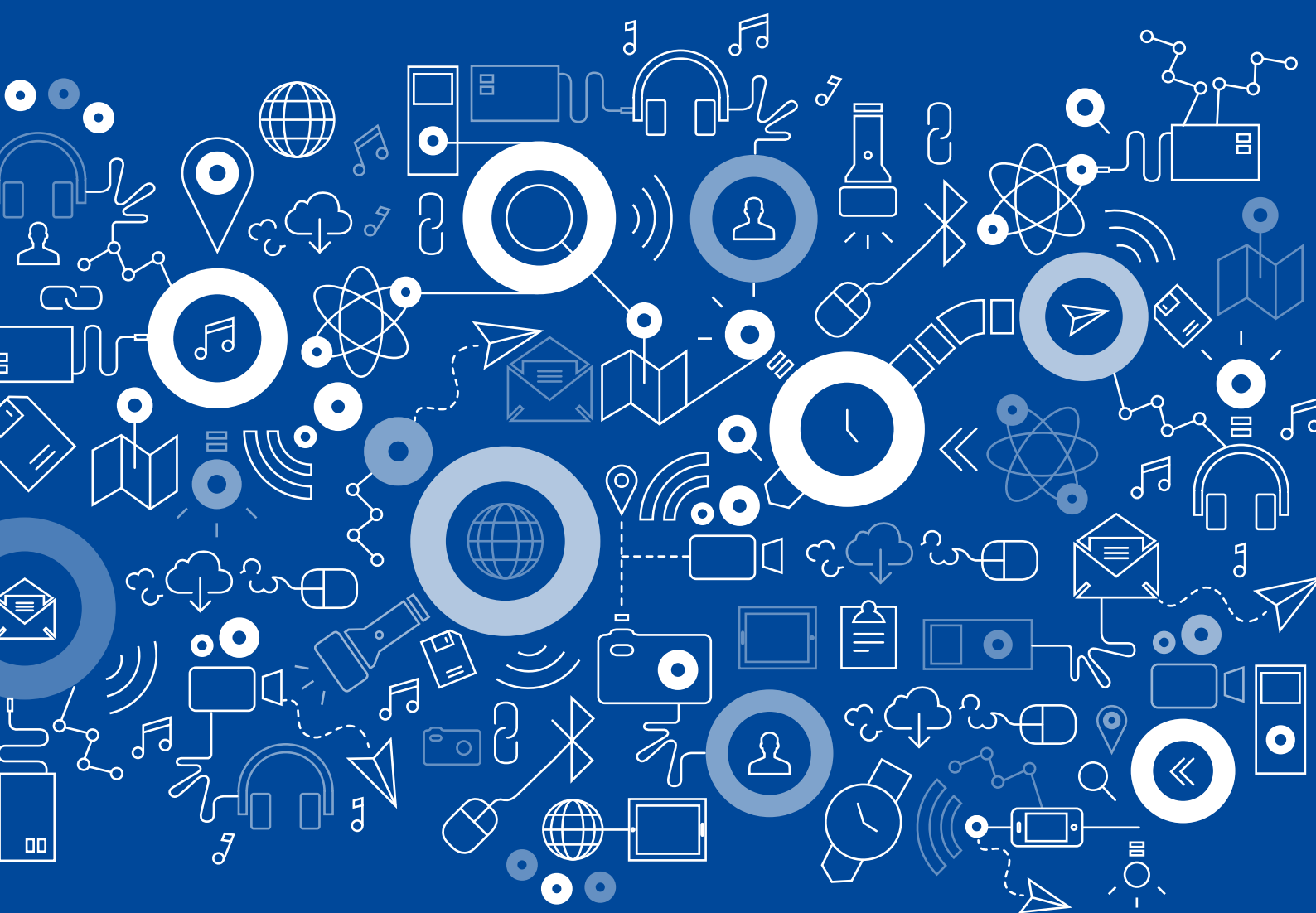
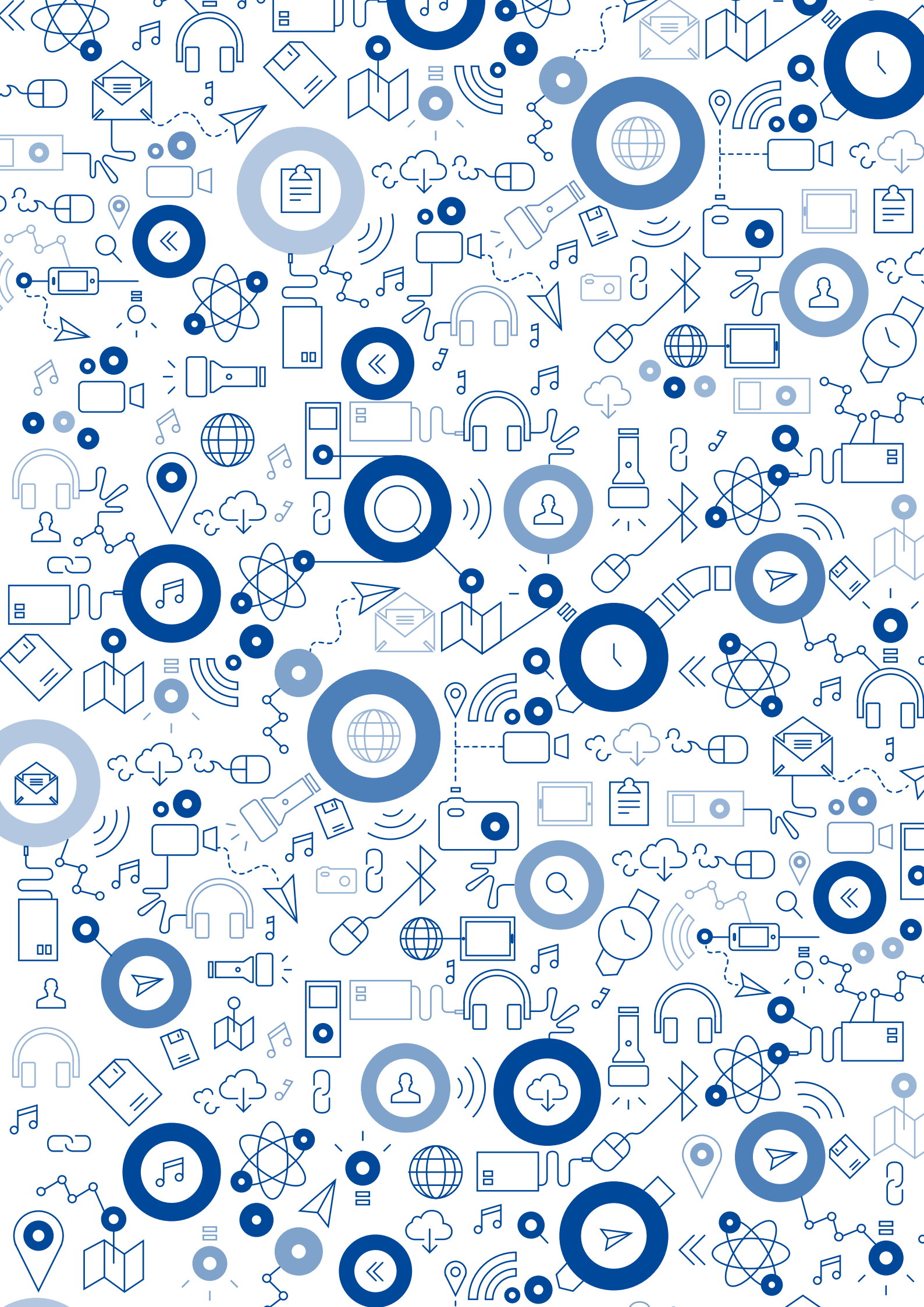


# INTERNET SOCIETY GLOBAL INTERNET REPORT 2015

MOBILE EVOLUTION AND DEVELOPMENT OF THE INTERNET





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# Foreword

The Internet Society's mission is the Internet for everyone. Today there are more than 3 billion people online, and mobile access to the Internet will be instrumental in bringing the next billion people online.

