience. Poor quality of experience can make the internet less attractive and reduce the likelihood of users staying online and connected.

Quality of experience is very specific to the application being used. Latency may not matter for downloading content, but can be problematic for interactive applications or making internet-based voice calls (e.g. Skype). Low network speeds may be adequate for messaging or web browsing, but not for accessing multi-media content.

Good quality of service relies on good end-to-end infrastructure. This means the mobile access networks that send the signal from the radio mast to the handset, but also the national and international backbones and IT systems that are essential to a good quality of experience.

As more users join a network, it can become capacity-constrained, which can affect quality. In India, for example, the limited amount of radio spectrum available for each operator limits the number of data users that can be supported from each site before service quality deteriorates.

Many industry stakeholders are working to improve quality of experience, e.g. by upgrading cellular technology, storing content closer to the end-users, applying data compression, and optimizing app experiences. For example, Facebook partnered with XL Axiata and Ericsson to measure and improve the quality of experience of Facebook users in Indonesia.[30] Likewise, YouTube offers adaptive bitrate for its video content, enabling adjustment to less critical quality parameters (e.g. definition) to protect more critical ones (e.g. uninterrupted playing).[31]

Rising incomes and growing awareness of the value provided by the internet will help to address affordability issues, however lower prices and more flexible ways to pay will be important.

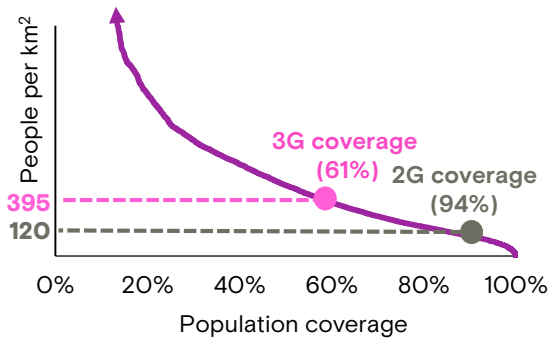
At least 1.6 billion people live outside mobile broadband coverage, which is constrained by economic, operational and policy factors

The highest estimates of 3G and 4G mobile broadband networks coverage suggest that at least 1.6 billion people lived in uncovered areas at the end of 2015, nearly all of them in developing countries. This is a material improvement compared to the end of 2014, when nearly 2 billion people lived out of mobile broadband coverage. Availability is most constrained in rural areas, where the ITU estimates over 70% of people do not have mobile broadband coverage.[32] Achieving the ITU's Connect 2020 Agenda, which calls for 90% of the world's rural population to be covered by broadband services by 2020, will therefore require extensive network roll-out.

Several factors make network expansion economically challenging in remote and rural areas. The deployment of each new mobile site requires substantial up-front investment by operators, who must also incur significant ongoing costs to provide services. It can be difficult for operators to offset these costs in rural areas where demand for services is typically lower. For example, in rural areas, populations tend to be sparse – meaning that there are fewer potential customers within the coverage area of a new mobile site. Moreover, rural populations in developing countries tend to have lower incomes, limited educational opportunities, and less developed digital skills; they are less aware of the benefits of the internet, and face greater cultural and linguistic barriers to internet adoption. All these factors lead to lower demand and hence increased risk for operators considering whether to invest in infrastructure.

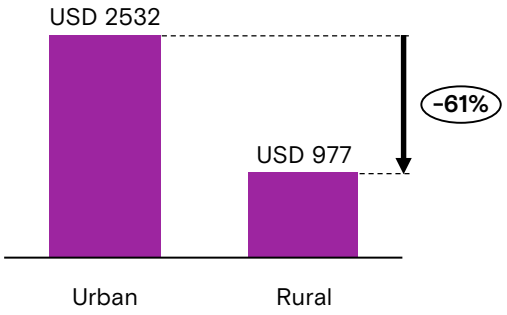
Population distribution in India, and implied density at edges of mobile network coverage

Source: Facebook analysis of SEDAC data,[33] ITU, GSMA 2014



GDP per capita in rural and urban areas in India[34]

Source: Indian Institute of Management, Ahmedabad, 2014

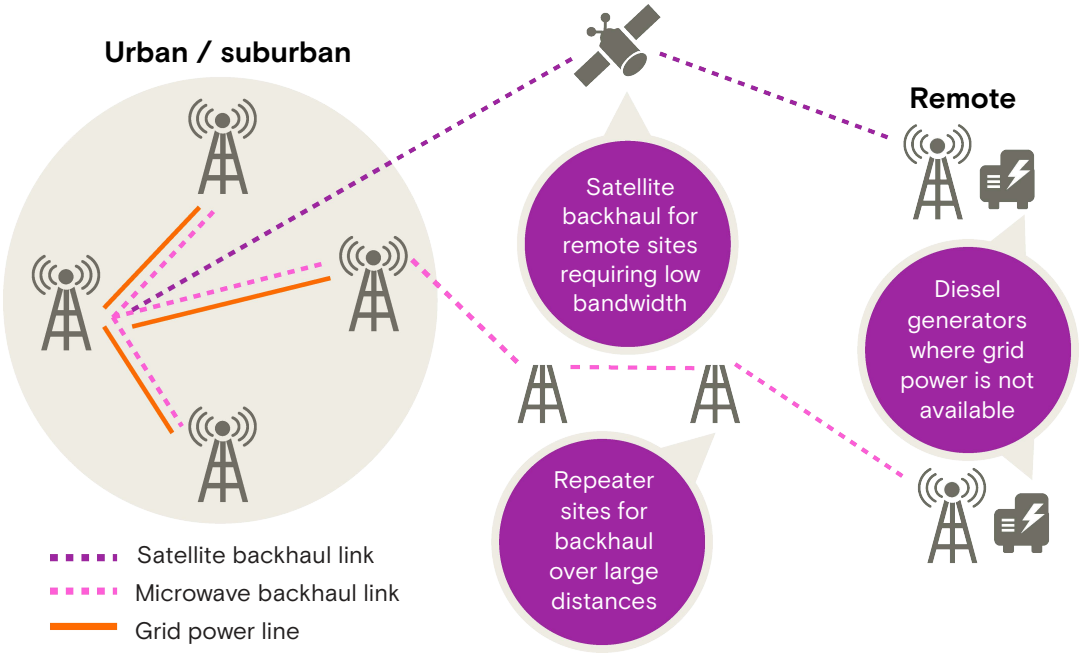


Compounding the problem is the fact that the cost to set up and operate mobile sites in remote, rural areas is significantly higher than in dense, urban ones. Connecting sites to the rest of the network ('backhaul') may require repeater sites to relay wireless signals

over large distances. The supply of electrical power is also expensive, as extending grid power is often not economically viable, and diesel generators or solar power solutions are therefore needed.

Typical mobile network architecture

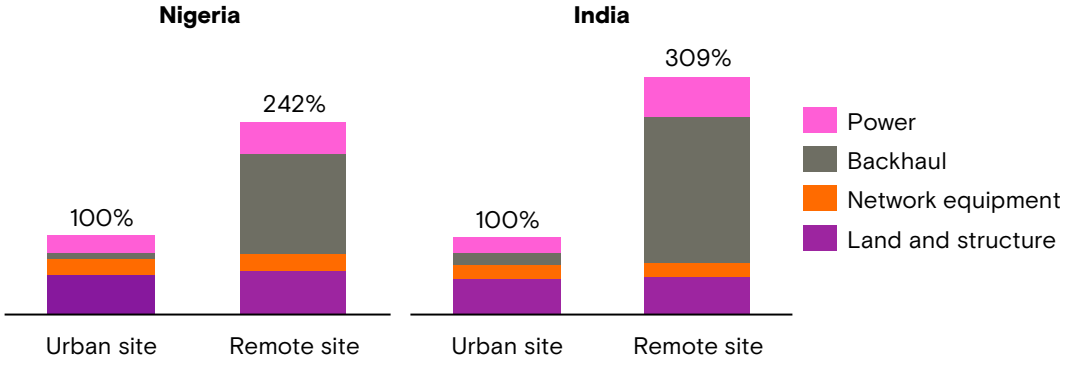
Source: Analysys Mason, 2015



The total cost (up-front and running costs) of remote rural sites is therefore typically two to three times higher than urban sites, as illustrated below for Nigeria and India.[35] These high costs mean that it is often not economically feasible to deploy traditional mobile sites in sparsely populated areas where there are fewer potential customers to use the network.

Comparative cost structures for urban and remote rural sites in India and Nigeria

Source: Analysys Mason 2015; figures are for a typical multi-technology site mounted on a 50m lattice tower, annualized and normalized to the cost of an urban site, which differs between countries. Explanatory notes provided in Annex B.



Private- and public-sector organizations and NGOs are developing innovative solutions to help extend the reach of broadband networks

Current technology is unlikely to address the availability gap, but innovative technology and business models may be able to significantly accelerate progress. If it is to be widely adopted, any new technology must be cost-effective and reliable.

Private companies, including operators, technology companies, network vendors and investors, will all need to play a role in the investment and innovation required to achieve costs savings for rural network deployments, including those related to:

Power: Diesel generators remain the main source of electricity for mobile networks in the many areas where commercial 'grid' power is not available. They are expensive to run and maintain, despite significant improvement in the energy efficiency of network equipment. Alternative technologies and renewable energy solutions (e.g. solar) can provide substantial cost savings over time, but their take-up by operators has been limited by relatively high up-front cost and by the high power requirements of traditional mobile equipment. The outlook for solar is progressively improving however:

- The cost of solar modules has fallen 75% since 2009, and is expected to fall by a further 40% by the end of 2017.[36]
- Initiatives such as the UN's Sustainable Energy for All, the GSMA's Green Power for Mobile, and the recently-formed Breakthrough Energy Coalition are focusing on bringing costs down further.
- Innovation has already significantly increased the power efficiency of mobile network equipment, but more improvement is needed to make solar power viable for all site types.

Backhaul: Rural sites are typically connected to the rest of the network using wireless microwave links. These have limited range so reaching remote locations requires repeater sites with very high up-front costs. Satellite technology is widely used as an alternative, but current generation satellites offer fairly limited capacity at high ongoing connectivity costs. Companies are working on alternative solutions to lower backhaul costs for remote sites and communities, including:

- Unmanned aerial vehicles ('drones') – Facebook and Alphabet (formerly Google)

- Balloons – Alphabet (discussed below)
- Low/medium-earth orbit satellites – OneWeb, O3B, SpaceX, LeoSat
- High-throughput geostationary satellites – Eutelsat, Intelsat, Avanti

Land and structures: Current mobile networks are largely based on large steel towers that are expensive to build. Innovative backhaul solutions enable use of smaller sites to offer targeted coverage at a much lower cost than with a standard land-based tower. These can be an extension of the mobile networks, or use other technologies such as Wi-Fi. For example, Facebook's Express Wi-Fi initiative is providing internet access to rural communities using antennas mounted on village rooftops.[37] Other innovations, such as Alphabet's Project Loon, are working towards providing a scalable alternative to land-based structures in low-density areas.[38]

Alphabet (formerly Google) is using stratospheric balloons to extend broadband coverage

The balloons travel at an altitude of 20km to provide mobile connectivity using solar-powered equipment. Each balloon can provide 4G connectivity to a ground area of about 5000km^2 (80km in diameter), and is able to stay airborne for around 100 days.

Loon is operated in partnership with telecommunication operators using their 4G mobile spectrum. The mobile signals are relayed from cell sites on the ground between balloons, and finally direct to the mobile device of the end-user, who can be thousands of kilometers from the nearest ground-based cell tower.

Project Loon could enable remote communities to get online, even though they cannot be covered economically by traditional mobile networks,

The technology behind this project is highly innovative. Being in the stratosphere, the balloons are able to avoid adverse weather conditions and aircraft. Software is used to navigate the balloons by joining appropriate wind currents at different altitudes. This approach enables many balloons to be maneuvered to cover areas with no existing mobile coverage. Loon's first operational pilot testing began in New Zealand in 2013 (30 balloons). Subsequent tests have been held in California, and in Brazil where the balloons were able to provide internet connectivity to children in a rural school for the first time, and the Indian government has approved testing as well.[39]

Project Loon's first national agreement was signed in July 2015 with the Sri Lankan government,[40] and launch is planned in Indonesia in 2016, in partnership with three mobile operators, hoping to cover more than 100 million new people.[41]

Governments, regulators and policy-makers also play a significant role in extending broadband availability by designing the right incentives for private-sector operators, or funding supply directly in some cases. Public policy and regulation play an enabling role, by ensuring that resources (e.g. radio spectrum) are available, and creating a business environment conducive to investment. More focused interventions are often part of national broadband plans (NBPs), which coordinate the efforts of the public and private sector to improve the supply and take-up of broadband services. NBPs can be applied to extend the availability of infrastructure, improve broadband speed and service quality, and to promote innovation, competition and affordability in the interest of consumers.

NBPs can be planned and implemented more effectively if they are based on rich, accurate, up-to-date information. Coordination of industry stakeholders can improve the availability of data and support the derivation of deeper insights into the state of connectivity and its constituent barriers. This will enable policy makers to design and execute more effective NBPs, by: better understanding the nature of connectivity gaps; benchmarking and assessing what policies have worked elsewhere; appraising intervention options on an informed basis; monitoring interventions more effectively; and enabling more adaptable and responsive NBPs.

National broadband plans supported by rich data are essential for effective policy intervention

NBPs can include a wide range of policy instruments, such as:

- Setting coverage obligations or providing incentives as part of spectrum / license award processes
- Subsidizing or investing directly in infrastructure using public funds
- Policies to reduce time and cost of deploying infrastructure e.g. through planning approvals, infrastructure sharing, or taxation policy
- Demand stimulation activities to raise awareness and educate potential users, improving the investment case for operators to extend coverage
- Policy as an enabler of innovation (e.g. aviation and spectrum policy)
- Appropriate levels of tax on devices and services to improve affordability.

According to the Broadband Commission, 148 countries had some form of NBP in place by mid-2015.[42] They vary widely in scope, ambition, timescales, detail and level of government commitment. Many NBP's were written a number of years ago, and unless regularly refreshed they can be outdated in relation to the fast-moving telecoms industry. Governments' capacity constraints can often limit their ability to implement NBPs.

In the developed world, most policy makers are focusing on high-speed broadband. Universal service commitments and obligations are being modernized to ensure a minimum level of broadband access is available to all citizens. This often involves public funding to enable deployment in rural areas where there is no commercial rollout.

