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ENABLING INTERNET FOR ALL

EXTRACT FROM THE
ERICSSON MOBILITY REPORT

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ENABLING INTERNET FOR ALL

Mobile networks have brought voice and internet services to billions of people around the globe over the last 25 years. Despite this, more than 50 percent of the world's population still doesn't have internet access. The most cost-efficient way to bring more people online is to leverage existing mobile network infrastructure. However, the main challenges in connecting the unconnected are primarily related to affordability, literacy, and provision of relevant services – rather than the availability of technology

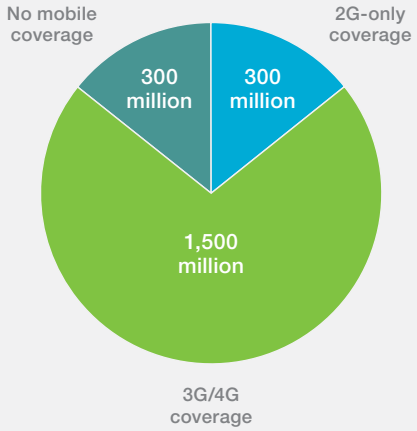
As part of the 70th session of the United Nations General Assembly held in September 2015, 193 world leaders committed to 17 Sustainable Development Goals (SDGs) over the next 15 years. Achieving the SDGs will mean leveraging existing and widely-deployed technologies, such as mobile broadband, to help overcome social and financial exclusion in developing countries.

Globally, the most widely used means of accessing the internet is through mobile networks and a mobile device; however, over 50 percent of the world's population doesn't have internet access. An overwhelming majority of the population without access to the internet live in developing countries. Internet access is a fundamental enabler for improving quality of life, as it provides the opportunity to access useful information and services. This is a critical factor in fulfilling the SDGs. Through selective investment with mature mobile broadband technologies[1], operators can sustainably expand mobile broadband coverage by upgrading existing 2G sites, as well as targeting uncovered areas with new deployments.

More than 1 million new mobile broadband subscribers every day

At the end of 2016, around 3.2 billion subscribers out of the world's total population of 7.4 billion had access to the internet via mobile broadband technology. It is forecast that an additional 2.6 billion subscribers will have mobile broadband internet access by 2022. This corresponds to an average of more than 1 million new mobile broadband subscribers being added every day through to the end of 2022. Key drivers behind this subscriber uptake are a growing young population with increasing digital skills, and decreasing smartphone prices, as well as continued deployment of 3G and 4G mobile broadband technologies in developing markets.

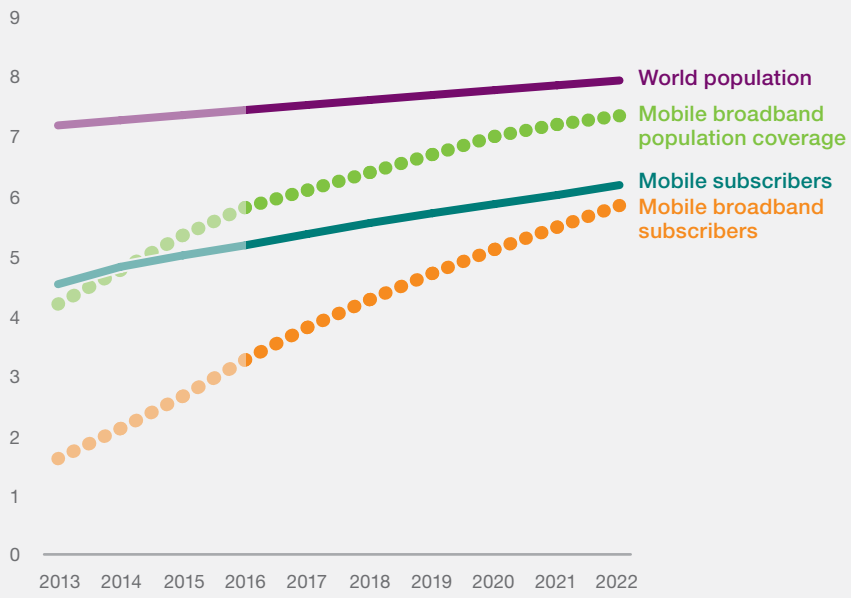
Estimated number of people without mobile broadband connection in 2022



70% of the 2.1 billion people without a mobile broadband connection in 2022 will have mobile broadband coverage

[1] Mobile broadband includes radio access technologies HSPA (3G), LTE (4G), 5G, CDMA2000 EV-DO, TD-SCDMA and Mobile WiMAX
Note: WCDMA without HSPA and GPRS/EDGE (2G) are not included

Mobile broadband networks – population coverage and subscribers (billion)



The world's population is increasingly being connected to mobile broadband networks

Connecting the unconnected with mobile broadband

As more radio base stations are deployed, the world's mobile network population coverage[2] continues to increase. At the current trajectory, mobile broadband will provide network coverage to around 95 percent of the world's population by 2022. To address the very low average revenue per user (ARPU) customer segments, expansion of network coverage requires capex and opex-efficient solutions. Telecom operators, vendors, governments and regulators should continue to address affordability and uptake of services usage in parallel with mobile broadband technology deployment. For example:

- Develop cost/benefit-based business models targeting urban and rural areas
- Nurture ecosystems for local apps and content development in local languages
- Prioritize development of ICT literacy and skills

The main barrier to internet access will not be the availability of network technology, but rather illiteracy, affordability and perceived relevance of digital services.