Mobile phone service, which is now available to more than 90% of the global population, represented a significant leap-frog in countries where there was no fixed service before, and it was adopted at a breathtaking rate. Upgrading networks to offer mobile Internet is an incremental step that is being adopted even faster than mobile telephony before it.

Accessing the mobile Internet is not just a matter of unplugging our laptops, however – we use smartphones and tablets with a range of features and sensors not available or needed in a traditional computer. These enable us to take and share videos; learn a trade and improve our livelihoods; help with our fitness and personal safety; and contribute to countless other activities. These new features are accessed through apps, not browsers, which is evolving how people use the Internet.

I am pleased to launch this second annual *Global Internet Report*, which continues to provide integrated analysis and reporting, with a focus this year on the mobile Internet. The report explores mobile Internet availability, affordability, and relevance to potential users, and highlights opportunities as well as challenges to ensure all users can enjoy the full benefits of mobile access to the open Internet.

I commend our Chief Economist, Michael Kende, for his vision and expertise in developing this report, and thank all the contributors who shared their time and insights.

We hope that this *Global Internet Report* series continues to contribute to the progress of Internet development.

**Kathy Brown**  
President and CEO

# Executive Summary

# Introduction

We focus this year's report on the mobile Internet for two reasons. First, as with mobile telephony, the mobile Internet does not just liberate us from the constraints of a wired connection, but it offers hundreds of millions around the world their only, or primary, means of accessing the Internet. Second, the mobile Internet does not just extend the reach of the Internet as used on fixed connections, but it offers new functionality in combination with new portable smart devices.

The benefits of the mobile Internet should not come at the expense of the founding principles of the Internet that led to its success. The nature of the Internet should remain collaborative and inclusive, regardless of changing means of access. In particular, the mobile Internet should remain open, to enable the permission-less innovation that has driven the continuous growth and evolution of the Internet to date, including the emergence of the mobile Internet itself.

Mobile voice technology was introduced in the 1980s and quickly upended traditional telephony around the world. Two major milestones of the last decade have multiplied the impact of mobile technology and shaped the mobile Internet of today.

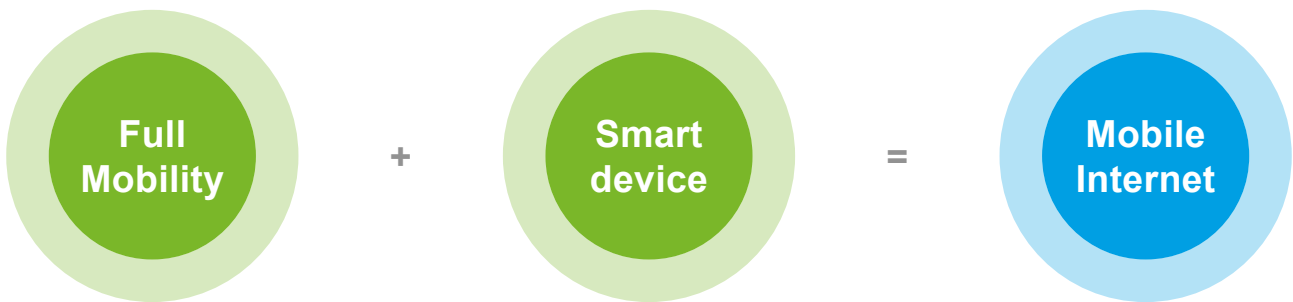


**The introduction of Internet access to traditional 2G mobile voice technologies in mid-2000, and then moving through 3G and now 4G technologies that are faster and have greater data capacity.**



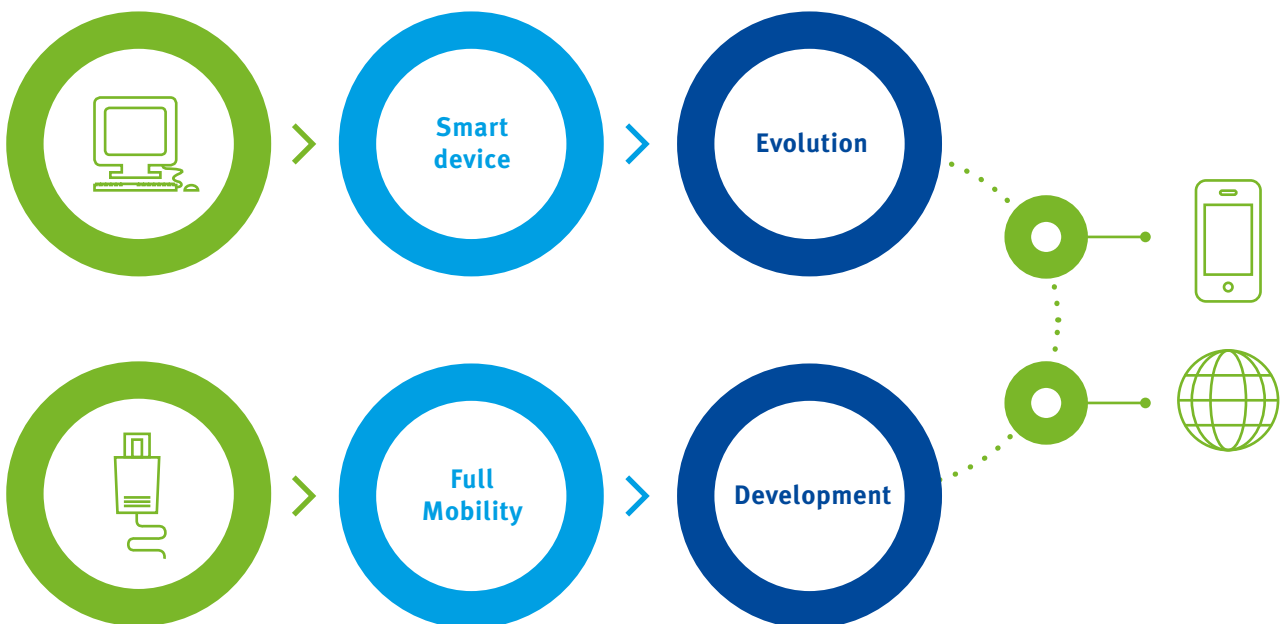
**The introduction of smart devices starting with the iPhone in 2007, a new type of portable computer with a number of advanced features such as location-awareness, which are accessible through apps distributed through online stores.**

For the purposes of this report, we define the mobile Internet as fully mobile access to the Internet using smart devices.