In the developing world, government funding is often much more scarce and there is less opportunity to raise funds through taxation. Universal service funds raised from operators' revenue are common however, but they are often not used transparently or effectively.[43]

Rich data to assess coverage gaps is essential to drive innovation, investments and policy to support increased availability

International organizations and governments, under the aegis of the ITU, have long championed efforts to collect and publish globally harmonized ICT indicators, including the 2G and 3G population coverage statistics shown in this report. As illustrated by the extensive use of these statistics in the annual Broadband Commission reports,[44] these indicators are already helping to inform other initiatives, including NBPs. In addition, the ITU is working closely with operators to develop the Interactive Transmission Map.[45]

In the ITU's words, these efforts to make data available broadly aim to help industry "assess market opportunities, thus serving as a management tool for making investment decisions, promoting broadband and achieving universal connectivity" and policymakers to "assess the status of national connectivity and to identify gaps enabling the design of targeted strategies and implementation programs for increasing the use of broadband."[46]

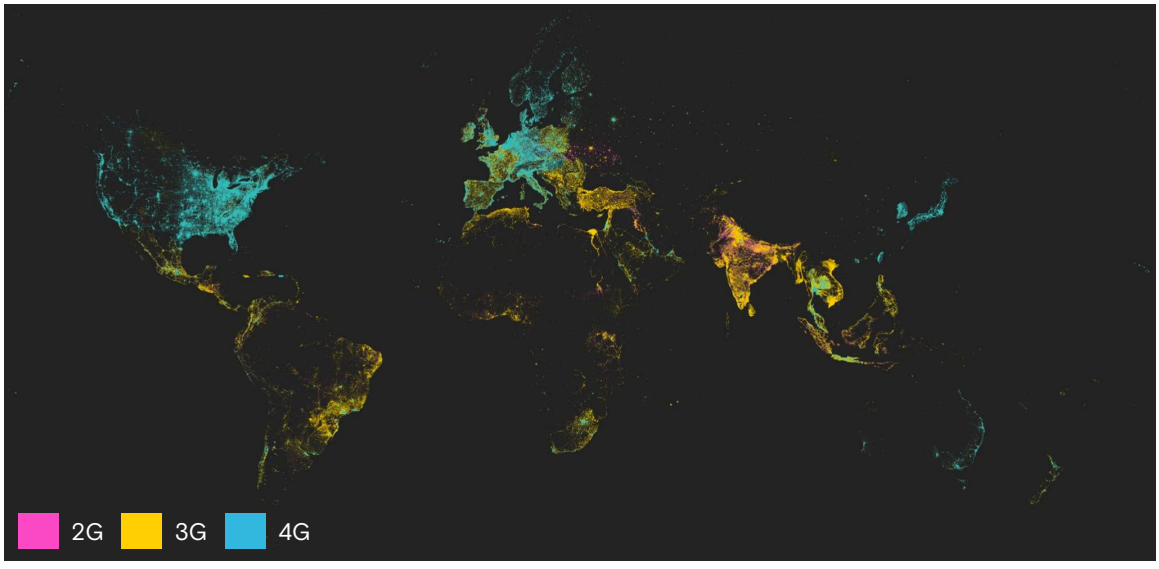
As part of efforts to make more data available, the Connectivity Lab at Facebook initiated an interdisciplinary project together with the Facebook Core Data Science, Infrastructure, and Artificial Intelligence (FAIR) teams to gain a deeper understanding of population distributions. These efforts focus on the analysis of existing commercial-grade satellite imagery for 20 countries, many with large unconnected rural areas. The resulting dataset provides the most accurate population distribution estimates to date. Facebook is partnering with the Center for International Earth Science Information Network at Columbia University to validate these maps, and plans to release them to the public in 2016. This data will provide valuable information for any party wishing to develop approaches to improve availability of connectivity, especially in a highly local, targeted way.

In addition, data on how people who use Facebook connect to the internet can provide insight into where mobile broadband coverage is currently available, and where people rely on slower connections. This data is measured and reported in the same way globally, enabling a highly consistent view across borders, which is not possible from many data sources.

This data is global, based on aggregated locations where Facebook is accessed through the Android app. It shows that 3G and 4G networks are now widely available throughout the developed world. Although this data is useful in making comparisons between countries, there are limitations when trying to extrapolate firm insights on network availability: some countries are not well represented, and the data may be biased by the fact that it reflects only a sample of locations where people have used mobile networks to access Facebook.[47]

Most recent generation of mobile network technology used to access the Facebook Android app

Source: Facebook anonymized sample data, November 2015

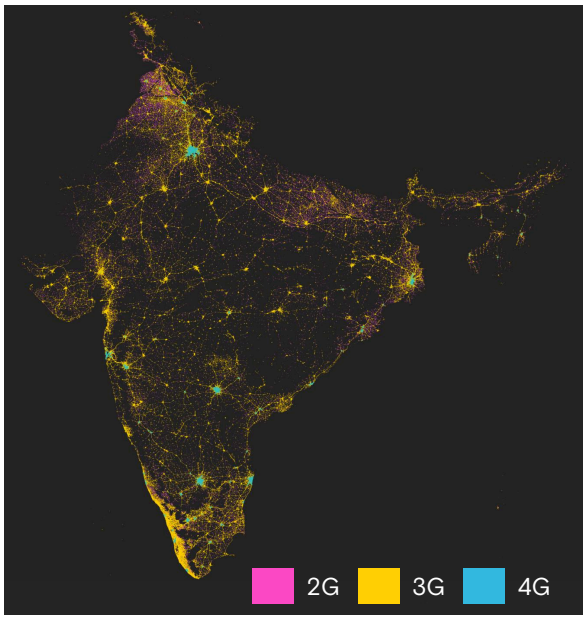


Mobile users do not always use the fastest technology in their area. It is common for 2G mobile networks to be used even in areas where 3G/4G services are available. In some cases, basic devices are not equipped to use 3G or 4G networks; or sometimes an overloaded 3G network forces users onto the 2G network to ease capacity problems. The maps of India below show that while 3G and 4G mobile broadband connectivity is available across most of the country (*Most recent generation technology detected*), many Facebook users connect to the service using 2.5G (especially outside of major cities), and 4G is not commonly used (*Main technology used*).

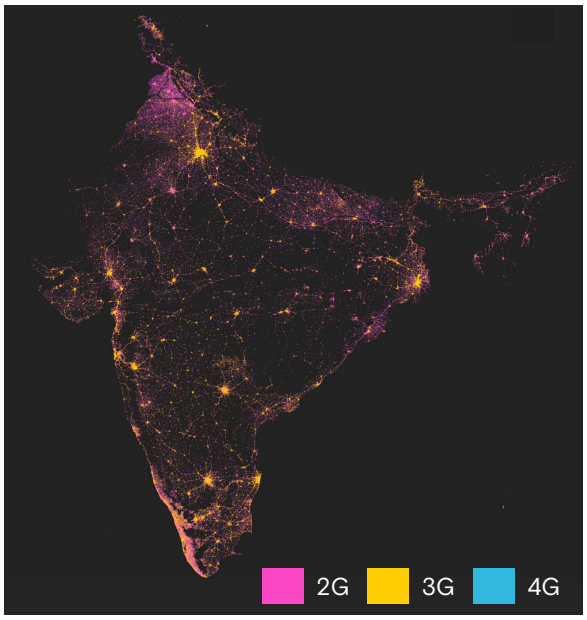
Mobile network technologies used to access the Facebook Android app

Source: Facebook anonymized sample data, November 2015

Most recent generation technology detected



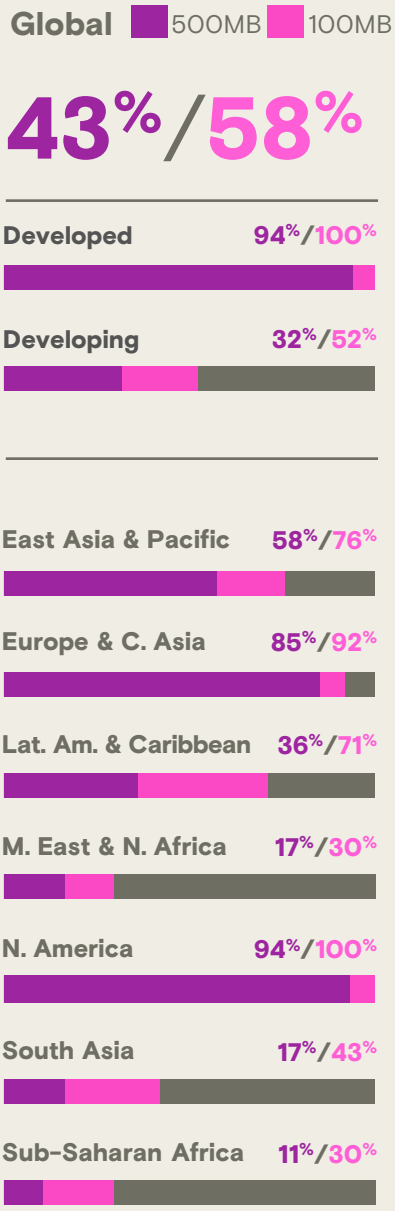
Main technology used



Connecting people who live outside mobile broadband coverage requires accurate information about where they are located and the barriers they face. Cooperation between public- and private-sector organizations is needed to create reliable, up-to-date, and privacy-preserving datasets that can inform the development and deployment of connectivity infrastructure.

Affordability

Percentage of the population who can afford the Internet



Source: Google/ Communications Chambers, Gallup, World Bank

For many people in developing countries, prepaid mobile broadband services are the most affordable way for new users to get online. Affordability depends on three key elements:

- **Income** determines how much people can spend on connectivity. Although mobile internet services are affordable to more and more people, nearly 30% of people in developing countries still live under the poverty line. [48]
- **Data service costs** are a major expense for many people, in addition to their basic mobile service. Increased take-up, technology innovation and competition in developing countries helped prices fall by 12% in 2014, for 500MB of prepaid mobile data.
- **Device and associated costs** add additional expense, for example purchasing and charging a device, as well as basic access to mobile services (in addition to data). These costs are significant for more than 2 billion people who are not yet mobile subscribers.

Understanding income distribution and pricing trends is important to inform the development and expansion of innovative business models, technology and policy solutions to increase affordability. This section proposes a methodology to estimate the number of people within each country who cannot afford internet services. Despite significant improvements during 2014, data plans of at least 500MB per month remained unaffordable for 2 billion people.

Availability of consistent and accurate data is currently limited. Household income data typically relies on surveys, and information on the distribution and regularity of incomes is scarce.[49] Data pricing is published on operators' websites, and is collated in part by the ITU and more recently by a Google-sponsored effort. Despite the limitations of available data, it allows for a global analysis of affordability as discussed in this section.

Connected people in developing markets spend less than 5% of their income on mobile data, supporting commonly-used thresholds

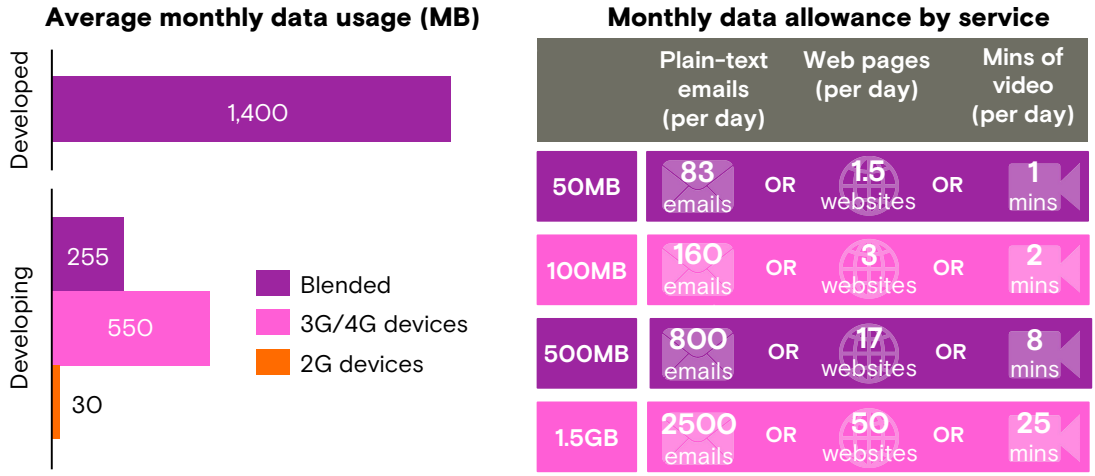
Previous studies on affordability have typically considered 500MB per month as the benchmark for useful levels of connectivity using broadband networks.[50] This is close to the average usage by those using 3G/4G devices in developing countries.

In practice, many existing internet users use less data, which can still allow extensive use of text-based messaging and email, but limited access to rich online content such as video. In some cases this is because they only have access to slow 2G networks which limit their online activity, and in other cases it may be due to affordability constraints.[51]

As shown below, demand in developed countries is typically far higher, reflecting the use of data-heavy services such as video streaming.[52] This is often in addition to fixed-line broadband access and Wi-Fi (for example, total internet usage per capita in South Korea is over 50GB per month over fixed and mobile networks combined[53]).

Average monthly data usage per unique mobile internet user, 2014

Source: Analysys Mason Research (total data traffic), GSMA Intelligence (unique mobile data subscribers), operator data-use calculators[54]



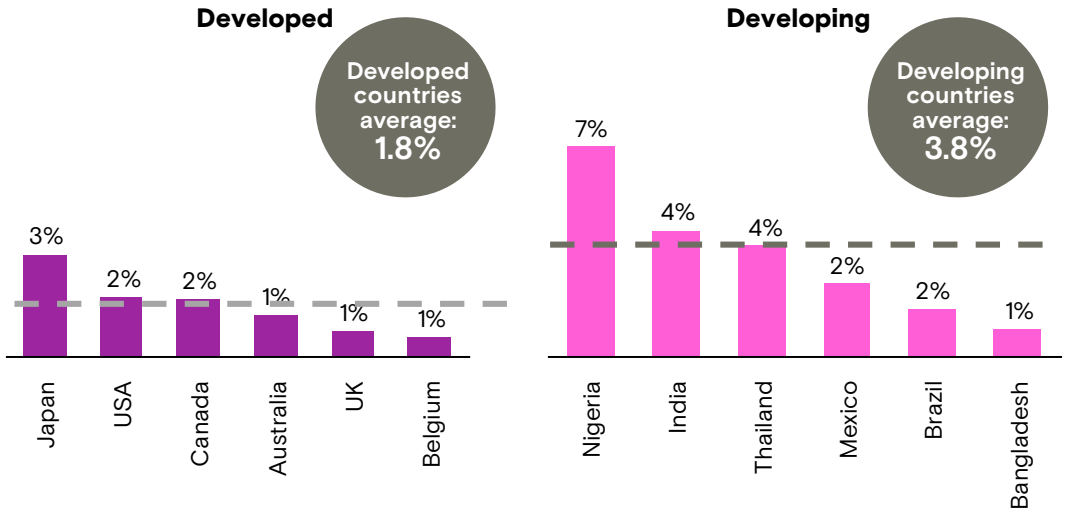
Studies from the Broadband Commission and the ITU consider a broadband service affordable if it accounts for up to no more than 5% of gross national income (GNI) per capita. GNI, however, includes flows of money between businesses, and tends to overstate the amount of money people can actually spend on goods and services,[55] whereas survey-based measures of household income per capita provide a more accurate basis on which to assess affordability.[56]

New analysis for this report has found that in developing markets, people who already use the internet spend on average 3.8% of their household income per capita on mobile data

services. This is over twice the proportion in developed countries, which have much higher internet penetration and usage, but appears to validate the commonly-used affordability threshold of 5% of average income.