By 2022, there will be an estimated 5.8 billion mobile broadband subscribers, which means there will still be around 2.1 billion people[3] without mobile broadband connection. Out of those, 1.5 billion will be within mobile broadband coverage, but will have no subscription to such a service. The 300 million people within 2G-only coverage could be provided with mobile broadband coverage at a relatively low incremental network cost by an upgrade of existing 2G sites with 3G/4G technology.

The main barriers to internet access will be illiteracy, affordability and perceived relevance of digital services – not availability of network technology

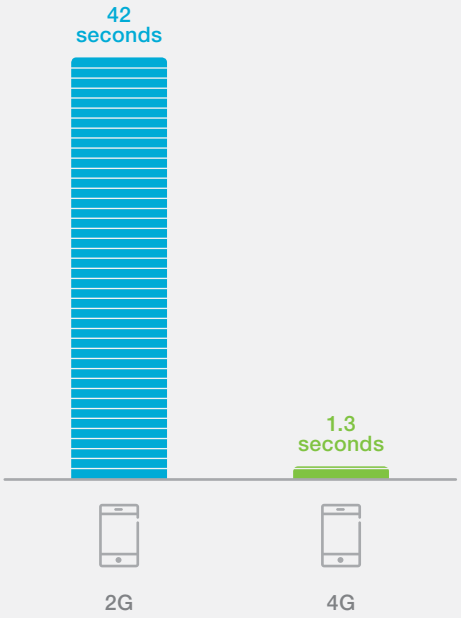
App coverage for the unconnected

The vast majority of those connected to the internet are 3G and 4G subscribers on mobile broadband networks. Some subscribers remain on 2G, which provides significant value to everyday life – including the possibility to use basic data services – but does not offer the full benefits of mobile broadband, or access to a wider range of services.

There is no universally agreed industry definition of broadband, or the minimum required service level for a user to be qualified as connected to the internet. Today, radio base stations in mobile broadband networks can deliver very high throughput and low latency – enough to serve the most demanding mobile applications. Mobile services can have very different sets of network performance needs (for example, a mobile banking app typically requires less from the network than a video-based app). The network performance needed for each user is therefore dependent on the specific service at a given time. The challenge is to build out enough bandwidth at site-to-site distances to enable sufficient performance throughout each cell.

[2] Population coverage is the percentage of the world's population that has sufficient radio signal to connect to a mobile network
[3] According to UN world population estimates, there will be 700 million people under the age of 5 in 2022. Most of these are assumed not to have a mobile broadband connection

Example of the difference between web page download times in live 2G and 4G networks[4]



Mobile broadband in areas with existing 2G coverage

In areas with existing 2G coverage, upgrading sites to 3G or 4G will provide mobile broadband network coverage and additional capacity for voice services. This would require a very low incremental investment compared to aerial access solutions, as most of the costly items – including tower, power, security and backhaul – are already available at the existing site. Typically, there is also no additional spectrum cost. Comparing web browsing download times in live 2G and 4G networks highlights the significant improvements to the user experience that an upgrade enables.

Factors such as demand for connectivity, availability of device types, cost sensitivity among mobile subscribers and operator business case will influence whether upgrading to 3G or 4G coverage will be preferred as an initial solution. Some steps to increase mobile broadband penetration are as follows:

- **Identifying potential mobile broadband subscribers' locations**
  To optimize investment decisions, operators should identify which sites to upgrade from 2G to 3G and/or 4G for the best return on investment. One of several ways to do this is by using call data records associated with the existing 2G network. Information in call data records can determine which existing 2G sites have the highest number of expected mobile broadband-capable users.
- **Mapping spectrum assets, technology choices and device capabilities of the subscriber base**
  The network operator should map how its spectrum assets match the capabilities of its subscribers' device capabilities. Existing spectrum assets, spectrum refarming opportunities and device penetration (supported technology and bands) influence the revenue potential of 3G and 4G deployments.
- **Building selective cost-efficient coverage**
  In areas with moderate traffic demands, operators can cover significantly larger geographical areas with mobile broadband solutions designed for cost-efficient coverage, based on traffic predictions indicating the best sites for mobile broadband expansion.