This mix provides significant benefits to users, many of which are readily apparent, others of which we can still only imagine. We highlight two benefits here.

First, it is clear that the mobile Internet will play a key role in bringing the next billion users online. Mobile Internet has already leap-frogged fixed access in many countries because of limitations in the coverage of the fixed network, and the availability of mobile Internet access significantly outpaces adoption today. The mobile Internet is therefore central to realising the Internet Society vision that 'The Internet is for everyone'.





Further benefits of the mobile Internet are arising from new innovative services based on mobile access to the Internet, using all the features embedded into the smart devices, and accessed through apps. These services enable social inclusion, interaction with government, and commerce, among other applications. These innovations are already driving a further evolution of the Internet that has been in a state of constant change since its founding.

## Trends and Growth

***WE ALWAYS OVERESTIMATE THE CHANGE THAT WILL OCCUR IN THE NEXT TWO YEARS AND UNDERESTIMATE THE CHANGE THAT WILL OCCUR IN THE NEXT TEN. DON'T LET YOURSELF BE LULLED INTO INACTION.*** .....

Bill Gates

Nowhere can this quote be more true than with respect to the rise of the mobile Internet. Ten years ago, fixed broadband had just surpassed dial-up as the main form of Internet access; one billion users accessed the Internet, the majority from developed countries; and it would be another two years before the iPhone was launched and four years before the first 4G network was deployed.

Today, the changes that have taken place would have been hard to fathom ten years ago. We highlight a few key statistics and trends:

- 3 billion Internet users were likely by May 2015.
- Mobile Internet penetration is forecast to reach 71% by 2019.
- Usage per device is forecast to more than triple by 2019.
- 192 countries have active 3G mobile networks, which cover almost 50% of the global population.
- Smartphone sales are the majority of mobile handsets sold worldwide; tablet sales will soon exceed total PC sales.
- While there are at least five mobile platforms, Android has an 84% share of smartphones, and 72% of tablets.
- There are well over 1 million apps available, which have been downloaded more than 100 billion times.
- Time spent using apps exceeds time spent on mobile browsers, and in the US, at least, exceeds time spent on desktop and mobile browsers combined.

# Benefits of the Mobile Internet

These apps, taking advantage of the advanced features of smart devices and the full mobility of users, have provided benefits in every part of our lives:

- Entrepreneurs have created billion dollar opportunities developing and selling apps worldwide.
- Users' livelihoods can be enhanced as farmers, fishers, and others use apps to increase their output and earnings.
- Opportunities abound for general education, and to help learn a trade through the mobile Internet.
- Users with disabilities can rely on mobile services to communicate, work, and shop, among other activities.
- Governments are increasingly using the mobile Internet to communicate with their citizens and make information available.
- A variety of mobile healthcare applications are emerging for users to track their own fitness or enable remote diagnostics.
- Smart devices can be used to send automatic alerts when the user's personal security is in danger.
- As with many new electronic devices, the mobile Internet is used for entertainment, including watching video and playing games.
- The sensors in smart devices, including not just location, but also barometers, accelerometers, and others, enable them to be a part of the emerging Internet of Things.
- Governments are beginning to use mobile networks to create smart cities that deliver infrastructure and communications more efficiently.

# Challenges of the Mobile Internet

The benefits of the mobile Internet bring their own challenges, however.

For instance, many of us rely on our phones to help us navigate an unfamiliar city, suggest restaurants in the area, summon a taxi, or find

constellations in the night sky. However, many of us also are surprised when confronted with the resulting data on our location and movements that is stored and shared among a variety of companies involved in providing location-based services. The same is true for other types of personal, and possibly sensitive data available through our smart devices.

The privacy concerns are heightened by security risks, as we put valuable personal data on our smart devices where they may be accessed by others. The installation of apps brings risks similar to installing any software on any computer, although app stores are able to screen for malware to protect customers. On the other hand, the app economy may limit our choices of platforms, where today the leading platform commands a market share of 84% of all smartphones sold and new platforms have difficulty building up a base of customers and apps.

Nonetheless, there is no question that the number of users, and the amount of their usage, will continue to grow, and the spectrum needed to increase the growth in users and usage must be made available at the national and international level. Further, to help the next billion get online, many of whose entry point will be the mobile Internet, services must be available, affordable, and locally relevant.

These challenges are summarized in the table below



## EVOLUTION



**Smart devices enable services such as location awareness and include features such as cameras; the flip side of the coin is increased privacy issues**





**Usage of the mobile Internet depends on a number of wireless interfaces and access to apps; these lead to heightened security issues**



**Apps provide convenient access to the advanced features of the phone such as the GPS or camera; but app stores create costs for developers and customers and may limit competition**




## DEVELOPMENT

-  More users are doing more with the mobile Internet; is there enough spectrum available?
-  Mobile Internet is the way the next billion are going to get online; will this close the digital divide?



# Recommendations

Each of the challenges identified can be overcome, through the actions of all stakeholders working in combination, as follows.

## EVOLUTION

-  **Privacy:** It is important to ensure that users have the ability to provide privacy permissions in a way that is simple to understand and implement.
-  **Security:** We should implement a Collaborative Security approach to mobile security, with all players in the ecosystem playing a role in this effort.
-  **App challenges:** We encourage multi-stakeholder support for the Open Web Platform, as a way to increase platform choices for users that is consistent with our OpenStand principles.

## DEVELOPMENT

-  **Spectrum: Policymakers must ensure that sufficient spectrum is available to meet new demand and ensure that congestion does not throttle demand.**
-  **Digital Divide: Policymakers should ensure that the mobile Internet is available throughout their countries; affordable without undue costs; and relevant to users based on language and content.**

## Conclusion

As we look forward on the challenges that must be met to increase the benefits of the mobile Internet for all, we should be mindful of both parts of Bill Gates' quote above; not just that we would have underestimated the change that took place in the past ten years, but that we may overestimate the change that can take place in the next two.

As a result, as we collectively celebrate the changes that have taken place over the past ten years, we should also work hard, together, to make sure that the challenges we have identified are met in order that existing and new users enjoy a mobile Internet that is private and secure, with easy choice between platforms new and old, and that it is available, affordable, and relevant to all users everywhere.

# Author's Notes and Acknowledgements

It is a great pleasure to introduce the second annual Global Internet Report covering the mobile Internet. This report is similar in many ways to the first one, containing key data and trends, highlighting challenges, and making recommendations. In order to make it more accessible, it is now available as an online version, and we are very pleased to be able to launch it directly to our members during our first InterCommunity global meeting.

The mobile Internet is of interest partly because it represents an evolution in the Internet. Where Internet access is largely independent of our PC, our operating system, and our browser, we associate the mobile Internet with our smartphone or tablet; in turn, we associate our smart device with a specific platform, consisting of an operating system and app store; and we largely associate our usage with the apps that we have chosen.