Average expenditure on mobile internet as a proportion of household income

Source: Analysys Mason for Facebook, using data from GSMA Intelligence, Analysys Mason Research, Gallup World Poll, World Bank[57]



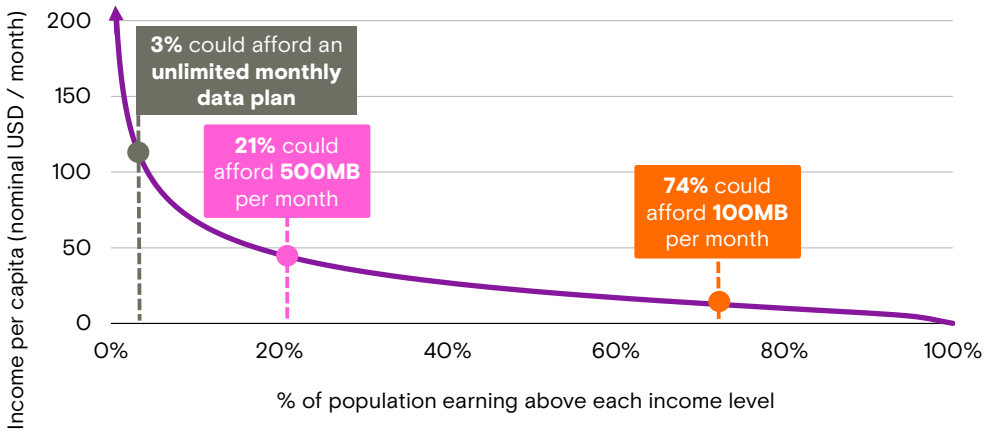
This analysis does not account for all the variables that affect affordability, but it enables an approximation of the percentage of people who can reasonably afford internet services. It is clear that in developing countries, connectivity remains unaffordable for many people. More granular data on incomes and purchasing decisions could enable a better understanding of how affordability thresholds vary within national populations, especially for those with very low incomes.

Lower prices and rising incomes have made the internet affordable to 500 million more people in 2015

Examining average income in a country is useful for making international comparisons, but does not account for the large variations in affordability within a nation's population due to income inequality. Therefore, it is also important to consider the distribution of incomes. The example of Kenya below shows that 500MB per month services are affordable for 21% of the population (i.e. service price is at most 5% of income).

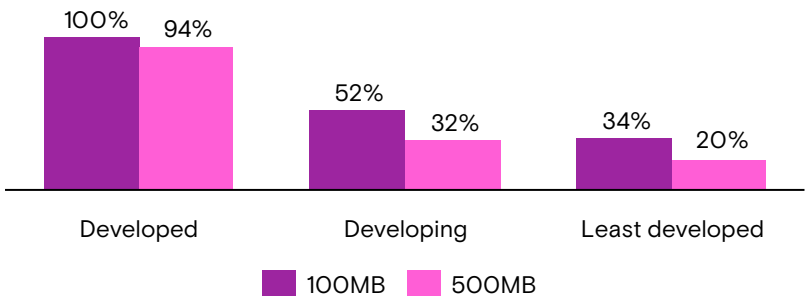
Comparing affordability in Kenya in 2014 at 5% of household income per capita

Source: Analysys Mason for Facebook, data from Google/Communications Chambers, Gallup World Poll, World Bank



Comparing Kenya (three major mobile operators) with neighboring Ethiopia (one mobile operator) suggests that healthy competition plays an important role in delivering prices that more people can afford. In Ethiopia 500MB of data costs four times more than in Kenya and is affordable for almost no one in the country, compared to 21% of the population in Kenya.[58]

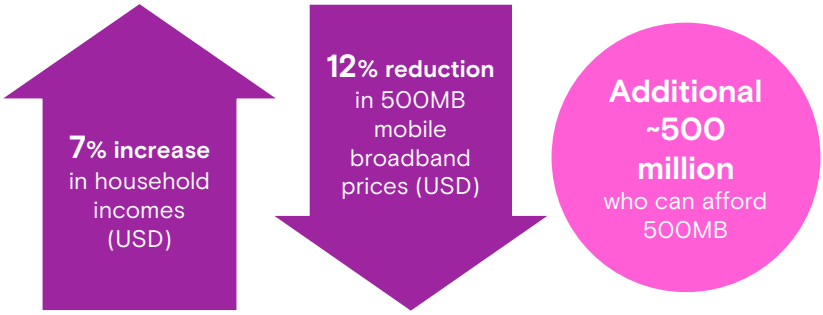
By considering income distributions and mobile data prices globally, this section estimates that a monthly allowance of 500MB of mobile data is affordable for over 90% of people in developed countries, but only one third of those in developing markets. Even basic data packages that offer 100MB of data use per month are affordable for just over half of the people in developing economies.



Affordability of prepaid mobile data services (% of population)

Source: Analysys Mason, Gallup, World Bank, ITU, Google/Communications Chambers Global Broadband Pricing Study

Significant and rapid progress is being made, however. Rising incomes and falling prices have improved affordability and fueled growth. As a result, over the course of 2014, 500MB data packages became affordable for almost 500 million more people in the developing world.



Changes in affordability in developing markets December 2013 – December 2014[59]

Source: Analysys Mason for Facebook, data from Gallup, Google/ Communications Chambers Global Broadband Pricing Study, ITU, World Bank

Prices have fallen considerably between the end of 2013 and the end of 2014 in many markets: by 64% in Bangladesh, around 35% in Thailand and Tanzania, and 25% in China and the Philippines. Further details of price changes, in the 20 countries with the largest unconnected populations, are provided in Annex A.

The costs of getting online are far greater for the 2.7 billion people who do not have mobile phone subscriptions

There are more active mobile subscriptions than there are people in the world,[60] however many people have multiple subscriptions. The GSMA estimates that there were 4.6 billion unique mobile subscribers in 2015, leaving 2.7 billion people without their own mobile subscription and device.[61]

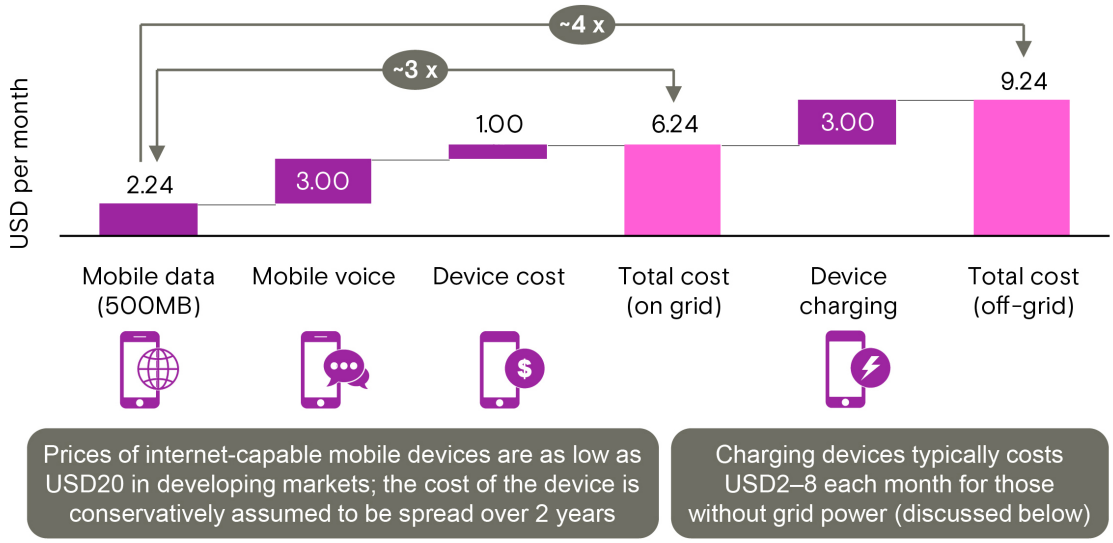
Many people will have access to mobile phones through friends and family: the World Bank estimates that 5.2 billion people have access to a mobile phone,[62] and Gallup World Poll data suggests that 90% of people live in a household where at least one person has a mobile phone.[63] Many of these, however, are not mobile subscribers themselves and will have only intermittent access to a mobile phone.

For mobile phone users, the main additional cost of getting online involves purchasing a mobile data 'add-on'.[64] For those who are not yet mobile users, including many of the world's poorest people, the incremental costs of connecting are higher: in addition to mobile data 'add-ons', they must be able to afford the costs of purchasing and charging an internet-capable device and paying for other mobile services such as connection costs, and some voice and text message usage.

In the developing world, these additional expenses can triple the overall cost for consumers, compared to mobile data alone. The example of Kenya, where mobile services were being used by just 42% of people at the end of 2014, clearly shows that bringing connectivity to non-mobile users at the bottom end of the income scale will require substantial changes in pricing and incomes.

Costs of getting online in Kenya

Source: Analysys Mason for Facebook, data from Google/Communications Chambers Global Broadband Pricing Study, Gallup World Poll, GSMA Intelligence, Analysys Mason Research



At over USD6 per month, the cost of 500MB per month mobile connectivity (excluding device battery charging) is over 30% of the median income in Kenya (USD21 per month).[65] For the poorest 10% of people, it is equivalent to their entire income (less than USD7 per month).[66]

Charging internet-enabled devices can be expensive for people without grid power

At least 1.1 billion people currently lack access to grid electricity, and for a further 1 billion people, electricity networks are unreliable.[67]

For these people, the cost of charging devices (in particular smartphones with larger screens and broadband capabilities) is significant. This can act as a barrier to internet connectivity: a survey in Kenya indicated that 45% of non-mobile users cited a lack of access to electricity at home as one of the reasons for not owning a phone.[68]

In much of Africa, users typically pay USD2–8 each month at charge shops (higher for smartphones).[69] This is in stark contrast to people living in developed countries with electricity delivered through the grid, where charging a phone costs USD0.25 per year.[70]

There is also a time cost: it is not unusual for users in Africa to need to travel 10–15km per week to the nearest charge shop.[71]

For those without grid power, household energy access can be provided through renewables (mini-solar, -wind, or -hydro) or diesel generators. The former require a significant up-front investment. The latter have a high cost of operation, in addition to negative impacts on health and the environment.

An emerging model in developing countries involves asset finance or pay-as-you-go charging for solar power systems. These typically cost between USD7 and USD15 per month for a system which supplies enough power for smartphone charging as well as two or three light points, and basic appliances such as radios.[72] These prices should reduce over time as equipment costs continue to fall and suppliers reach greater scale.

A viable opportunity exists for telecommunications and internet companies to support electrification in developing markets. They can invest in the energy sector by providing capital to help companies grow, or collaborate in distribution and marketing. For example, MTN in Uganda has partnered with energy company Fenix to provide affordable pay-as-you-go solar systems for basic household energy access including mobile charging.[73]

These efforts can be mutually beneficial, as having access to free or low-cost electricity typically increases mobile ARPU[74] by 10–14%, as users transfer some of the costs of travel and charging to additional airtime purchases.[75]

Technology and business model innovations, enabled by better data on income and prices, are essential to improving affordability

The affordability picture can be improved by price reductions that stem from greater scale and technology advancements, in addition to innovations in mobile data pricing structures. The introduction of prepaid tariffs has already made mobile services more affordable by providing greater transparency in prices and more flexibility on spending patterns.[76] Relatively new tariff structures such as zero-rating could also contribute to lowering affordability barriers further.

Tariff innovation can improve affordability by providing more flexible ways to pay for data services

As shown for the Philippines below, innovative pricing can help users control mobile expenditure. Some operators have already begun to offer mobile broadband packages with a fixed number of browsing hours.

People on very low incomes may be unable or unwilling to commit to a set level of mobile expenditure every month. Those living at or near poverty face unpredictability in everyday life, and are often unable to foresee their income even from one week to the next.[77] Mobile data that is packaged in smaller increments on a prepaid basis are therefore likely to be the only way for some individuals to connect to the internet each month, even if it is more expensive on a per-MB basis. Further tariff and marketing innovation will be required to improve the balance between affordability for more users and sufficient returns on incremental investments for suppliers; promotional activities such as temporary free access can also play a role in fostering willingness to pay for internet connectivity.

Mobile broadband tariffs in the Philippines illustrating the trade-off between a shorter commitment and a higher unit cost

Source: Google/Communications Chambers Global Broadband Pricing Study

	MONTHLY		DAILY			1.5 HOURS
Volume	700MB	100MB	Unlimited	100MB	5MB	Unlimited
Price (USD)	6.65	2.20	1.11	0.44	0.22	0.33
Price per MB (USD cents)	0.95	2.20	n/a	0.44	4.40	n/a

The public sector has a role to play in enabling further innovation, and can also directly impact affordability through appropriate taxation, to minimize the affordability impact of taxes and encourage greater adoption.[78]

Even with further tariff innovation, the cost of owning a personal device and accessing mobile internet services is likely to remain unaffordable for many individuals. Cost reductions for operators based on technology innovations may enable them to reduce prices on a sustainable basis.

In addition, models involving family or community connectivity can play a role in extending affordability, by enabling consumers to share service and device costs, as well as pooling skills to help each other get online. These models do not provide the same level of empowerment and connectivity as a personal connection would, but may offer people the opportunity to experience internet services and gain an appreciation of the internet's value.

Microsoft's low-cost technology is enabling affordable internet access through community Wi-Fi

Microsoft is trialing innovative technology solutions to provide wireless hotspots which can be shared by rural communities, providing low-cost Wi-Fi internet access.[79]

One of the first hotspots, opened in November 2013, is found in a solar-powered shipping container converted into a shop, located almost 20km outside of the town of Nanyuki in rural Kenya. The shop provides not only access to the internet, but also use of devices/computers, a charging service and digital expertise or guidance to those who need it.[80]

Customers can access 15Mbit/s internet and charge their devices for a total of USD3 per month.[81] As customers can charge mobiles phones or use the computers on site, this reduces cost barriers further especially for those who do not own mobile phones.

Since the initial launch in Nanyuki, the internet has had a significant impact on the community: one of the agents stated that "having access to internet and technology is life-changing – and it's the way to alleviate poverty".[82] The project went on to introduce 15 Wi-Fi hotspots in Kenya, including at schools, libraries, pharmacies and shopping centers.[83]

Microsoft has since partnered with internet service providers to pilot a total of 14 similar projects to communities on five continents. As of June 2015, low-cost internet was provided to 36,000 school students and 58,000 university students in Africa, as well as both remote communities and urban centers.[84]

In September 2015, Microsoft announced plans to serve 500,000 villages in India with low-cost broadband services,[85] after successful trials in the state of Andhra Pradesh[86].

Innovations that have the potential to significantly improve affordability, particularly at the bottom of the income distribution, are by nature risky. Given the very low amounts of money that individuals can commit, operators and other innovators must carefully plan and implement new tariffs or business models, to balance effectiveness with financial sustainability.

Consistent data on incomes, income distribution, spending patterns and prices will assist this planning process and reduce risks. Such data, when available and analyzed rigorously over time, can also provide very valuable insight on the impact of specific initiatives or market conditions on affordability.