To select which 2G sites to upgrade, a first step could be to identify those with the most subscribers with 3G/4G-capable phones attached

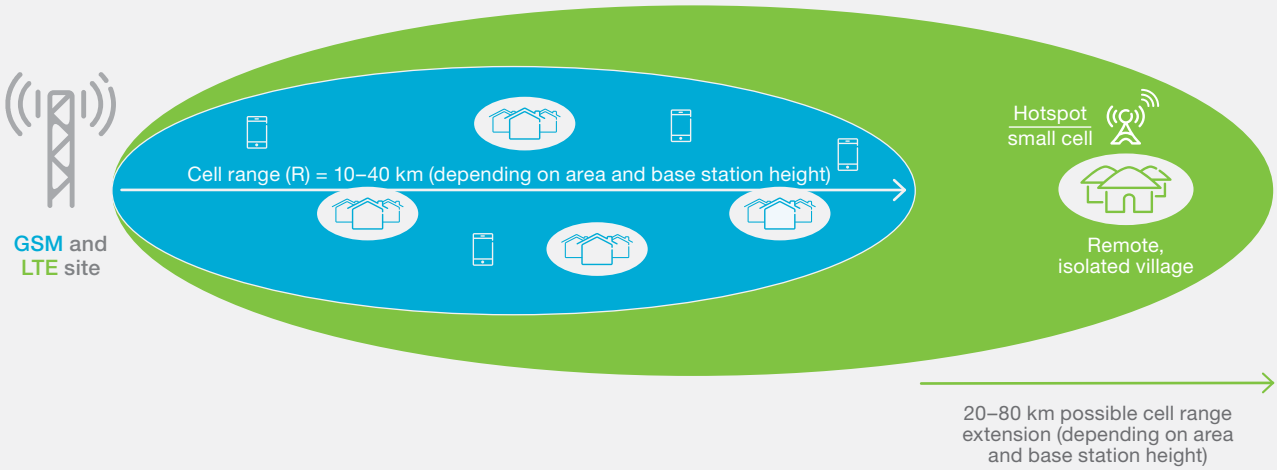
Upgrading 2G sites with 3G/4G technology

Upgrading existing 2G sites to 3G or 4G operating at low bands is possible on the existing network grid, and there is potential to utilize larger antennas and beamforming to increase 4G coverage and capacity even further.

Today, there are hundreds of thousands of legacy 2G sites suitable for a cost-efficient 3G/4G technology upgrade. For example, compared to deploying new conventional 3G sites, the reuse of existing 2G combined with new 3G equipment can result in total cost of ownership (TCO) savings of more than 60 percent. To select which 2G sites to upgrade, a first step could be to identify those with the most subscribers with 3G/4G-capable phones attached.

[4] Measurements done in 2016. Download time for KEPLER webpage from etsi.org (many small objects)

Example of solutions for providing mobile broadband coverage in remote rural areas



Mobile broadband for areas without existing coverage

Extending mobile broadband coverage to populations that reside outside any existing mobile coverage area is more challenging, as they are typically spread over large areas at different geographical locations. For instance, villages may be geographically concentrated, or isolated and distant from concentrated areas in some rural locations.

Assume a scenario where several villages have access to 2G coverage and some villages are outside any mobile coverage. Different solutions to provide mobile broadband coverage can be applied.

Villages within existing 2G coverage area:

- Can easily be provided with mobile broadband coverage by site upgrade to 3G or to 4G. Comparing 2G cell coverage with 3G or 4G on the same frequency band, a coverage gain of up to 7 dB could be achieved due to a better link budget, which translates into a doubling of the cell range.[5] Using LTE (4G) with beamforming has the potential to double this extended cell range again, i.e. achieving a fourfold extension[6] compared to the base case with 2G

Villages outside existing 2G coverage area:

- For important hotspots in a village, such as schools and hospitals, an outdoor high-gain antenna can be used to provide broadband access to the premises (fixed wireless). This solution requires low investment and the 4G site can serve a hotspot that is located 20–80 km outside the 2G coverage range. In this scenario, the school or hospital is equipped with a roof-top antenna, which as an example, would get 3 Mbps downlink speed[7] at a distance 100 km away from the 4G-upgraded base station site using 2x10 MHz of spectrum
- To reach one or more villages outside a 2G coverage area, an alternative solution could be to deploy a small cell, with backhaul to a macro site using microwave technology. In the case where the villages are isolated and further away from an aggregation point than a single microwave link can reach, satellite backhaul can be used

Scale effects of mobile broadband technologies

Today's mobile broadband technologies and building practices have two major advantages:

- Scalability of technology, as the demand for performance grows
- Economies of scale, as solutions that have the greatest volumes continuously achieve decreasing cost per unit of output

This enables deployment of cost-effective mobile coverage solutions, making it possible to connect low-income subscriber groups with low-cost, low-energy solutions where needed, in presently uncovered areas.

At the current trajectory, mobile broadband will provide network coverage to around 95 percent of the world's population by 2022. Further adoption of internet services depends on how the barriers outlined in this article are addressed by governments, regulators, network operators and service providers.

At the current trajectory, mobile broadband will provide network coverage to around 95% of the world's population by 2022

[5] Assuming free-space propagation loss
[6] Calculation based on using eight antenna elements
[7] Wireless indoor coverage, roof-top antenna and LTE modem connected to e.g. a Wi-Fi router

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