One consequence of this is that the mobile Internet has introduced the concept of a new upgrade cycle to the Internet. We now anticipate, or may be surprised by, new features that are added to the phone or operating system that enable apps to do new things, and it is not unheard of for long queues to form outside stores to be among the first to have a new phone. We can thus put our finger on the day that selfies became possible, with the introduction of forward-facing cameras, or new payment systems were enabled with the introduction of near-field communications, leading to whole new uses of the mobile Internet.

The mobile Internet is also characterized by leap-frogging. Where mobile phones surpassed fixed telephony in developing countries at a rate much faster than most anticipated, the mobile Internet, building on the existing mobile infrastructure, is growing even faster. This, alone, is worth celebrating – but ultimately, it is the services enabled by the mobile Internet, helping farmers grow their crops, entrepreneurs find a market, and people with disabilities gain accessibility, that truly mark the impact of the mobile Internet, particularly in regions where there were few offline alternatives.

This report examines the evolution of the mobile Internet and the impact on development as two parts of the mobile Internet story. In the online version, the evolution and the development parts can be navigated separately, to make the report yet more accessible. Online it can also be easily shared, and we invite you to do so to help spread the word.

Finally, the report covers a wide span of issues – some, such as security and development, are long-standing Internet Society issues, while others, such as spectrum issues, are specific to the mobile Internet. With respect to the former, we only focus on the new issues raised in the mobile context, in keeping with our focus on the mobile Internet.

The list of contributors to the report is long and distinguished.

At the Internet Society, I would like to thank Bob Hinden, Kathy Brown, and Sally Wentworth for their leadership and input; and the Global Internet Report working group for their input throughout the process, consisting of Dawit Bekele, Jane Coffin, Mat Ford, Raquel Gatto, Lia Kiessling, Olaf Kolkman, Konstantinos Komaitis, Karen Mulberry, Steve Olshansky, Vyria Paselk, Andrei Robachevsky, Karen Rose, Christine Runnegar, Nicolas Seidler, Rajnesh Singh, Robin Wilton, Dan York, and Fernando Zarur. I would also like to thank my colleagues Nicole Armstrong, Wende Cover, Joyce Dogniez, Graham Minton, Ted Mooney, Jairus Pryor, and James Wood for their input and help in preparing the report and launch.

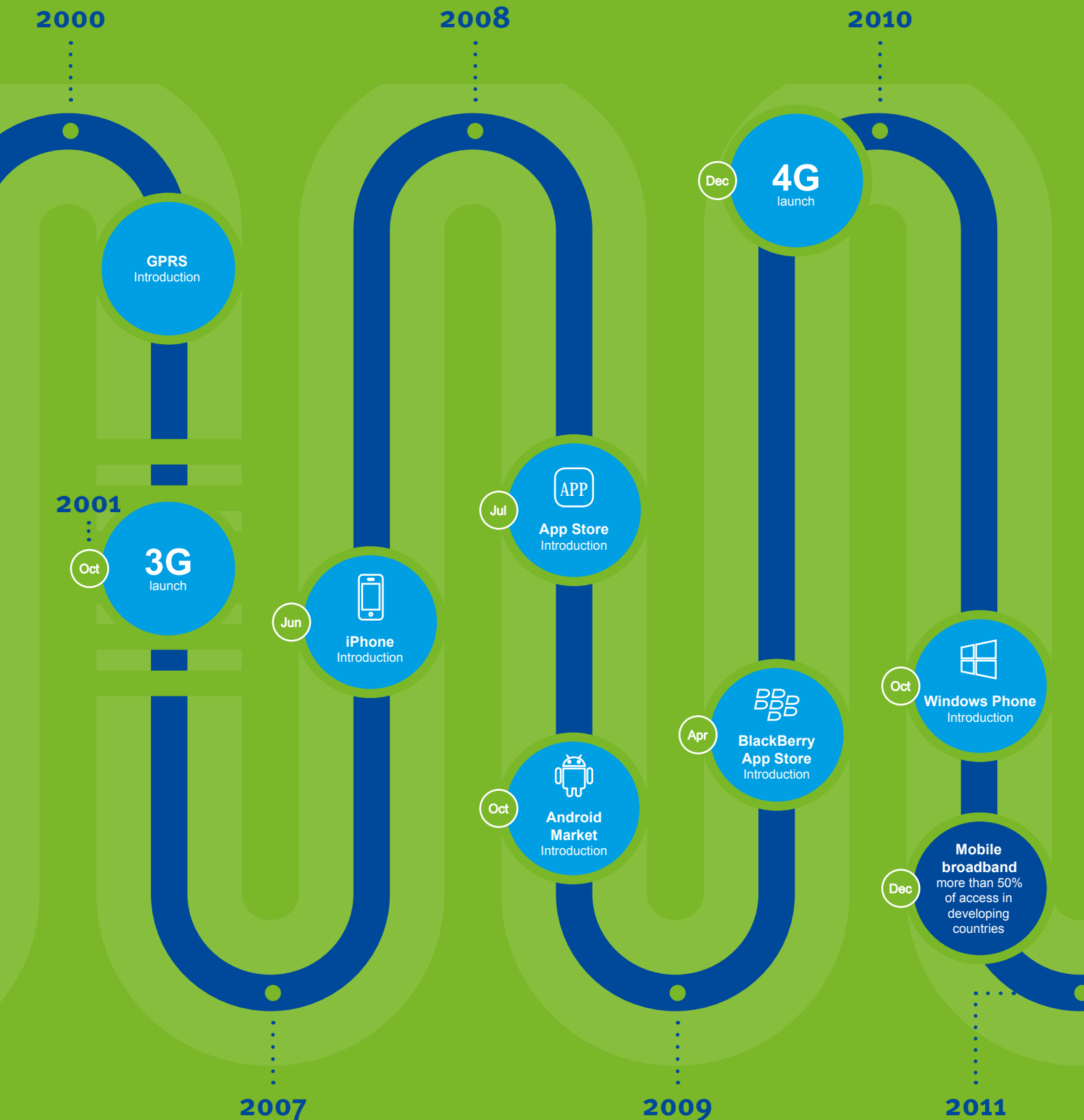
I would also like to thank the Internet Society Chapter Leaders who provided insights and advice on their regional calls, notably Gunela Astbrink on accessibility issues, along with members of the Internet Society Joint Policy Action Team of the Advisory Council.

Valuable inputs came from the broader Internet community, including Russ Housley (Vigil Security, LLC), Richard Barnes (Mozilla), Mark Nottingham (Akamai Technologies), Christoph Steck, Gonzalo Lopez-Barajas Huder, and Miguel Schneider (Telefónica), Jeff Jaffe, Daniel Dardailler, Wendy Seltzer, and Dominique Hazaël-Massieux (World Wide Web Consortium), Colin McElwee (Worldreader), and Gour Lentell (biNu).

Finally, thanks to Mark Colville, Alex Reichl, David Abecassis and Valérie Gualde of Analysys Mason for their research and analysis, and also Internet Society interns Daniela Pokorna and Victoria Situ. Special thanks to Phillippa Biggs of the ITU for her peer review of the entire report. Finally, thanks to Blossom Communications for their beautiful design and development of the printed and online versions of the report. The Internet Society would like to thank TeliaSonera for their sponsorship of the work of Blossom Communications.