Relevance

Percentage of the population who have access to encyclopedic knowledge online

Global — Primary language / Primary & secondary

58%/67%

Developed	93%/94%
Developing	50%/60%
East Asia & Pacific	70%/80%
Europe & C. Asia	89%/90%
Lat. Am. & Caribbean	92%/96%
M. East & N. Africa	85%/88%
N. America	97%/97%
South Asia	19%/28%
Sub-Saharan Africa	4%/27%

Source: Ethnologue, Wikipedia

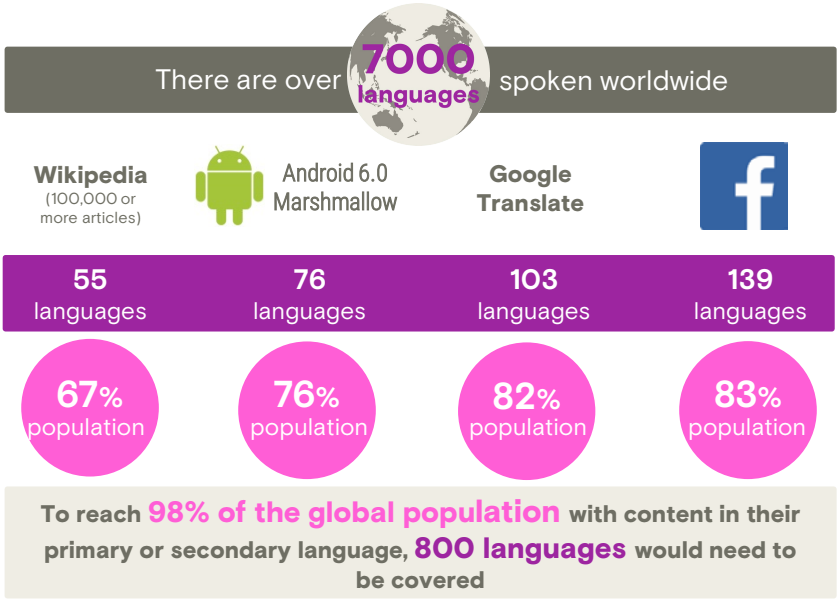
Right-hand side: Analysys Mason based on data from Wikipedia, Google and Facebook; Android is a trademark from Google, Inc.

For internet content and services to be relevant to people, they must be:

- **Useful:** content and services must bring value to people, economically or otherwise.
- **Relatable:** content must be compatible with individuals' interests and culture, and services must meet local needs.
- **Accessible:** beyond word-of-mouth, advertising and promotion, platforms and devices must enable people to find relevant content and share it easily.[87]

All three of these requirements are underpinned by the need for content and services to be available in the languages people speak. This report examines the availability of online content across global languages, and the impact of language support on take-up of applications.[88] This section advances this discussion by also considering the impact of people's fluency in secondary languages.

Beyond language, there is currently no harmonized way of assessing the relevance of the internet, particularly for people who are not yet connected. Better data on what drives adoption and usage of the internet, and how this varies across markets, would enable more efficient design of content and services that are attractive to new users.



The internet is deeply relevant to people who use it, but there is a lack of content in the language of many unconnected people

The benefits the internet provides to individuals and communities depend on the availability of content and services. Some of these categories focus on 'consumable content', such as books, news, and videos. Others provide services, such as local information, financial applications, messaging and communications, business and productivity, e-commerce, health, and many others. Content and services are often organized and delivered through platforms, which bring together buyers and sellers (e.g. Uber, eBay), or simply people who want to communicate with one another (e.g. messaging apps, social media).

The internet can be immensely **useful**, but this is best understood through the experience of using it, or seeing it used first-hand by friends or family.[89] For example, a migrant worker in Singapore using online video calling to keep in touch with her family in Indonesia helps her relatives understand the value of the internet. This sort of experience, shared between people with a social, cultural, and linguistic connection, helps people to **relate** to online content and services.

Online content must be **accessible**, for example through app stores, search engines or promotions by operators. Whilst the reach and sophistication of advertising in many developing countries remains limited,[90] cross-promotion of content and services by operators is becoming more common. App stores from Apple and Google are now available in 155 and 136 countries respectively, in about 50 languages, and Google Search is available in 149 languages and localized sites.[91]

Language is a common requirement: in order to be relevant, the internet needs to be accessible to people and therefore delivered in a language they understand. Over 7,000 languages are spoken around the world,[92] but just ten languages account for 89% of websites (56% are in English).[93] As with the other barriers to connectivity, developing countries are most severely affected by the lack of local language content, which both results from and contributes to lower connectivity.[94,95]

Online translation tools can help people discover and access content and services in other languages. One of the most developed translation tools, Google Translate, currently supports 103 languages. This represents languages spoken by 82% of the world's population;[96] however it is unavailable in the minority languages which have the least native content online. Furthermore, relying heavily on these tools diminishes one's online experience, since they require users to take additional steps and the quality of the output is still variable.

Secondary language skills enable more people to get online, but 2 billion people still do not have access to sufficient online content

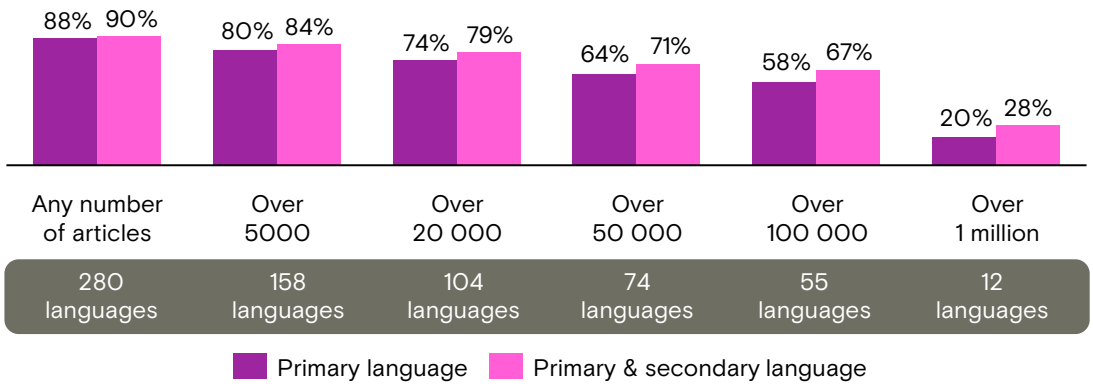
The State of Connectivity 2014 report highlighted the lack of content in many languages. 'Encyclopedic knowledge' was used as a gauge for the critical mass of content available online in a given language, and was defined based on the breadth of content in the English version of the online Encyclopaedia Britannica, over 100,000 articles.

Wikipedia provides a useful benchmark for such 'encyclopedic' online content, even though it does not fully reflect the broader availability of relevant content on the internet. It is available in 280 languages, but many of these have a limited number of articles. There are 55 languages with more than 100,000 articles (up from 52 last year), and these represent the mother tongue of over 4 billion people (58% of the world's population).

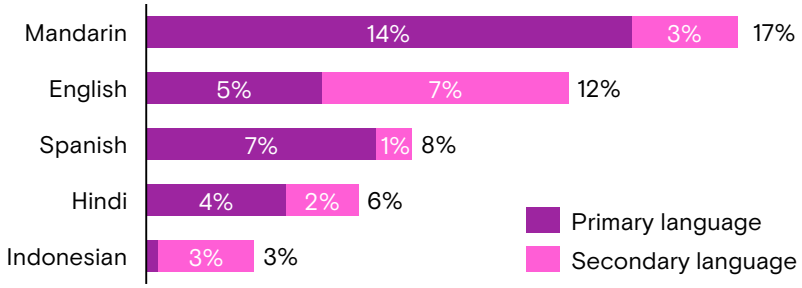
Statistics are increasingly being collected on secondary languages. This provides valuable additional insights for countries where there is a shared national language, or where linguistic diversity is moderated by fluency in a second language (for example, many people in India speak Hindi or English fluently as a second language). Applying this new data to Wikipedia, 67% of people in the world have access to encyclopedic content in their primary or secondary language, 9 percentage points higher than considering only primary languages (see methodology Annex B for details).[97]

Global population covered by number of Wikipedia articles in their primary and secondary language

Source: Analysys Mason for Facebook, using data from Ethnologue 19th Edition (2015), Wikipedia (2015)



It is clear that, for the many people whose primary language is not well represented online, skills in a secondary language can open up access to much richer content, although in many cases it is not a good substitute for native language content. Looking at five of the major languages in the world (Mandarin, Spanish, English, Hindi and Bahasa Indonesia) the data suggests that secondary language skills bring the reach of these languages from 30% of the world's population to over 45%, an increase of over a billion people.



Percentage of the global population who speak one of the main languages spoken in the world

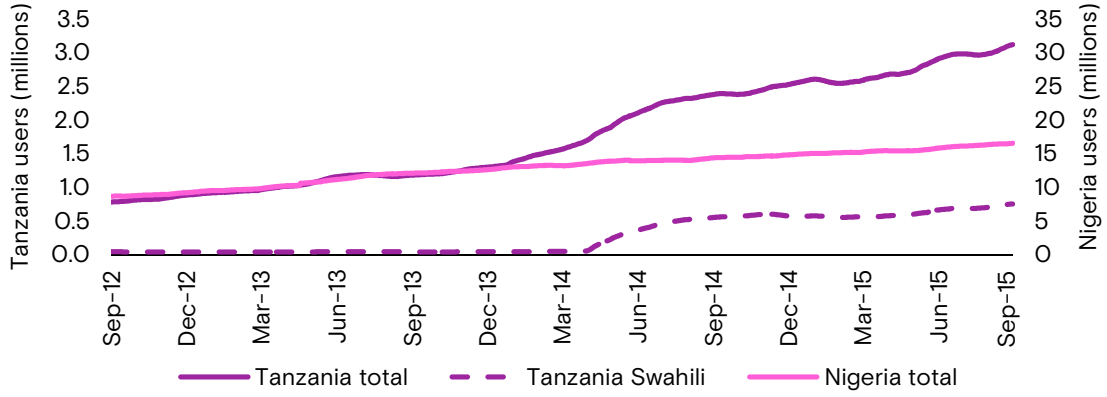
Source: Analysys Mason for Facebook, using data from Ethnologue 19th Edition (2015)

Platforms can drive content creation and consumption if local languages are well supported by devices and software

Platforms facilitate the creation and consumption of content, without necessarily creating this content themselves. They can play an especially powerful role if successfully localized. This is visible in the impact the introduction of a Swahili user interface into Facebook in Tanzania (where 98% of the population speaks Swahili and only 8% speak English)[98] in early 2014. Whilst adoption (measured as monthly active users) had previously followed broadly the same trend as Nigeria (where local language interfaces are not yet launched), it increased significantly when Swahili was introduced.

Impact of launch of Swahili language user interface on people using Facebook

Source: Facebook, 2015



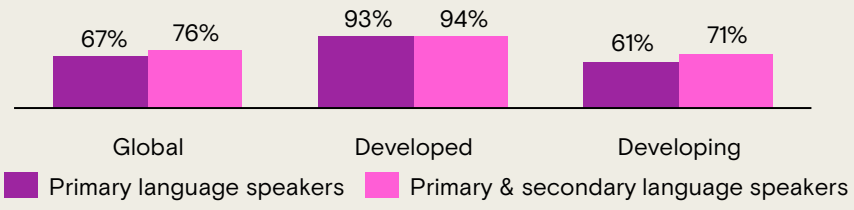
The requirement to support local languages is central to the ability to interact with the internet and access or create content. Even if platforms, content and services are available in their language, people can only use them if their devices are set up to use and display this language. Unfortunately, many local languages and scripts remain unsupported, limiting the potential for content discovery, consumption and creation online. This is a major barrier even for people with digital skills, including those with the potential to be the creators of relevant content.

Devices and OS must support local languages to be effective gateways to the internet

Android is leading the market in terms of language and script support, and the latest version supports 76 languages and dialects based on 19 core scripts.[99] These languages are spoken as a primary language by 67% of the world's population, 14% as a secondary language.

Not all devices and operating systems support as wide a range of languages as Android, and the prevalence of older or second-hand devices in many developing markets can make it less likely that a user's primary language (and script) is supported.

With the necessary technical skills it may be possible to resolve these issues by downloading software updates or third-party keyboard apps, but not all devices will support these changes.



Population with access to languages supported by Google Android 6.0

Source: Analysys Mason for Facebook, using data from Ethnologue 19th Edition (2015), Android

Relevant content can help increase connectivity, but more can be done to understand and improve relevance for the unconnected

Myanmar provides an interesting case study for how connectivity can grow quickly when multiple factors are being addressed in a coherent way. Internet penetration is reported to have risen from less than 2% in 2012,[100] to reach 35% of individuals in 2015, far above the LDC average of 10%. Over 80% of mobile users now own smartphones,[101] and Telenor is predicting internet penetration will reach 60% by 2016.[102]

The widespread availability of 3G networks, with prices affordable to a large number of people thanks to competition, has been essential in driving internet use since late 2014. Highly local, relevant content can flourish if it is directly relatable to people, as illustrated by the internet's role in the recent 2015 elections, and further support connectivity.

The internet supported a resurgent democratic process in the 2015 elections in Myanmar

Political engagement surrounding the election illustrates how people use the internet in ways that are deeply relevant to their lives, with social media sites such as Facebook and local provider MySQUAR playing a key role in the election.

These sites, as well as a locally-developed election app MVoter2015, became the core platforms for party leaders to post updates and share videos of political debates.[103] As well as providing a rich source of information, social media and messaging platforms provide a means by which citizens can communicate outside of government surveillance. The internet also provides an alternative to state-controlled media outlets, allowing people to access news and content not subject to government censorship.

With almost three quarters of the population speaking Burmese as a primary language,[104] Myanmar's internet users are demanding localized content and services in the zawgyi font, in which the Burmese language is written. Google's Burmese search engine gained significantly greater traction once it supported zawgyi.[105]

In Myanmar and throughout the world, messaging applications provide a clear example of how platforms can be highly successful if properly localized. Since there are no content constraints, individuals can generate and consume information that is useful and relevant to them, as long as the interface is available in their language and the service is used by enough people around them. Thanks to these lower constraints, messaging apps have spread rapidly throughout the world. They are now becoming broader platforms, helping more people find content and services that are relevant to them.

Messaging apps are becoming a vehicle for more content to be created and consumed

Communication is a universal need and messaging apps have become hugely popular, as shown by the number of people who engage monthly with many different apps:[106]

- WhatsApp: 1 billion
- Facebook Messenger: 800 million[107]
- Weixin+WeChat: 650 million
- QQ: 860 million
- Line: 212 million[108]
- Viber: 300 million[109]

These apps are used very regularly: many of these companies report daily users at about 70% of monthly users

Although initially adoption was driven to lower prices compared to SMS, messaging apps developed much beyond simple text messaging to become much broader platforms for content sharing, e-commerce, micro-blogging, taxis bookings, and even the delivery of remote education and health.[110]

The popularity of messaging platforms has enabled them to use their scale to expand into new types of content and services.

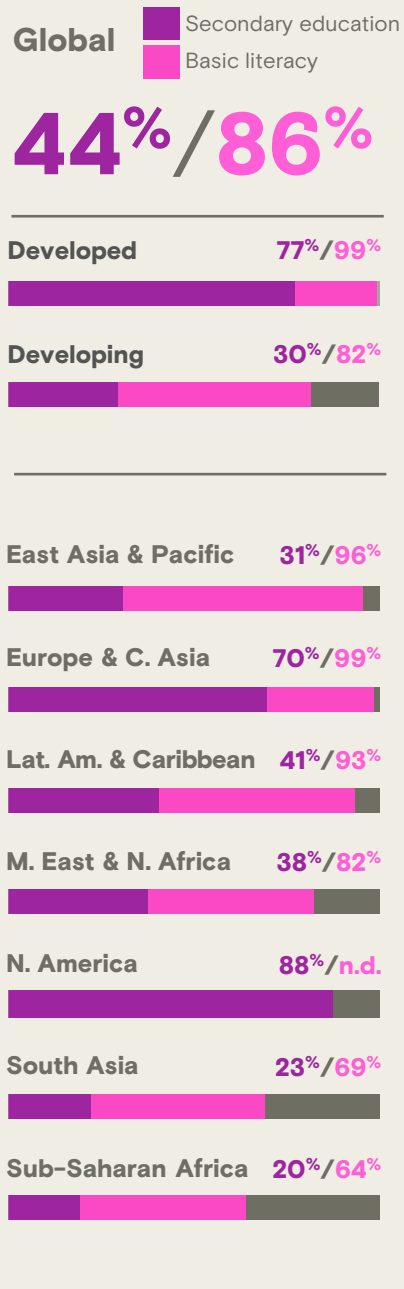
These platforms are attractive for developers and content creators because they reach so many people, and for users they offer a familiar environment and ease of use.

Continued improvement in the range of languages supported by devices and platforms is essential to extend the opportunity for local internet ecosystems to develop. Retailers, entrepreneurs and local communities can all play a part in supporting new users to make sure they can choose the right device, OS and apps that support their language.

As the internet's appeal to each individual is subjective, beyond well-defined aspects such as language, it can be challenging to assess the state and progress of its relevance to people who are not yet connected. Better data on what drives adoption and usage of the internet, and how this varies across markets, would mark significant progress in helping design content and services that can motivate new users to get online. Further data is required on how frequently specific content and services are used by different segments of society, what drives online behaviors to change, and what benefits are delivered to end-users. This data will need to come from a range of sources, and internet companies, content providers, telecoms operators and governments can work together to share information and derive better insights into the internet's potential relevance for the unconnected. These insights can be used to drive initiatives and programs designed to bring more people online.

Readiness

Percentage of the population who are literate and have attended secondary school



Source: UNESCO, 2015
(no literacy data available for North America)

Readiness reflects the ability of people to use the internet. Individuals must be 'ready' to use the internet, which is a function of:

- **Skills** to find and consume content, including language literacy (the ability to read and write) and digital literacy (the ability to use connected devices and the internet)[111]
- **Awareness and understanding** of the internet and the benefits of being online.
- **Cultural or social acceptance** of using the internet. This aspect of readiness particularly affects women, and is linked to attitudes about their education and empowerment.

Readiness barriers affect the demand side of connectivity. Reducing these barriers and stimulating demand is a major focus of National Broadband Plans, and plays a central role in enabling greater supply of networks, content and services. This is particularly important in countries where government funding is limited.

There are no authoritative multi-country statistics on digital literacy, awareness or understanding of the internet. Moreover, it is not currently possible to ascertain how these factors correlate with phone ownership or gender. This report showcases some of the available data, including new survey data linking lack of awareness with lack of connectivity, and quantifying inequalities in connectivity associated with gender.

Better data around these issues will enable more targeted actions to be taken, and outcomes to be monitored. Governments, operators and international organizations all have a role to play in defining and collecting this data, as well as using it to address the readiness barrier.

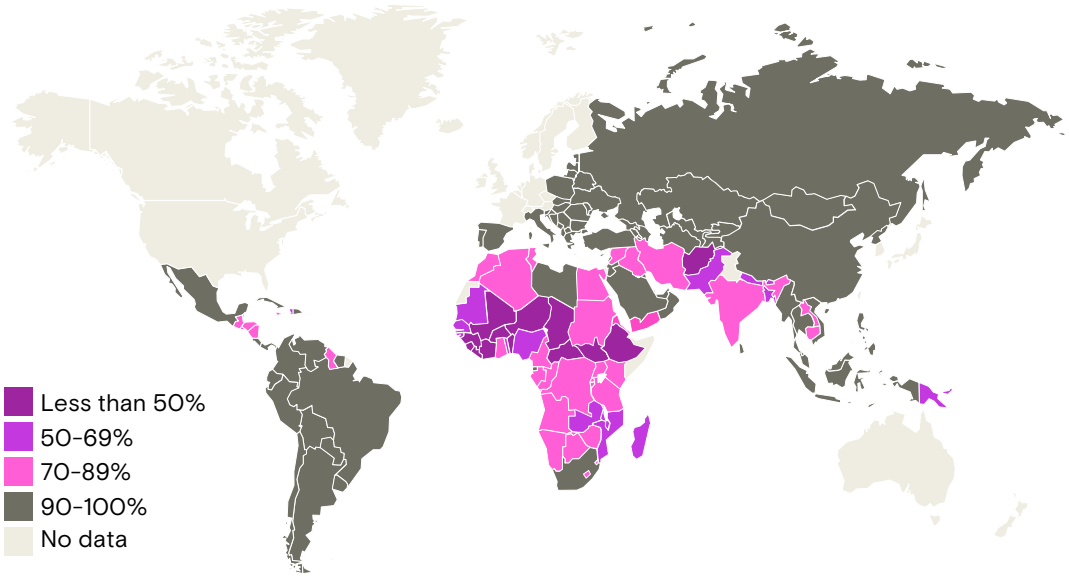
The ability to read and write remains essential to make the most of the internet, which excludes one billion illiterate people

People use the internet to search for and consume many different types of content and services: they access factual information, read articles, watch and listen to video and audio content, communicate with each other, and complete transactions with business partners, merchants or government agencies.

Much of this usage is heavily text-based, however one billion people lack basic literacy skills. Nearly all of these live in developing countries, with over three quarters in South Asia and sub-Saharan Africa.[112]

Adult literacy rates across the world in 2015

Source: UNESCO



Literacy is closely related to the quality and availability of education, which is more limited in developing countries, and especially in rural areas. In South Asia and sub-Saharan Africa, only around 20% of adults have completed secondary school (compared to 44% global average and 30% developing countries average). Education systems take a long time to change and have a visible impact at a national level, resulting in a very gradual growth in the global literacy rate (from 76% to 86%) over the past 25 years.[113]

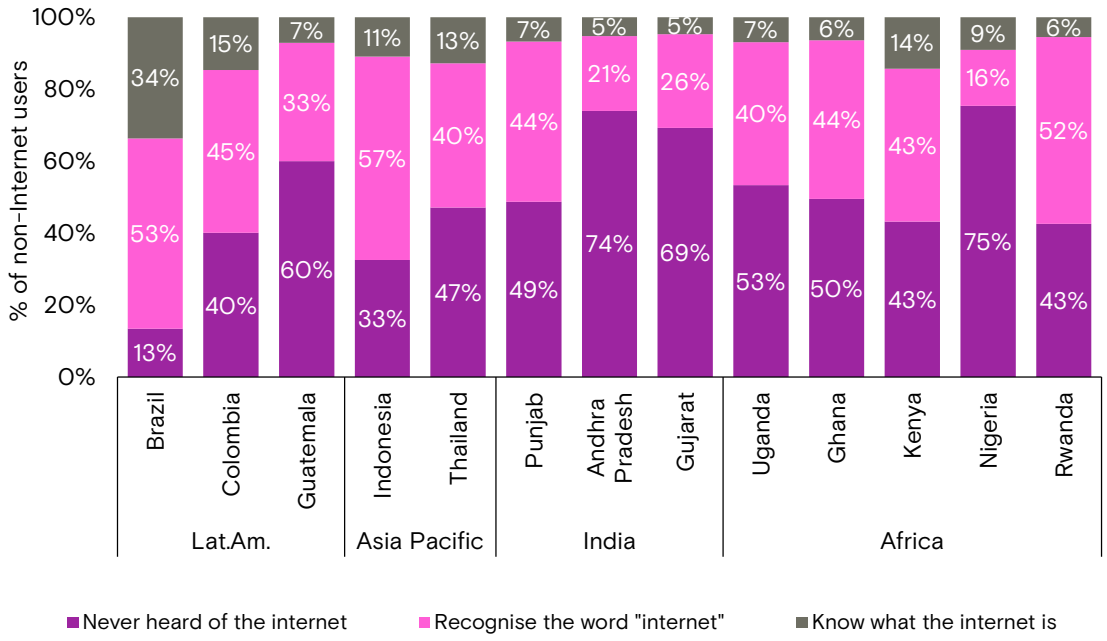
Over two thirds of the unconnected do not understand what the internet is, and many lack the digital skills required to use it

A series of surveys conducted by Facebook in 11 countries (including 42,000 people aged 15 to 64) show that the majority of the unconnected are not aware of the internet: they either do not know what it is at all, or have heard the word but do not know anything else about it.

In Nigeria, for example, 75% of the unconnected had not heard of the word "internet".[114] Even among people who have heard of the internet, levels of understanding are often very low. In all countries except Brazil, less than 15% of unconnected people said they know what the internet is.[115] These findings are supported by research conducted in 2015 by Analysys Mason in Indonesia, Sri Lanka and Thailand, which found that about 70% of a smaller sample of unconnected people mention lack of awareness as a major reason for not connecting to the internet.[116]

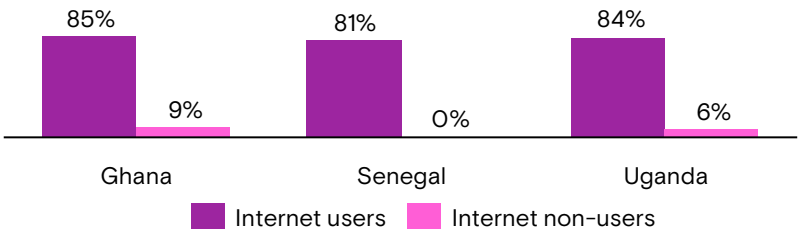
Awareness and understanding of the internet among non-users

Source: Surveys conducted by Facebook between 2014 and 2015



Awareness is higher in Brazil than in the other markets surveyed: this may be partly because the education system is better developed, with school attendance significantly above almost all of the other countries surveyed. This supports the view that education can act as a gateway through which children and their parents can gain a better understanding of what the internet is.[117]

There is a scarcity of global, up-to-date data available on digital skills. Many people who can read and write lack the digital skills or a sufficient understanding of the technology required to get online, which affects their confidence and likelihood of becoming connected. The majority of unconnected people who do not use a mobile phone have little or no experience with telecommunications, computers, or even electronic devices. Surveys conducted in sub-Saharan Africa show that the majority of internet users are familiar with computers (and probably mobile phones), whilst people who do not use the internet are not.



Familiarity with using computers

Source: InsightsAfrica[118]

Existing evidence suggests that there is a significant gender gap in use of digital technology: stark inequalities between men and women in parts of Asia and sub-Saharan Africa are correlated with women being less likely than men to own a mobile phone (14% less likely in developing markets as a whole, but 50–60% less likely in India and 10–40% less likely in sub-Saharan Africa).[119]

In some parts of the world, women are up to 70% less likely than men to be connected to the internet

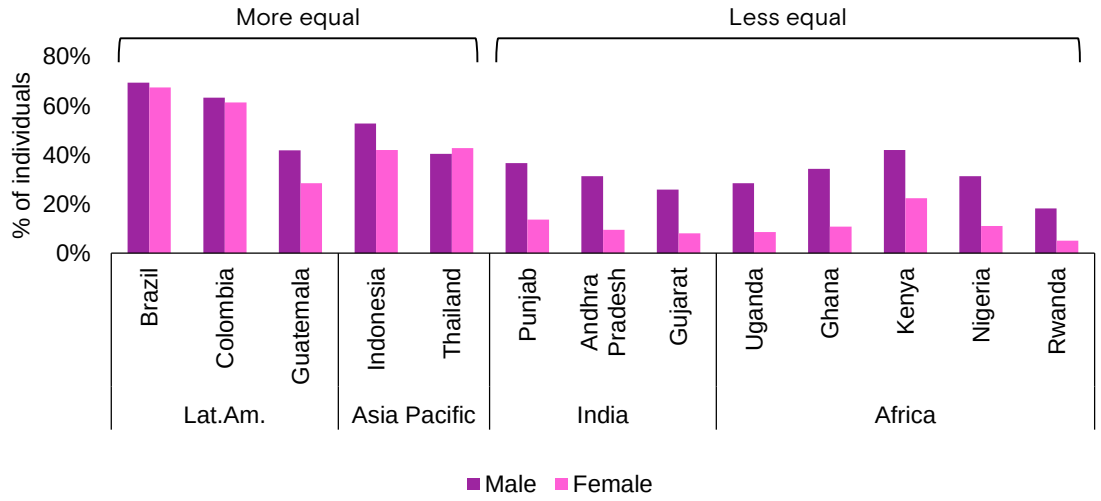
In part because of unequal access to education and economic opportunities, girls and women remain disproportionately excluded from internet use. Almost two thirds of illiterate adults in the world (63%) are female, [120] and in South Asia, women are 33% less likely to have completed lower secondary school than men.[121] According to the UN, globally, the per-capita income for women is approximately half of what it is for men.[122] Particularly in the developing world, women lack financial independence, and are 18% less likely than men to have a bank account.[123]

The ITU's estimates suggest that women are 11% less likely than men to use the internet on a global basis, with this figure rising to 28% in LDCs. Studies in 2012 and 2015 found that that women in developing markets were 15-25% less likely to be online than men, with stark inequalities in sub-Saharan Africa (45%) and South Asia, the Middle East and North Africa (35%),[124] and in LDCs in general (29%).[125]

The same series of surveys by Facebook described above show varying levels of inequality between men and women, with a large gender gap in India (where women are 60–70% less likely than men to have ever used the internet) and sub-Saharan Africa (where they are 45–70% less likely to be internet users).[126]

Internet use by each gender in selected developing countries

Source: Surveys conducted by Facebook between 2014 and 2015 [127]



Initiatives are under way to address the readiness barrier, but better metrics are required to support them and assess their effectiveness

Gaining an understanding of the internet and acquiring the digital skills needed to use it can be far more challenging for people whose peer groups are not online. Social support is a key enabler for people to overcome the readiness barrier, since friends and families can share skills, pool resources, and introduce each other to relevant content and services. Low levels of connectivity among communities can therefore make it more difficult for individuals to get online. However the reverse is also true and initiatives to increase awareness and digital skills can have a positive impact beyond their immediate audience.

As a result, getting more adults ready to use the internet in the short term requires a combination of targeted skills-building and outreach to improve awareness.

Emerging technologies can make it easier for people with low literacy or digital skills to interact with and benefit from text-based content on the internet, for example voice-to-text and text-to-voice technology (in some but not all languages) and more visual interactions reduce barriers to engagement with devices and services, but require high-end devices, fast networks and significant data allowances.