**Michael Kende**  
Chief Economist

# TIMELINE OF MILESTONES IN THE DEVELOPMENT OF THE MOBILE INTERNET





2012

May

App usage more than 50% of online usage on a smartphone

2014

Sep

More smartphones than non-smartphones sold worldwide

Aug

More tablets than laptops sold

Jul



50 billion Google Play downloads total

Apr



Firefox OS Introduction

Jun



75 billion iOS downloads total

Jun

More than half of online time was on mobile apps in the USA

Sep

More smartphones than non-smartphones sold in developing countries

Oct

More tablets sold than total PCs

May



3 billion users

2013

2015

# Section 1

## Introduction



**DEVELOPMENT BASED  
ON FULL MOBILITY**

**EVOLUTION BASED  
ON SMART DEVICES**

---

**THE MOBILE  
INTERNET**



## The mobile Internet should remain open

We focus this year's report on the mobile Internet for two reasons. First, as with mobile telephony, the mobile Internet does not just liberate us from the constraints of a wired connection, but it offers hundreds of millions around the world their only, or primary, means of accessing the Internet. Second, the mobile Internet does not just extend the reach of the Internet as used on fixed connections, but it offers new functionality in combination with new portable access devices.

The benefits of the mobile Internet should not come at the expense of the founding principles of the Internet that led to its success. The nature of the Internet should remain collaborative and inclusive, regardless of changing means of access. In particular, the mobile Internet should remain open, to enable the permission-less<sup>1</sup> innovation that has driven the continuous growth and evolution of the Internet to date, including the emergence of the mobile Internet itself.

1980

Mobile voice technology was introduced in the 1980s and quickly upended traditional telephony around the world. Two major milestones of the last decade have multiplied the impact of mobile technology and shaped the mobile Internet of today.



**The introduction of Internet access to traditional mobile voice technologies**



**The introduction of smart devices in place of more traditional mobile phones**

<sup>1</sup> For more detail, please see <http://www.internetsociety.org/blog/tech-matters/2014/04/permissionlessinnovation-openness-not-anarchy>.

# Internet Invariants

It is important that the benefits of the mobile Internet are not achieved at the expense of the fundamental principles of the Internet. The Internet has seen significant change since it was established as a research network more than forty years ago, in terms of both network technology and services offered, including the rise of the mobile Internet that is at the heart of this report. In the light of those considerations, it is important to understand what is actually important and unchanging about the Internet – the invariants that have been true to date – and that should continue to apply to the mobile Internet.<sup>2</sup>



<sup>2</sup> For more detail, please see <http://www.internetsociety.org/sites/default/files/Internet%20Invariants-%20What%20Really%20Matters.pdf>.

# Introduction of Internet access to traditional mobile voice technology

MID-2000

The first milestone in the development of the mobile Internet is the introduction of the General Packet Radio Service (**GPRS**) in mid-2000. GPRS added Internet access to the existing second-generation (2G) GSM mobile voice service. For this reason, GPRS is often referred to as 2.5G technology. While GPRS is very slow by today's standards, it is packet-switched and thus provides always-on access to the Internet, albeit originally over traditional **feature phones**.



..... This is the Nokia 3510, the first mass-market GPRS phone, which had a 96x65 pixel screen

## GPRS

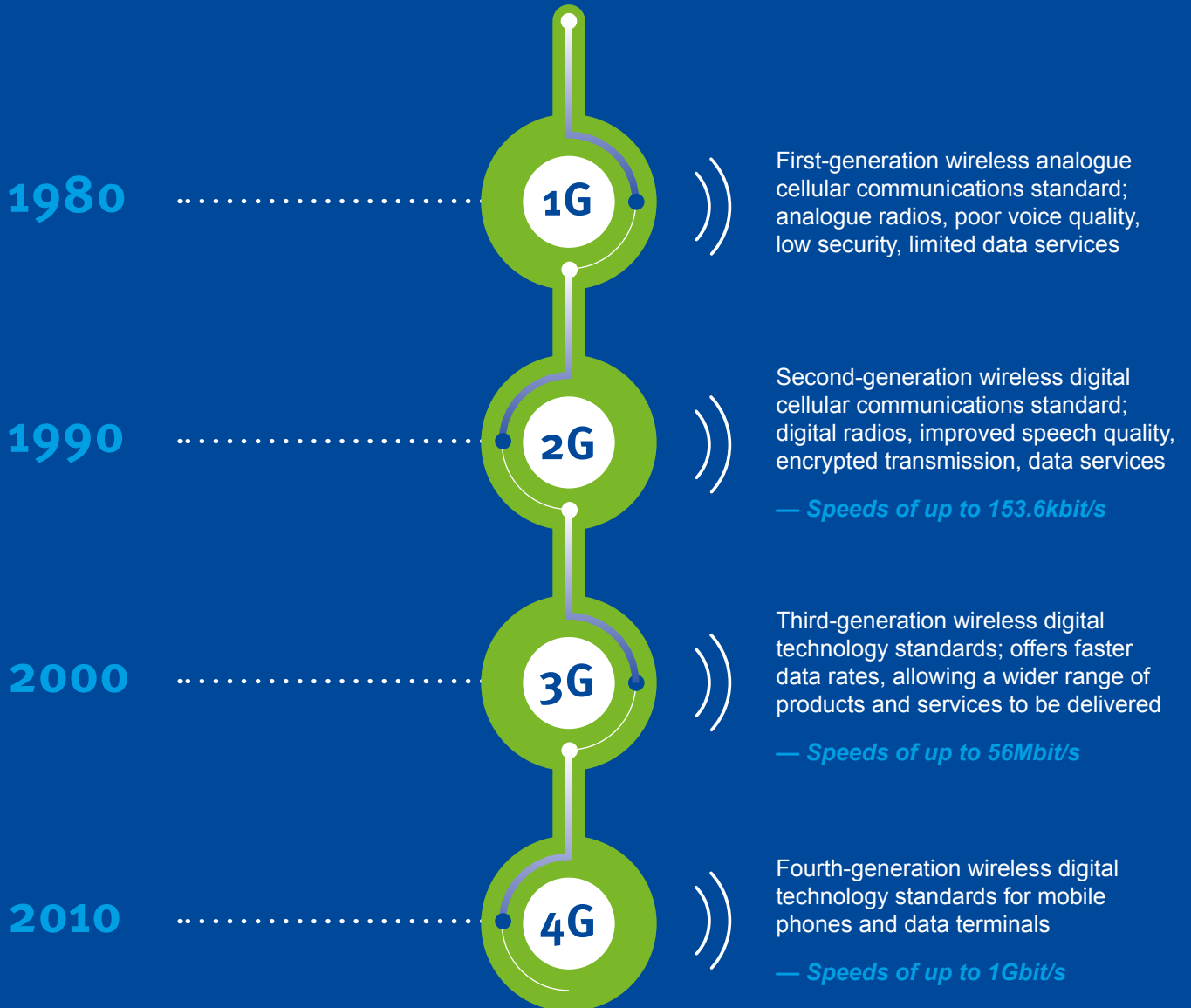
*At its introduction, GPRS offered speeds at the same level as a dial-up modem, that is under 56kbit/s. While GPRS speeds are now greater, more importantly GPRS paved the way for EDGE, 3G, 4G, and beyond. These more recent technologies allow for faster download (and upload speeds) but also mean that data capacity is more likely to be available to users, and at lower latency. For example, setting up a data connection with EDGE takes much longer than on a 3G or 4G network, and voice traffic tends to have priority to a greater extent than in 3G and 4G networks.*

## FEATURE PHONES

*Feature phones are the precursors to today's smartphones, which, along with other smart devices, are the focus of this report. In particular, they are distinguished by small screens and phone keyboards. This has the impact of increasing the level of effort required from users to input data (having to tap out letters using the numeric keyboard) and also limiting the output that could be received to a few short lines of text on a small screen.*

# Mobile technologies

Mobile technologies have been evolving throughout the years, with each new release acting as a step towards improved performance and reduced cost.



● Start of Standards Development

○ Commercial System Launch

**2G/3G** are widely available

**4G** networks are currently available in 102 countries, although with limited coverage

Our focus in this report will be on networks that offer full mobility, such as the evolution of technologies provided above. This does not downplay the general benefits of wireless access using technologies such as Wi-Fi accessed through a wide variety of devices including laptop computers. Such access has a myriad of benefits, cutting us loose from our desks, extending our productivity, even allowing in-flight access to the Internet for those who want that.

However, such access is not the same as full mobility – it is typically an extension of our existing access. For instance, **Wi-Fi** is often linked to a fixed connection to provide limited mobility and/or to offload mobile network traffic. This does not offer the possibility of accessing the Internet everywhere, as with full mobility; and it does not fundamentally change the nature of the services available over the Internet as with a smartphone.

Other technologies exist or are being developed for mobile Internet access, including **Wi-Max** and **white spaces**, while new forms of extending the mobile network are being explored, including high-altitude **balloon**, **drone**, or new **satellite** systems.

#### Wi-Fi



*There are some examples of the use of Wi-Fi as a network, rather than an extension.*

*Wireless@SG is a national Wi-Fi network in Singapore developed by a consortium of operators led by the IDA (Infocomm Development Authority of Singapore) and launched in 2006. Any user of a Wi-Fi enabled device with a registered Wireless@SG account (acquired via registration online or at a customer service centre) can connect to the network. The network offers speeds of up to 2Mbit/s at 1950 hotspots.<sup>3</sup>*

*Innovative Wi-Fi-first networks are also being deployed, such as those of Republic Wireless and FreedomPop in San Francisco. These prioritise carrying traffic via strategically placed Wi-Fi routers. It is only when there are no routers available that traffic falls back on the traditional cellular network.<sup>4</sup> Wi-Fi operates over license-exempt spectrum.*

#### WI-MAX

*Wi-Max networks are deployed using high frequency licensed spectrum over Wi-Max base stations to provide speeds of up to 1Gbit/s to support mobile, nomadic and fixed wireless applications, which require Wi-Max<sup>5</sup>-compatible devices. Wi-Max has more than 455 networks deployed in 135 countries.<sup>6</sup>*

#### WHITE SPACE

*White space technology makes use of the unused spectrum in bands allocated to broadcasting services, for example those chunks of spectrum left open as buffers between digital TV channels to avoid interference or in geographic areas where the spectrum is not being used for broadcasting. Opening up this white space spectrum to lower-powered devices provides more wireless spectrum for data transmission to support a large range of services and devices. This is a relatively new technology without large scale deployment to date. White space technology would operate using license-shared spectrum.*

<sup>3</sup> See <http://www.ida.gov.sg/Individuals-and-Community/Infocomm-You/Wireless-SG>

<sup>4</sup> See [http://www.nytimes.com/2015/02/16/technology/small-phone-companies-use-wi-fi-to-punch-above-their-weight.html?\\_r=0](http://www.nytimes.com/2015/02/16/technology/small-phone-companies-use-wi-fi-to-punch-above-their-weight.html?_r=0)

<sup>5</sup> See [http://resources.wimaxforum.org/sites/wimaxforum.org/files/wimax\\_in\\_india\\_protiviti\\_paper\\_0.pdf](http://resources.wimaxforum.org/sites/wimaxforum.org/files/wimax_in_india_protiviti_paper_0.pdf)

<sup>6</sup> <http://www.networkworld.com/article/2883162/wireless/major-phone-network-exploring-drone-and-balloon-masts.html>

## SATELLITES

Satellites can also be used to deliver communications services (voice or data, one- or two-way) to mobile users such as cars, trucks, ships, and planes. Such systems are likely interconnected with traditional land-based cellular networks.

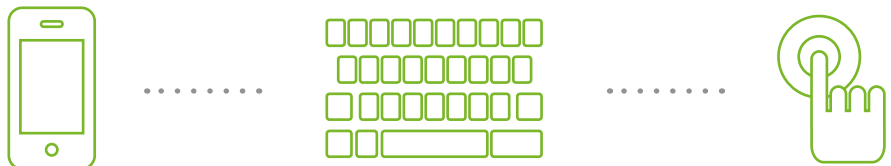
## BALLOONS AND DRONES

Small aerial cells positioned in the sky in tethered balloons or drones over hard-to-reach, patchy signal areas are being considered as a method of boosting coverage and signal strength in such areas.<sup>7</sup> UK mobile operator EE is proposing the introduction of such micro-base stations in 1500 UK communities not currently served by reliable mobile data networks. Unlike Wi-Max, white space and satellite, services provided using balloons or drones will be designed to work with users' existing mobile devices.

# The introduction of smart devices in place of more traditional mobile phones

June  
2007

The second milestone paving the way for the introduction of the mobile Internet was the release of the Apple iPhone, in June 2007. Although this was not the first mass-market **smartphone**, the iPhone had the ability to input with a full keyboard and **finger gestures** using a multitouch touchscreen which also conveyed full color output. This allowed users the ability to use a browser in a similar way as on a traditional personal computer, and the iPhone also created the path for **applications** (commonly referred to as apps).



<sup>7</sup> <http://www.networkworld.com/article/2883162/wireless/major-phone-network-exploring-drone-and-balloon-masts.html>.