Initiatives to improve awareness are being developed and trialled to introduce individuals and communities to what the internet is and the potential it has to offer. For example, MTN Uganda has hosted a number of internet expos designed to allow people to experience the internet for themselves, allowing users to download apps, ask questions, and experience using devices such as tablets and laptops for the first time.[128]

In the medium to long term, school systems play a central role in improving awareness and understanding of technology or introduce children to the internet, and as such play a key role in improving digital literacy. In Thailand, for example, the operator DTAC plans to provide free internet access to over 2000 rural schools (1 million students) in the next three years as part of its 'internet for all' vision.[129] Funding mechanisms are critical, as many initiatives are perceived to be chronically underfunded and short-staffed. Public funding can also play a role in extending internet services to schools. In Turkey, funding was used to connect 15 million students, with broadband internet and ICT infrastructure provided in 620,000 classrooms.[130]

The rationale for governments supporting and funding connectivity programs in schools is two-fold: it prepares children for a digital world, but technology also helps deliver traditional skills in an enhanced way. Initiatives to improve literacy and digital literacy skills are increasingly focused on the use of mobile devices, as seen in Papua New Guinea and India.

Mobile devices are increasingly being used by initiatives to improve literacy and digital skills

In Papua New Guinea, more than 35% of the population is illiterate,[131] partly because of a weak education system.[132] A project called SMS Story was launched to examine whether daily mobile text messages (including stories and lesson plans) could be used to improve reading skills for children in rural primary schools.

The project resulted in a 50% reduction in the number of children who could not read at all, compared to other schools. It proved a simple and low-cost strategy for improving literacy, as well as introducing and encouraging the use of digital technology in education.[133]

In India, where digital literacy is a key barrier to internet adoption,[134] mobile operators have set up initiatives to educate consumers on how to use mobile broadband to engage with content and services.

In 2014, Idea Cellular launched an initiative to provide step-by-step lessons using interactive voice response technology (Har Mobile Par Internet, or internet on every mobile). The lessons cover basic skills such as email, social media, local travel information and search.

Telenor India and Vodafone India have been actively opening rural mobile broadband education centers and stores in rural communities, acting as hubs for unconnected people to get familiar with mobile broadband.[135]

More can be done to address the gender gap in internet use. In societies where economic and educational inequalities are very entrenched, gender-focused approaches require significant efforts. In Pakistan, initiatives combine ICT education and training with financial support, and seek to foster acceptance by highlighting employment opportunities available to connected women.

A number of initiatives are addressing gender inequalities in connectivity in Pakistan

Since 2012, the Pakistan Social Association (PSA) has provided basic training in computer and internet use to over 3000 girls in 120 e-villages in some of the most remote areas of the country. The girls receive a certification after completing their exams, and the success of the program so far has led to PSA announcing plans to expand the training to 20,000 girls. PSA noted that training one girl brings change to her entire family, including her own children, thereby creating sustainable change in Pakistan's gender inequalities.[136]

Towards the end of 2015, the Pakistan Ministry of IT launched another program named 'ICTs for Girls', a joint effort between Pakistan Bait-ul-Mal, the country's Universal Service Fund, and Microsoft.

The initiative will provide 50 fully-equipped ICT labs in 'women empowerment centers' across the country, with the goal to improve their employability and provide an opportunity to guarantee their financial freedom. This is a small-scale initiative targeting 4000 to 5000 girls in the first phase, but its ambition is to provide the foundation for professional skills including coding, communication and coaching, and will have a special emphasis on local relevance to ensure it is understandable and useful to the women involved.[137]

Once skilled in computer software, women would be able to work from their homes, if needing to balance family duties.

Despite these initiatives, women in Pakistan also face barriers related to security issues with getting online. They are commonly exposed to online harassment, blackmail and abuse, and websites often fail to offer appropriate protection due to a lack of understanding of local languages and cultures. An initiative called Hamara Internet was launched to empower women to connect via social media, and to provide training to protect against digital abuse and online harassment.[138]

The characterization of readiness in this report aims to provide a structure against which better metrics can be defined and measured. This is complex, because of the multiple aspects of the problem and the interconnectedness between skills, awareness and socio-economic factors including gender inequalities.

Theoretically, readiness could be measured through a single indicator: the proportion of unconnected people who would be interested to connect to the internet if it was free, available and had relevant content or services to offer to them. Framing such an indicator properly is extremely difficult, and would need to rely on tightly-controlled surveys. In practice, indicators measuring basic and digital literacy and awareness, in parallel with whether people perceive the internet as relevant to them, would offer valuable proxies if they could be scaled up globally.

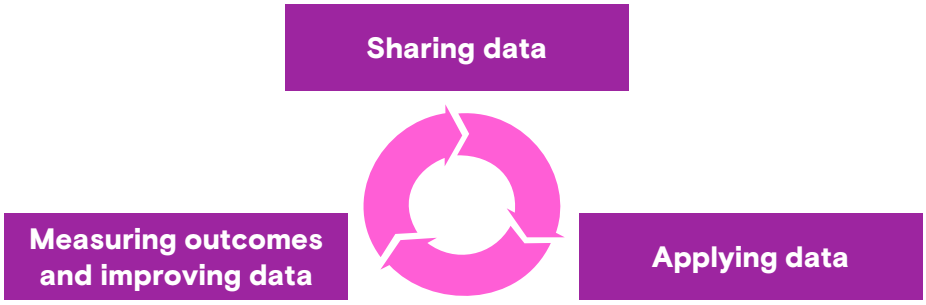
Once readiness can be measured, it can be addressed systematically through a greater range of experiments and initiatives, which can then be assessed and benchmarked consistently. This would form the basis of an evidence base, so that stakeholders (operators, technology companies, governments) can adopt more broadly the approaches that work.

Conclusion

As this second edition of the State of Connectivity report makes clear, there has been good progress in the last year, with hundreds of millions more people getting online. However, connecting the remaining 4 billion will become increasingly challenging, as many are living in poverty, lack basic literacy skills and are not familiar with digital technology such as mobile phones.

The internet's power to connect people, support the sharing of knowledge and unlock economic opportunities will not be fully realized unless all the barriers to connectivity are addressed. This will require coordinated effort from many stakeholders, with governments, operators, technology companies and content providers taking a leading role, supported by academia, media, international organizations and NGOs.

All parties have a role to play in developing better indicators, richer data and deeper insights around connectivity, to help design and deliver effective solutions to bring more people online. This is an ongoing and iterative process, with all stakeholders working together in an open and collaborative manner to continually improve data, insights and ultimately connectivity outcomes.



Sharing of data is the foundation of these efforts. This report highlights both established indicators made available by the ITU and GSMA Intelligence, as well as new data released by companies such as Google and Facebook. Data should be available broadly, and become progressively richer, more granular, consistent and accurate to best support the many initiatives and innovations required to improve connectivity.

Applying this data to derive more sophisticated insights into the barriers to connectivity and how they can be mitigated is key to bringing many of the 4 billion unconnected people online. Data is essential for governments and policy makers to develop robust evidence-based policies, monitor outcomes more effectively and share best practice. Telecoms operators and technology companies use data to develop business cases to expand network

coverage, develop new content and services and innovative new approaches to reducing the barriers to connectivity.

Measuring outcomes and improving data is an essential feedback loop to identify approaches that work and enable new ones to be developed. It requires insights to be shared broadly, through international organizations (e.g. ITU, World Bank) and publications such as this report. Stakeholders must share experiences of how data is being used in practice and how data can be improved, for example through refining metrics and indicators or developing new ones. Demonstrating how data and insights are being used effectively will help to strengthen the call for participation by more industry stakeholders. Academia can also play a lead role in analyzing available data to provide deeper and more actionable insights.

Facebook is deeply committed to finding a path to connect everyone in the world. By working together to improve the availability of data and design data-driven solutions, the broad community of public- and private-sector organizations committed to improving connectivity can make great progress in breaking down the barriers to connecting the next 4 billion people.

Annex A Affordability at a country level

Country	2014 non-internet users (million)	Price of 500MB in 2014 (USD nominal)	% able to afford 500MB in 2014	% able to afford 500MB in 2013	% change in price in LCU (2013-14)	% change in price in USD (2013-14)
India	1,039	1.62	13%	12%	-1%	-5%
China	707	6.19	66%	50%	-24%	-23%
Indonesia	209	2.07	26%	23%	0%	-5%
Pakistan	160	1.46	6%	6%	0%	3%
Bangladesh	143	1.25	56%	6%	-64%	-64%
Nigeria	102	12.19	n.m.	n.m.	0%	-2%
Ethiopia	94	0.77	7%	n.m.	-91%	-91%
Brazil	86	8.46	53%	34%	-36%	-39%
Mexico	69	14.00	25%	24%	0%	-2%
DRC	67	1.50	35%	n.m.	-100%	-90%
Philippines	60	6.65	4%	1%	-25%	-27%
Egypt	57	3.50	7%	3%	-17%	-22%
Myanmar	53	1.92	n.d.	n.d.	n.d.	n.d.
Tanzania	48	1.51	11%	1%	-58%	-60%
Vietnam	48	2.36	27%	13%	-29%	-29%
Iran	48	8.87	12%	33%	437%	70%
Thailand	44	6.13	40%	20%	-33%	-36%
Russia	42	5.06	90%	92%	34%	10%
USA	41	20.00	93%	97%	33%	33%
Turkey	37	8.68	53%	81%	111%	84%

Notes:

LCU = local currency; n.d. = no data; n.m. = not meaningful (due to limitations of modelled income distribution curves. See methodology notes)

Prices for 2014 are based on research conducted at the end of December 2014 (published in February 2015). Price changes in Iran are due to a currency revaluation.

Prices are a Google/Communications Chambers and ITU World Telecommunications / ICT Indicators 2015.

2014 non-internet users are from ITU World Telecommunications / ICT Indicators 2015.

Annex B Methodology notes

This annex provides the definitions, data sources and descriptions of the approach to determine the quantitative indicators for each barrier (Availability, Affordability, Relevance, and Readiness). This should be read in conjunction with the detailed end notes in Annex C.

Consistent data for individual countries is generally available for the end of 2014. More recent data is available for some indicators, albeit not consistently, and often not at country level. We have provided estimates for some indicators for end of 2015 when available (primarily from the ITU's Measuring the Information Society 2015 report, released on 30 November 2015). We have also analyzed the more recent pricing data released by Google in December 2015, based on data collected in June 2015.

Availability

The primary measure for the availability barrier is the percentage of the population living within range of either a 2G or a 3G mobile network. Data on country-level 2G population coverage has been drawn from the ITU World Telecommunications / ICT Indicators database. In each case we have used the latest year for which data is available over 2012–14 (2014 for 127 countries , 2013 for 22 , 2012 for 12 , representing 89% of the global population). Data on country-level 3G population coverage has been drawn from the GSMA Intelligence, as the 3G population coverage from ITU was relatively limited for 2014 (110 countries representing 52% of the global population).

Coverage levels have been established for groups of countries (on the basis of geographical regions and extent of economic development) by calculating the average of 2G or 3G population coverage for each country, weighted by population data from UNPD. Countries for which 2G or 3G coverage data is not available are excluded from the calculation. The countries with data account for about 89% and 99.6% of global population for 2G and 3G respectively.

Maps illustrating how people who use Facebook connect to the internet show an anonymized, aggregated sample of locations where people have used Facebook through the Android app, using 2.5G technology and above. Less populous areas and countries with fewer people who use Facebook (for example China) are not as well represented as denser areas and countries where there are more people who use Facebook.

On page 13, the costs of building and operating an urban site and a remote site were compared for India and Nigeria. The estimates used to derive the diagrams shown in the

report are shown in the table below. They represent typical costs, but it should be noted that even within a country, actual costs vary for each site depending on location, exact configuration, year in which they are deployed etc.

Cost assumptions for a typical urban and remote mobile tower

Assumptions	Nigeria urban site	India urban site	Nigeria rural site	India rural site
Key capex items (USD)				
Land & structure: 50m lattice tower, includes passive infrastructure e.g. antenna (tri-band), cabling and installation capex	165 000	105 000	165 000	105 000
Network equipment: 4G-ready active equipment, including installation and commissioning	35 000	35 000	35 000	35 000
Backhaul: microwave, backhaul repeater sites required when over 30km away from backhaul backbone network (rural sites assumed to be 90km distance from backbone network)	15 000	15 000	195 000	195 000
Power: assumes connection to the grid at urban sites with one generator required as backup; two generators required at rural sites,	40 000	25 000	20 000	20 000
Key opex items (USD per annum)				
Land & structure: site rental (co-location not assumed), maintenance and site security (security costs not applied in India)	10 000	5 500	14 000	6 500
Backhaul: maintenance opex assumed to be 20% of backhaul capex	3 000	3 000	39 000	39 000
Power: assumes grid power and use of deep-cycle batteries at urban sites; assumes generator and use of deep-cycle batteries at rural sites; urban sites in Nigeria assumed to require generators to run six hours a day due to power outages	8 000	3000	15 000	9 500

These costs were derived from benchmarks collected by the consultancy Analysys Mason from multiple operators, tower companies and equipment vendors, suitably averaged and anonymized to preserve confidentiality. These costs relate to the incremental cost of a new mobile site in an operator's network, but exclude core network costs required to support a new site (e.g. RNC, IT, core national and international bandwidth), which do not vary specifically according to whether a site is urban or remote.

Capital costs were amortized over the life of a tower, assumed to be 20 years, in order to calculate an annualized capital expenditure cost. Certain equipment was assumed to have a

shorter life span, such as generators (two years) and active equipment such as antennas and backhaul (seven years).

Certain costs vary between countries. For example, diesel prices are heavily influenced by local taxes, subsidies and other market factors, resulting in large variations in the running cost of generators. Other examples include the cost of tower security costs to prevent theft of certain equipment, which are high in some countries but negligible in others.

Affordability

The percentage of the population who can afford data services is defined as those who can purchase a prepaid mobile data package with a minimum of either 100MB or 500MB monthly allowance for no more than 5% of their household income (apportioned to a per-capita value). As shown on page 21 of the report, the 5% affordability threshold is validated by calculating the average amount spent by existing mobile data users in developing countries on data services (3.8% of income, discussed further below).

In order to assess the widest possible level of affordability, prices of prepaid mobile data packages are based on the lowest available price point at the end of 2014 from two sources: the Global Broadband Pricing Study by Google and the Communication Chambers (range of operators and tariffs) and the ITU World Telecommunications / ICT Indicators 2015 database[139] (dominant operator by market share, 500MB monthly package tariffs only). Where significant variation exists between the two sources[140], spot-checks of operator websites have suggested that the lower of the two figures is more appropriate in the majority of cases, and this has been applied as a rule for using the two datasets in combination for this analysis.

Both of these databases report prices valid as of the end of 2014. Prices of packages with validity of less than 30 days were normalized to represent a 30-day equivalent tariff. For example, the price and volume for a weekly package would be multiplied by 4.3 to give a 30 day equivalent. The price considered was the minimum normalized price of a package. In cases where buying multiple tariffs was more economical than a single tariff (e.g. buying 5 tariffs of 20MB to achieve 100MB in a month), the price of the tariff combination was selected.

Household income distribution is based on a lognormal estimation of the income distribution. The income distribution curve is mathematically related to the Lorenz curve, which forms the basis of synthetic measures of income inequality (the Gini index). Although the lognormal distribution is only an approximation of income distribution, it has been shown to be a highly accurate one. [141]

This estimation uses two inputs: median income and Gini index (provided by the World Bank). Household incomes are not normally reported in official statistics, and rely on surveys or estimates based on private consumption of national income (typically GNI). The approach used in this report uses the median household income per capita reported by the 2014 Gallup World Poll. This is a survey-based dataset, which is intended to provide a more accurate picture of incomes than GNI (in particular because it strips out the effect of high income concentration at the top of the income distribution). The median household income data was found to be strongly correlated with private consumption statistics.