## SMART DEVICE

*In retrospect, the iPhone created a new category, the smart device, which one could define as handsets or tablets that have the characteristics of a PC, including advanced multimedia capabilities and the ability for the consumer to install third-party software on it.*

*Smart devices include smartphones, which combine Internet access and telephony in a pocket-sized form, as well as tablets, which are larger than smartphones, to enhance viewing and interaction, but do not have mobile telephony incorporated. More recently, larger smartphones have been introduced, as well as smaller tablets, with the dividing line being the inclusion of mobile telephony.*



## FINGER GESTURES

*The use of finger gestures enables mobile users to overcome the “bottleneck” in computer literacy that comes from requiring the use of traditional interfaces, such as keyboards and mice. This in particular can have uses in enabling disabled access, for example with sign language translation and hand-gesture based wheelchair movement control.*



## APPLICATIONS

*Mobile applications are computer programs that are downloaded to smart devices and operated through an icon that is put on the smart device screen. They are usually available through online applications distribution portals, or app stores, which are typically operated by the developer of the mobile operating system (mobile OS), such as Apple or Google. Many apps can operate offline, interacting with the Internet at varying intervals; others are based on continual real-time interaction. Such apps, designed for a particular OS and available from a particular app store, are often called native apps.*

*Native apps differ from HTML5 web apps which, while also accessed via an on-screen icon, run in a web browser and are limited by the browser capability. See Section 5 for more details.*



## MOBILE OS

*A mobile operating system, also referred to as a mobile OS, is software that operates a smart device, tablet, PDA, or other mobile device, managing hardware and software resources and providing common services for programs. Modern mobile operating systems combine the features of a personal computer operating system with other smart device functions, including a touchscreen, cellular, GPS mobile navigation, camera, voice recorder and music player.*



## APP STORES

*App stores are online digital distribution platforms from which mobile applications can be downloaded. The different stores provide apps designed to run on specific devices, and written for a specific operating system. Some, such as the Apple App Store, are offered by the same company as the mobile OS; others, such as Amazon function as third-party stores.*

July  
**2008**

The first iPhone was introduced with applications. However, these pre-loaded apps were all developed by Apple until the introduction of the Apple App Store in July 2008. Mobile apps are hugely popular and a May 2012 comScore study reported that during the previous quarter, the proportion of mobile subscribers using apps exceeded that browsing the web on their devices for the first time, in the United States.<sup>8</sup>As discussed **below**, apps are not just a convenient way to interact with the smart device, similar to a software program on a computer, but rather they **enable users to access the full-range of features on the smart device.**

<sup>8</sup> We were not able to find similar studies for other countries, but there is no reason to believe that this trend is limited to the US.

# Smart device features

The smart device combines many formerly separate devices into one; enabling an amazing range of functionality.

A reporter recently came across a Radio Shack advertisement from 1991, promoting a wide range of electronic devices, including a CD player, camcorder, and early mobile phone. The reporter noted that 13 of the devices advertised were replaced by the functionality of his iPhone, and noted that in 1991 those 13 devices would have cost USD 3,054.82 (equivalent to USD 5,361.04 in 2015).<sup>9</sup>



<sup>9</sup> "Everything from 1991 Radio Shack ad I now do with my phone," Steve Cichon, January 14, 2014, Trending Buffalo. See <http://www.trendingbuffalo.com/life/uncle-stevesbuffalo/everything-from-1991-radio-shack-ad-now/>. Radio Shack is an American electronics retail chain that recently went bankrupt, likely not helped by the implications of calculations such as this one.

# Smart device hardware features

A smart device, at heart, is a small but powerful computer, with many of the same features as a larger laptop in a more portable version.



These features include significant amounts of storage, a fast processor, the ability to input based on a keyboard or voice, a high-quality screen, and a variety of communications options. For more details, please see the Annex at the end of this section.

## A smart device has many new senses



In addition to its personal computer functionality, a significant number of features are included in a smart device that are not included in a traditional laptop computer. These include sensors that measure the environment and the motion and position of the smart device. We note in particular that these features provide detailed information on the user's location, which is used in many location-based services that feature throughout this report. For more details on the sensors in a phone, including location technology, please see the Annex below.

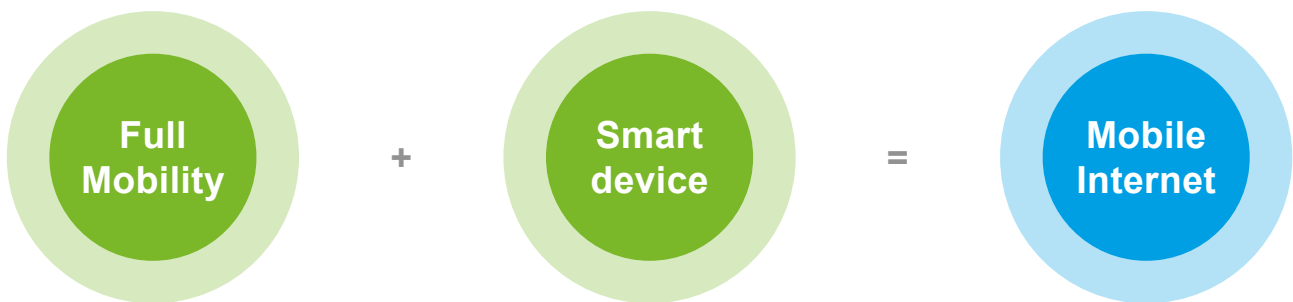
The full hardware features of smart devices can only be accessed through native apps.

A smart device's mobile OS is used as a conduit through which the hardware, including its sensors, speakers and camera, are accessible. However, the related Application Programming Interfaces (APIs), a set of building blocks for developing software applications, are traditionally only accessible to developers through native apps. Traditionally these APIs are not fully accessible to websites, meaning that web pages accessed via a web browser can use less of the smartphone's hardware features than those accessed via a specially developed App.

However, mobile web browsers are getting increasingly good at accessing certain mobile-specific functions such as click-to-call, SMS and GPS, with developments such as WebRTC allowing browser-based services to access phone and camera resources. Nonetheless, this still does not provide the same capabilities as are available through the use of native apps and therefore there is still a limit to the capabilities of browser-based services using HTML5.

## The Mobile Internet

For the purposes of this report, we define the mobile Internet as fully mobile access to the Internet using smart devices.



This mix provides significant benefits to users, many of which are readily apparent, others of which we can only imagine. We highlight two benefits here.

First, it is clear that the mobile Internet will play a key role in bringing the next billion users online. Mobile has already leap-frogged fixed access in many countries because of limitations in the coverage of the fixed network – as we show in Section 2, mobile network coverage is already extensive in many countries, with the result that the availability of mobile Internet access outpaces adoption. The mobile Internet is therefore central to realising the Internet Society vision that 'The Internet is for everyone'.<sup>10</sup>

<sup>10</sup> See <http://www.internetsociety.org/who-we-are/mission>.

Further benefits of the mobile Internet are arising from new innovative services based on mobile access to the Internet using all the features embedded into the smart devices, and accessed through application usage. These services enable social inclusion, interaction with government, and commerce, among other applications, and we highlight these further in Section 3. These innovations are already driving a further evolution of the Internet that has been in a state of constant change since its founding.