All income figures reported at PPP were converted into nominal US dollars using the World Bank's reported individual consumption PPP conversion factors (in USD) and exchange rates.

The formula of the cumulative lognormal estimate of the income distribution curve is:

$$f(x) = \frac{1}{x\sigma\sqrt{2\pi}} e^{-\frac{(lnx-\mu)^2}{2\sigma^2}} \; in \; which$$

$$\sigma = \varphi^{-1}\left(\frac{(Gini+1)}{2}\right)\sqrt{2} \; and$$

$$\mu = ln(median \; income \; per \; capita) \; and$$

$$x = income \; level \; and \; f(x) = \%\; earning \; below \; x$$

The income distribution curves allow determination of the percentage of the population in each country which can afford each level of monthly data (100MB, 500MB) at a maximum of 5% of household income. Affordability for global, regional, and development status groups is an average of the country-level affordability levels (percentage of people who can afford the selected product) weighted by population from the UNPD. Countries where affordability could not be determined due to a lack of pricing data, Gini index or median income, were excluded from the calculation.

The income distribution curve derived above was used to determine how much existing mobile internet users typically spend on data services (average 3.8% in developing countries). This was in order to inform an appropriate affordability threshold, which had been set at 5% of income by other studies. Each market's total mobile data revenue (Analysys Mason Research) and unique mobile internet users (GSMA Intelligence) were used to calculate the average data expenditure per internet user. This average spend was compared to the median income of existing mobile internet users, assuming they are the top end of the country's income distribution curve (wealthiest *x*% of the income distribution, where *x* is mobile internet penetration). This approach means that the low

mobile internet penetration in some developing countries leads to a low implied affordability threshold, as the calculation only considers the income of the wealthiest segment of society.

There are a number of limitations to the source data and approach to the affordability analysis:

- This approach is used to enable a simplified measurement of affordability based on prices and incomes alone, and does not consider price elasticity or consumer decisions relating to other goods and services.
- Treatment of pricing outliers: the simple optimization approach described above (cheapest equivalent 500MB / month tariff) does not correct for outliers, which may be explained by an operator's strategy or in some cases by input errors (see below).
- Input errors in price databases: as tariffs are collected manually from websites, human error within the data is possible and likely given the large volume of information. When such errors were evident and confirmed as errors through analysis of the relevant mobile operator's online tariffs, they have been corrected.
- Incomplete data: tariffs are collected from operators' websites, and cannot capture promotional pricing which can result in significant discounts compared to published pricing.
- Variable availability: tariffs are collected from multiple operators with varying levels of national network coverage. The lowest pricing in a market may be offered by an operator with lower coverage than the market leader, meaning individuals in rural areas may not have access to the lowest prices used in this analysis.
- Income distribution approach: the Gini coefficients reported by the World Bank are not updated on a regular basis, and are based on income data that is different from the income data used in the analysis. Although a cumulative lognormal distribution is a good approximation for the distribution of incomes, it suffers from reduced accuracy towards the upper and lower end of the distribution curve. In some countries with low median income, affordability of 500MB services appears to be nil, however this is due to the wealthiest individuals in society not being represented by this modeling approach (results marked as 'not meaningful' in Annex A).

Relevance

Data on the availability of content and platforms in different languages was obtained from publicly available information from Wikipedia, Google (for Google Translate and Android

6.0) and Facebook. The population coverage of these languages within each country, and globally, was then derived using data on spoken languages (primary, and secondary where available) from Ethnologue (19th Edition).

As there is no information as to the overlap between speakers of multiple languages, a conservative approach was taken to estimate the population supported by each platform in both primary and secondary languages. For each country, the total number of speakers (primary and secondary languages) was considered to be the higher of:

- the total number of **primary** language speakers of **all languages** supported by the platform (e,g. with 100,000 Wikipedia articles)
- the total number of **primary and secondary** language speakers of the most widely spoken **single language** supported by the platform.

The share of national population speaking a language was calculated as a share of the total primary language speakers reported by Ethnologue. Results for global, regional, and development status group were calculated as an average of the country-level results weighted by total primary language speakers (based on the proportion reported by Ethnologue and population from UNPD). Countries and languages for which data was not available from Ethnologue were excluded from the calculation.

Readiness

Basic literacy rates for global, regional, and development status groups is an average of the country-level literacy rates from UIS weighted by 2014 population from UNPD. Countries without reported literacy rates were excluded from the calculation.

Attainment rates of secondary education for the population aged 25 years and older are based on UNESCO statistics for those who have at least completed upper secondary school for the latest year available. The percentage of the population who have completed secondary school in global, regional, and development status groups is calculated as the average of the country-level attainment rates weighted by 2014 population from UNPD. Countries without attainment data were excluded from the calculation.

Familiarity with mobile devices is based on GSMA unique mobile subscribers for 2014. This may be conservative, as it is likely that there are individuals who make use of shared devices or another person's phone, but do not own a phone themselves.

Awareness or understanding of the internet is based on surveys conducted by Facebook between 2014 and 2015. 41,625 survey respondents between the ages of 15 and 64 in eleven countries (Brazil, Colombia, Guatemala, Indonesia, Thailand, India, Uganda, Ghana,

Kenya, Nigeria, Rwanda) were asked “Before today, have you heard of the internet?” and if they answered that they had heard of the internet, they were then asked “How much do you know about the internet?” This allowed for one of three answers: “Have only heard the name, but don’t know what it is”, “Know the name, and know a little about what it is”, or “Know the name and know a lot about what it is”.

Internet use by gender has been reported on a global or developing market scale by a number of organizations, but the data can be further supported by the surveys conducted by Facebook (as described above). The surveys asked the question “Have you ever used the internet?”

Annex C End notes

Executive Summary

1 Available at: http://newsroom.fb.com/news/2015/02/the-state-of-global-connectivity/
2 Defined by the ITU as having used the internet in the last three months, as reported in ITU's Measuring the Information Society Report 2015,
3 GSMA Intelligence 2016
4 http://www.itu.int/en/connect2020/Pages/default.aspx
5 http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E
6 For example through the Partnership on Measuring ICT for Development, http://www.itu.int/en/ITU-D/Statistics/Pages/intlcoop/partnership/default.aspx

The State of Connectivity

7 Defined by the ITU as having used the internet in the last three months
8 Colin Scott (2012): Does broadband Internet access actually spur economic growth? Available at http://www.eecs.berkeley.edu/~rcs/classes/ictd
9 WEF Global Information Technology Report 2015: Chapter 1.2 (ICTs, Income Inequality, and Ensuring Inclusive Growth); Chapter 1.4 (ICTs for Inclusive Growth: E-Entrepreneurship on the Open Internet); Key messages from the Networked Readiness Index (ICTs contributions to shared prosperity, page 18)
10 ITU and Cisco, Harnessing the Internet of Things for Global Development, available at http://www.itu.int/en/action/broadband/Documents/Harnessing-IoT-Global-Development.pdf
11 World Bank, World Development Report 2016
12 World Bank, World Development Report 2016
13 Melhem, Samia, Claudia Morrell, and Nidhi Tandon. 2009. "Information and Communication Technologies for Women's Socioeconomic Empowerment."
14 This report's definition of universal connectivity does not make an explicit distinction between age groups and considers the entirety of the world's population. The US Census Bureau estimates that in 2014, 8% of the global population is over 65 years of age, 17% is under the age of 10, with 9% under the age of 5. Increasingly, children are accessing the internet and learning digital skills at a very early age, and older people are an important demographic when considering the benefits of the internet in aging societies, for example to provide remote care.
15 The GSMA's definition of unique mobile internet user is for those who have ever used the internet (compared to in the last 3 months for ITU), and includes use of IP messaging (e.g. WhatsApp) which may not have been considered as internet use by respondents to surveys contributing to the ITU's statistics.
16 GSMA Intelligence, 2016
17 Regional breakdowns are not yet available for end of 2015
18 ITU Measuring the Information Society Report 2015
19 Based on ITU definitions of development (full list of country classifications can be found at http://bit.ly/1vzGWey); the potential to improve the quality of people's lives is particularly important for the least developed countries (UN definition, available at http://bit.ly/1cmPb5u), which also face the greatest barriers. 2015 estimates from the ITU are based on ITU Facts and Figures 2015 and ITU Measuring the Information Society Report 2015.

[20] UN Sustainable Development Goals, listed at https://sustainabledevelopment.un.org/?menu=1300

[21] Listed in full at http://www.itu.int/en/connect2020/Pages/default.aspx

[22] ITU estimates for 2020 predict that 47% of individuals will remain disconnected; we note that population growth is higher in developing countries

The Global Barriers to Connectivity

[23] For example, the McKinsey Barriers framework (available at http://bit.ly/Ztobeu) referenced a similar set of four barriers (Infrastructure, Low incomes and affordability, Incentives and User Capability), and the 2014 State of Connectivity report referred to three sets of barriers (Infrastructure, Affordability and Relevance), the WEF internet For All 'Future of the internet' report mentioned Infrastructure, Affordability, Skills and Awareness and Locally Relevant Content and Applications, Google's Measuring Connectivity: A Call to Measure Internet Development with Open, Timely, and Relevant Data uses the same pre-adoption barriers of Availability, Affordability, Relevance and Readiness (available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2664359)

[24] The ITU Telecommunication Development Sector (ITU-D) attempts to "foster international cooperation on telecommunication and ICT development issues", among other goals

[25] The Partnership on Measuring ICT for Development was launched in 2004 and is a multi-stakeholder initiative to improve the availability and quality of ICT data and indicators internationally, particularly in developing countries. Other initiatives include the UN Post-2015 Development Agenda, the UN Millennium Development Goals, Broadband Commission for Digital Development, the UN Committee for the Coordination of Statistical Activities (CCSA), UNData, the internet Society [Note: others to be confirmed]

[26] http://policybythenumbers.blogspot.co.uk/2015/02/global-broadband-pricing-study-updated.html, ITU World Telecommunication ICT Indicators, 2015

Availability

[27] Satellite coverage is ubiquitous, but there are places where the topography or weather patterns may not allow for practical satellite connectivity. Price and throughput are however much greater constraints on satellite broadband than availability. End-user equipment such as satellite dishes and terminals are relatively expensive compared to mobile devices, as well as complex to install and set-up.

[28] Advanced applications (e.g. video streaming) can require *high bandwidth*, which enables large amounts of data to be transferred at once, but sometimes (e.g. real-time communications) require *low latency* (and/or *jitter*), which measures the delay between sending a request and getting a response (jitter measures the variability of latency). 3G and 4G offer much greater bandwidth than 2G, and 4G offers much lower latency than 2G or 3G

[29] GSMA Intelligence's estimate of 73% 3G coverage at the end of 2014 is above the ITU's 2015 estimate of 69% (ITU Measuring the Information Society Report 2015). Ericsson's assessment is more conservative still at 90% 2G and 65% 3G coverage in 2014 (Ericsson Mobility Report November 2015).

[30] Ericsson press release: http://bit.ly/1Mmz6dB

[31] See https://www.google.com/get/videoqualityreport/

[32] ITU Measuring the Information Society Report 2015

[33] Facebook analysis of data from SEDAC, the Socioeconomic Data and Applications Center – Gridded Population of the World (GPW), v4. The population distribution data is based on a 20kmx20km grid square basis to approximate the coverage of a mobile site

34 Estimated rural and urban per capita GDP for 2011-12, Urban – Rural Income Differential in Major States: Contribution of Structural Factors, Dholakia et al, W.P. No. 2014-02-07, IIMA, February 2014; Converted into USD by using average exchange rate for 2011 from Oanda.com

35 Annualized cell site costs in urban and remote areas are based on assessment of industry benchmarks by Analysys Mason. For a remote site requiring two microwave backhaul repeater sites, the lifetime cost of backhaul can be over 10 times higher than for an urban site. Similarly, by relying solely on diesel generators rather than a mix of grid power and backup generators, power costs are typically around three times higher.

36 Clean Technica: Solar Costs Will Fall Another 40% in 2 Years. Here's Why., available at http://cleantechnica.com/2015/01/29/solar-costs-will-fall-40-next-2-years-heres/; Renew Economy: The plunging cost of renewables, available at http://reneweconomy.com.au/2015/graph-day-plunging-cost-renewables-49704

37 http://bits.blogs.nytimes.com/2015/10/25/facebook-strives-to-bring-cheap-wi-fi-to-rural-india-2/?_r=0

38 http://www.google.com/loon/

39 http://www.dnaindia.com/scitech/report-google-receives-government-approval-to-beam-internet-connectivity-across-india-with-project-loon-2141458 /

40 http://www.ft.com/intl/cms/s/0/0d39ff20-367c-11e5-b05b-b01debd57852.html#axzz3t6VYggdz

41 https://googleblog.blogspot.co.uk/2015/10/indonesia-loon-internet.html

42 Broadband Commission: State of Broadband annual reports, available at http://www.broadbandcommission.org/publications/Pages/publications-category1.aspx

43 Broadband Commission: State of Broadband 2015 (Section 5.2 Approaches to achieving universal service). The Broadband Commission found that only 38% of 69 USFs studied in 2015 were highly active, 14% had a moderate activity level and 22% had a low activity level. The remaining 26% were inactive.

44 http://www.broadbandcommission.org/resources/Pages/default.aspx

45 https://www.itu.int/itu-d/tnd-map-public/

46 https://www.itu.int/en/ITU-D/Technology/Documents/InteractiveTransmissionMaps/Misc/Flyer_MAPS_FINAL.pdf

47 This map shows an anonymized sample of locations where Facebook users have connected to the Facebook app using 2.5G technology and above. Less populous areas and countries with fewer Facebook users (for example China) are less visible on the map.

Affordability

48 World Bank: using available poverty data, it was calculated that 28% of the developing world live below national poverty lines, of which 68% live in rural areas

49 Survey based measures of income are subject to respondent bias however they typically provide a more representative measure of household income than macro-economic metrics such as GNI per capita

50 Broadband Commission: State of Broadband 2015; ITU: Measuring the Information Society 2015, Alliance for Affordable Internet: Affordability Report 2014

51 Of course, some people consume little data because they do not use services such as video and audio streaming, which drive much of the consumption in developed markets

52 This is close to the 'fully connected' usage of 2GB per month defined in the State of Connectivity 2014 report.

53 Cisco Visual Networking Index 2014, available at: http://www.cisco.com/web/solutions/sp/vni/vni_forecast_highlights/index.html

54 Data usage for specific services is estimated based on operator data use calculators in developing markets, assuming 20kB per email (non-attachment), 1MB per multimedia website,

and 2MB per minute of video streamed; there may be significant variation in the amount of data consumed based on screen size, the types of webpages visited, the resolution of video content, and the use of browsers such as Opera Mini. Websites in particular can consume from 200kB up to 2.5MB per page.

55 Gross National Income reflects the wealth created in a country in a given year, but much of this wealth is tied up in assets through retained business profits and capital formation

56 The affordability analysis in this report is based on median household income per capita from Gallup World Poll. Gallup has conducted face-to-face or telephone-based surveys in more than 160 countries and in over 140 languages that include 99% of the world's adult population. The target population is the entire civilian, non-institutionalized, aged 15 and older population. The typical World Poll survey includes at least 1,000 surveys of individuals.

57 This is calculated as each country's data ARPU as a percentage of the median data user's household income, assuming that the highest earners are online. Based on data from GSMA Intelligence (unique mobile internet subscribers), Analysys Mason Research (mobile data revenue), Gallup (median household income per capita), and World Bank (Gini coefficient)

58 The price of 500MB data in Ethiopia is based on EthioTelecom's published rate per MB on pay-as-you-go (http://www.ethiotelecom.et/products/residential-tariff.php?q=internet-mobileinternet); Kenya's 500MB price is based on the Global Broadband Pricing Study by Google/Communications Chambers released in Q4 2014.

59 The increase in income is calculated as the weighted average (by population) % change in median household income, where there is data available. The decrease in 500MB prices is calculated as the weighted average (by population) % change in 500MB mobile broadband prices. All amounts are in nominal terms (non-PPP). This results in an increase of 467 million in the number of people who can afford to pay for 500MB of data each month, between 2013 and 2014.

60 GSMA Intelligence reports 7.6 billion mobile connections in Q4 2015

61 GSMA Intelligence, 2016

62 World Bank, World Development Report 2016: Digital Dividends

63 Data from Gallup World Poll, based on survey responses of people aged 15 and over to the question "Does your home have a cellular phone?" Country averages weighted by World Bank national populations of individuals over 15 years old to derive global average

64 They may also face additional costs such as device upgrades and higher charging costs

65 Gallup World Poll (2014), USD nominal (non-PPP)

66 Based on income distribution curves using Gallup's median household income per capita and Gini from World Bank

67 Sustainable Energy For All: Global Tracking Framework Report 2015; UN Foundation: Achieving universal energy access, available at http://www.unfoundation.org/what-we-do/issues/energy-and-climate/clean-energy-development.html

68 infoDev: Mobile Usage at the Base of the Pyramid in Kenya (December 2012)

69 Based on a charging cost for feature phones of USD0.20 per charge, with charging occurring 2-3 times per week. Vendors charge a small premium for smartphones, which require daily charging. GSMA: Green Power for Mobile Charging Choices (2011)

70 Scientific American: Charging a mobile phone in rural Africa is insanely expensive, November 2013. Available at: http://bit.ly/1HpPqer

71 GVEP International: Phone charging micro-businesses in Tanzania and Uganda (2011)

72 Lighting Global & World Bank: Off-grid Power and Connectivity (2015);), Greenlight Planet (available at https://www.greenlightplanet.com/easy-buy/#products), M-KOPA (available at http://www.m-kopa.com/products/)

73 TechLoy: MTN Launches ReadyPay, a pay-as-you-go solar powered system in Uganda, available at

http://techloy.com/2013/12/17/mtn-launches-solar-powered-readypay/; Red Pepper: MTN ReadyPay Solar system launched, available at http://www.redpepper.co.ug/mtn-readypay-solar-system-launched/

74 Average revenue per user

75 GSMA Community Power for Mobile: Harnessing The Full Potential of Mobile for Off-Grid Energy (2011); GSMA Green Power for Mobile: Green Power for Mobile Charging Choices (2011)

76 http://www3.weforum.org/docs/GITR/2012/GITR_Chapter1.6_2012.pdf

77 World Bank, Poverty: Listen to the Voices, available at http://bit.ly/1Xv8HCw; FSD Kenya: Kenya Financial Diaries, Shilingi kwa Shilingi – the Financial Lives of the Poor (2014), available at http://bit.ly/1N6rrjT ; Portfolios of the Poor: Household portfolios, available at http://bit.ly/1jK3XGG

78 See for example: Alliance for Affordable Internet, The Affordability Report, available at: http://a4ai.org/affordability-report/report/#a_roadmap_to_affordable_internet

79 TV white space technology can rely purely on solar energy and a station is therefore reportedly one-tenth of the cost of a 4G site, allowing for affordable, low-cost services. http://blogs.microsoft.com/on-the-issues/2015/06/09/delivering-low-cost-solar-powered-internet-access-to-rural-kenya/

80 http://research.microsoft.com/en-us/projects/spectrum/impact-mawingu.aspx

81 http://www.mawingunetworks.com/our-technology.html

82 http://research.microsoft.com/en-us/projects/spectrum/impact-mawingu.aspx

83 http://www.itnewsafrica.com/2015/05/microsoft-launches-low-cost-internet-in-rural-kenya/

84 http://blogs.microsoft.com/on-the-issues/2015/06/09/delivering-low-cost-solar-powered-internet-access-to-rural-kenya/, http://research.microsoft.com/en-us/projects/spectrum/pilots.aspx

85 http://timesofindia.indiatimes.com/tech/tech-news/Microsoft-to-take-low-cost-broadband-tech-to-5-lakh-villages-Satya-Nadella/articleshow/49125332.cms

86 http://cio.economictimes.indiatimes.com/news/corporate-news/microsoft-is-under-attack-in-india-for-its-plans-to-harness-white-spaces-for-last-mile-connectivity/49733984

Relevance

87 For new users, the retail experience plays a role in discovering new content and services, either through marketing (e.g. an operator promoting the use of certain apps or content) or through pre-loading of specific apps or websites onto a device or SIM

88 Percentage of the population in the infographic represents those who speak supported languages in either their primary or secondary language. Languages supported for each platform is the reported number of languages, except for Wikipedia which represents the number of languages with over 100,000 articles ('encyclopaedic knowledge') as of 9 December 2015.

The definitions of languages differ across the platforms, so to calculate the percentage of the population able to speak these languages, the language counts were defined based on Wikipedia classifications (e.g. English (UK) and English (US) were combined as one language). Based on these classifications, Android supports 56 languages, Google Translate supports 89 languages and Facebook supports 122 languages. To calculate how many languages are needed to cover 98% of the population, languages were ranked according to Ethnologue 19th Edition (2015) primary language speakers.

Language lists are available at:

- Wikipedia https://meta.wikimedia.org/wiki/List_of_Wikipedias
- Android: https://www.android.com/intl/en_uk/versions/marshmallow-6-0/ and http://blog.globalizationpartners.com/android-lollipop-and-multiple-languages.aspx

- Google Translate http://translate.google.co.uk/about/intl/en_ALL/languages.html
- Facebook: https://developers.facebook.com/docs/internationalization.

89 This is a characteristic of all information goods and services, for which experience drives utility; see for example Shapiro, C. and Varian, H., *Information Rules: A Strategic Guide to the Network Economy*, Harvard Business School Press, 1999

90 PwC Global Entertainment and Media Outlook 2015-2019: based on average advertising spend (across internet, newspaper, radio, TV and out-of-home advertising) per capita is the USA compared to that of India, Nigeria and Brazil. In the USA, this was over USD500 per capita, compared to around USD50 per capita in Brazil and less than USD10 per capita in India and Nigeria.

91 Source: Apple, Google, information collected between 2015/11/26 and 2015/12/09

92 Ethnologue 19th Edition (2015)

93 w3techs.com

94 In some countries, language is relatively homogeneous: the vast majority of people in Brazil speak Portuguese as a first language. In others, such as Indonesia, there is a common national language that people use fluently, even though their native language is often different. In both types of countries, content and services available in the main language can reach the vast majority of the population. In a third group of countries, including for example India, language is so diverse that no single language can cover the majority of the population, even when considering secondary language skills. Widespread adoption, and therefore the ability for content and application providers to gain scale, requires that multiple languages are well supported.

95 Less well represented minority languages are also more likely to be spoken in rural and remote areas, compounding the other barriers that are most pronounced in these areas.

96 Google, Ethnologue 19th Edition (2015). , includes secondary languages

97 Ethnologue 19th Edition (2015); "second languages" are defined as an ability to speak or read a language other than an individual's primary language. Secondary language data is a recent addition to Ethnologue and is so far available for 240 languages across 129 countries.

98 Ethnologue 19th Edition (2015)

99 Google Android 6.0 Marshmallow, as of November 2015

100 http://www.pbs.org/newshour/rundown/firsts-myanmar-gears-general-election/

101 http://e27.co/startups-betting-big-quick-growth-myanmars-internet-user-base-20151116/ , http://www.ictworks.org/2015/09/30/wow-myanmar-is-going-straight-to-smartphones/

102 ICTworks: Wow! Myanmar is Going Straight to Smartphones, available at http://www.ictworks.org/2015/09/30/wow-myanmar-is-going-straight-to-smartphones/

103 http://www.reuters.com/article/2015/10/07/us-myanmar-election-idUSKCN0S118L20151007#8c0DWkwtf4AfZZ6V.97

104 Ethnologue 19th Edition (2015)

105 http://timesofindia.indiatimes.com/tech/tech-news/Internet-revolution-sweeps-Myanmar/articleshow/43790165.cms

106 As reported by each company: https://blog.whatsapp.com/616/One-billion, http://mashable.com/2016/01/07/facebook-messenger-users/#VnctuAh9TSqJ, http://files.shareholder.com/downloads/AMDA-NJ5DZ/1074695824x0x859262/A5B93BE0-6167-44D5-A6BE-EA219A2471AA/Q315_Earnings_Conference_Call_Transcript.pdf, http://www.tencent.com/zh-cn/content/ir/fs/attachments/ProductlistofTencent.pdf, https://linecorp.com/en/pr/news/en/2015/1134, http://corp.rakuten.co.jp/investors/documents/results/

107 End of 2015 for WhatsApp and Facebook Messenger

108 September 2015 for Chat, QQ and Line

109 Rakuten, who owns viber, reported 236 million monthly active users at the start of 2015 out of 445 million unique IDs, and 664 million unique IDs in Q3 2015

110 For example, MedicSMS helps to diagnose healthcare emergencies via text messaging in developing countries - http://techcrunch.com/2015/12/06/medicsms-helps-diagnose-medical-emergencies-via-sms-in-developing-countries/

Readiness

111 Digital literacy is dependent on the types of services, as different skills are required to (for example) watch video/listen to audio content, read text content, discover new content/services (e.g. search on web browsers, find in app stores), complete online transactions (i.e. forms for commerce, government services), or compose text-based messages (e.g. email, text, social media)

112 UNESCO (2015): 51% of illiterate adults in South and West Asia and 25% in sub-Saharan Africa; Project Literacy estimates there are 757 million illiterate people globally, http://www.projectliteracy.com/about

113 Between 1990 and 2015. Source: UNESCO

114 Survey respondents were first asked “Before today, have you heard of the internet?” and if they answered that they had heard of the internet, they were then asked “How much do you know about the internet?” This allowed for one of three answers: “Have only heard the name, but don’t know what it is”, “Know the name, and know a little about what it is”, or “Know the name and know a lot about what it is”

115 Respondents either said they “knew a little about the internet” or “knew a lot about the internet”

116 Survey conducted in person and by telephone in Indonesia (400 respondents), Sri Lanka (402 respondents) and Thailand (415 respondents) in August 2015. About 70% of respondents listed “I don’t need it” or “I don’t know what it is” as the main reason for not connecting. A further 7% indicated they did not trust it or did not think it was safe. Study sponsored by google, available at http://www.analysysmason.com/Research/Content/Reports/Broadband-in-Asia-Pacific-investment-partnerships-policy/

117 The percentage of the adult population which has at least completed upper secondary school in Brazil is at 41%, which is much higher than that of Guatemala (19%), Ghana (21%), Kenya (23%), Rwanda (11%), Uganda (8%), Thailand (28%) and Indonesia (29%). Colombia has similar levels of secondary school education to Brazil at 43% of the adult population.

118 InsightsAfrica conducted 2000 face-to-face in-home interviews with consumers in key cities of six sub-Saharan African countries in 2010/11; the chart aggregates the categories of “Very comfortable” and “Quite comfortable” into “comfortable”, the remainder (not displayed) either responded “Not very comfortable” or “Not comfortable at all”

119 GSMA Connected Women (2015): surveys conducted in Colombia, Mexico, Niger, the Democratic Republic of the Congo (DRC), Kenya, Egypt, Jordan, Turkey, India, China, and Indonesia.

120 UNESCO (2015)

121 UNESCO (2015)

122 UN Human Development Index: 2013 estimated GNI per capita for male vs female

123 World Bank Global Findex: 56% of males have access to a bank account in developing countries, compared to 46% of females

124 Intel & Dalberg: Women and the Web (2012)

125 ITU Measuring the Information Society Report 2015

126 Surveys conducted by Facebook over 2014-15

127 Survey respondents were asked “Have you ever used the internet?”

128 MTN Press Box: The MTN Internet Expo continues on its journey across Uganda, available at http://bit.ly/1RaYSVo

129 National Multimedia: DTAC kicks off its 'Internet for all' project, available at http://bit.ly/1PSeJJ4

130 Intel White Paper: The Benefits of Applying Universal Service Funds to Support ICT/Broadband Programs (2011)

131 UNESCO (2015)

132 World Bank: Promoting literacy with mobile phones in rural Papua New Guinea (October 2014) available at http://bit.ly/1ThUpPT

133 Papua New Guinea Department of Education: SMS Story Impact Assessment Report (2013)

134 Ericsson ConsumerLab: The Changing Mobile Broadband Landscape (April 2015) available at http://bit.ly/1QHdgE5

135 Idea Cellular: 'Har mobile par internet = No Ullu banana', What and Idea Sirjee! (Feb 2014) available at http://bit.ly/1PSfbae; Light Reading: Digital Illiteracy Hinders India Internet Adoption (August 2015) available at http://ubm.io/1Xl646d

136 Internet Society: Pakistan's girls and the future of the local technology industry, available at http://www.internetsociety.org/pakistans-girls-and-future-local-technology-industry

137 Pakistan USF: Minister for Information Technology Mrs. Anusha Rehman announces special IT labs for Girls to provide technology training, available at http://www.usf.org.pk/newsdescription.aspx?135

138 Hamara Internet http://hamarainternet.org/
Aljazeera: How social media is failing Pakistan's women, available at http://www.aljazeera.com/indepth/opinion/2015/10/social-media-failing-pakistan-women-151011072105188.html
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Methodology

139 December 2015 release was used for 2014 pricing data, however data relating to tariffs with validity periods of at least 28 days was available for fewer countries than the June 2015 release. June 2015 release was used where pricing data for 28 days tariffs was not available in the December 2015 release"

140 There are significant variations in some cases, leading to the two datasets having a correlation coefficient of 0.4 for countries where both datasets provide a figure

141 Kemp-Benedict, Eric. *Income Distribution and Poverty, Methods for Using Available Data in Global Analysis,* 2001, PoleStar Technical Note number 4 (revised report)
J. Humberto Lopez & Luis Servén, The World Bank. *A Normal Relationship? Poverty, Growth, and Inequality,* 2006, World Bank Policy Research Working Paper 3814.
Maxim Pinkovskiy & Xavier Sala-i-Martin. *Parametric Estimations of the World Distribution of Income*, 2009.

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COVER:

Percentage of Population Online by Country

Source: International Telecommunication Union,

World Telecommunication/ICT Indicators Database, 2015