## Leap-frogging

*Mobile phones have long since leap-frogged fixed phone connections in developing countries. By **December 2010**, mobile broadband exceeded fixed Internet connections in developing countries.*

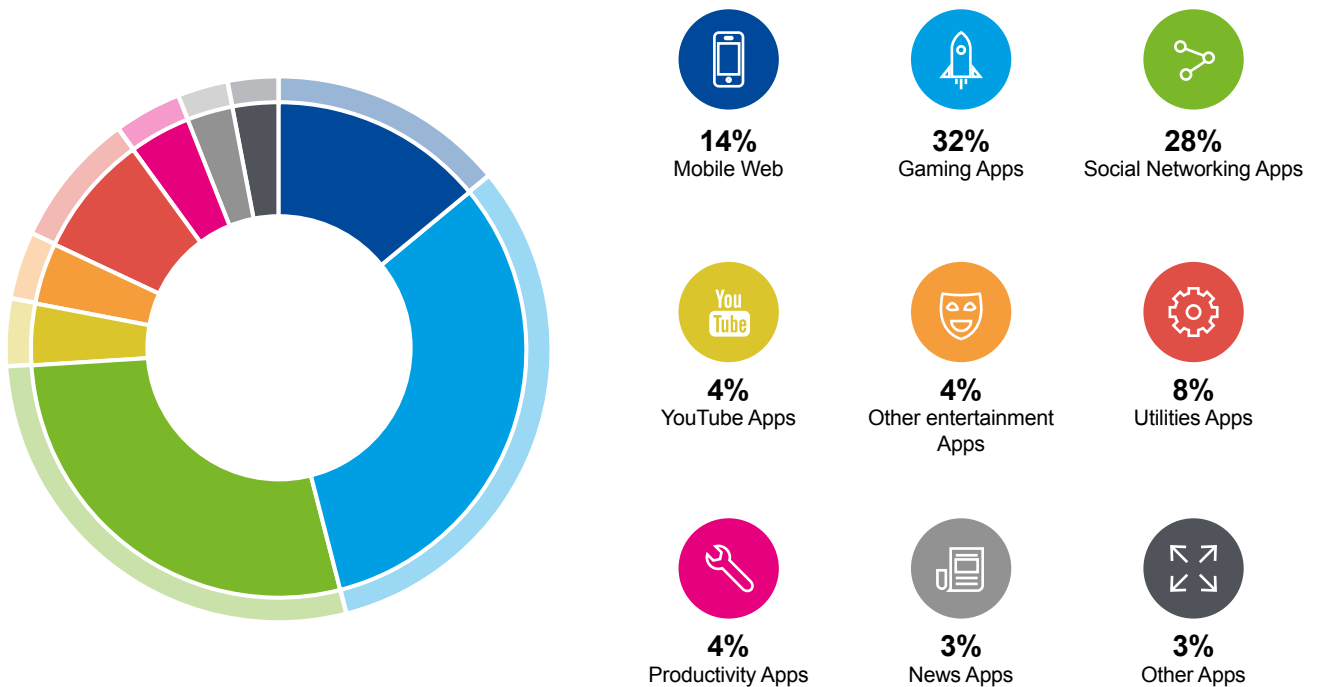
*Further, smartphone shipments exceeded 50% of all mobile handset shipments in developing countries by **September 2014**.*

## Application usage

*Apps are likely to be the predominant mode of access to the mobile Internet for most users, in part because they enable access to the full features of the smart devices.*

*For example, by 2014, 86% of users' time on mobile devices in the US was spent on apps (the remaining 14% on the mobile web).<sup>11</sup> Consumers in Q4 2013 used an average of 26.8 apps, spending 30 hours and 15 minutes on them a month.<sup>12</sup>*

*In the US at least, mobile apps are now the predominant mode of accessing the Internet.*



Source: Flurry Insights, 2014

<sup>11</sup> See <http://www.flurry.com/bid/109749/Apps-Solidify-Leadership-Six-Years-into-the-Mobile-Revolution#.VM-EmbzmzWM8>.

<sup>12</sup> See <http://techcrunch.com/2014/07/01/an-upper-limit-for-apps-new-data-suggests-consumers-only-use-around-two-dozen-apps-per-month/>.

# Conclusion

The impact of the mobile Internet goes well beyond simply unplugging our traditional access to the Internet. It is not simply providing app icons that we can use for convenience instead of using a website from a browser. These changes, alone, have extended access and usability far beyond what it was just ten years ago. However, the mobile Internet is defined by use of a smart device in addition to the lack of a wire; by the functionality of the apps as well as their convenience.

We want to stress, though, that the mobile Internet involves the interaction of these smart devices with the Internet, and not just the functionality of the smart devices themselves. One way to picture this is to subject services and applications to what might be called the 'airplane mode' test.

## AIRPLANE MODE

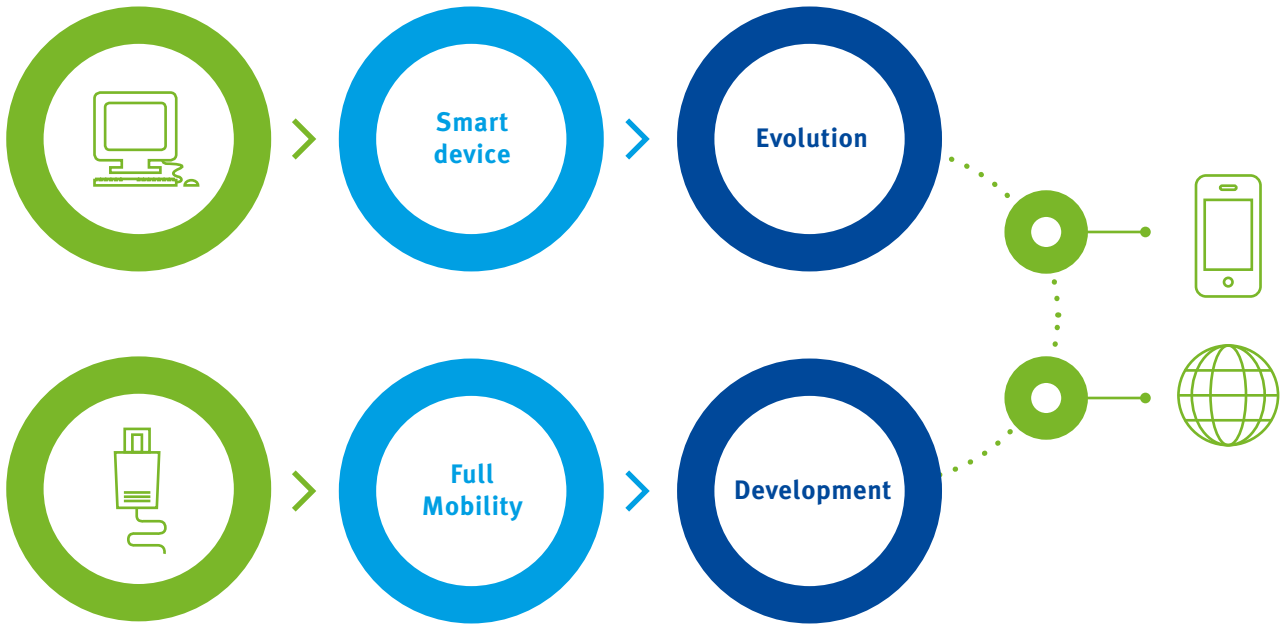


*In airplane mode, a smart device turns off all of its wireless communications, including the connection to the mobile network and Wi-Fi, to avoid interfering with airplane avionics. As a result, the device can be used as a portable computer, with all of its processing, memory, and touchscreen capabilities, but cannot interact with the Internet.*

There are apps that are usable in airplane mode having already downloaded all usable functionality or relevant content. For instance, ebooks can still be read, many games can be played, and PowerPoint presentations can be edited. Such apps, while interacting with the Internet to download functionality or upload edits, mainly rely on the features of the smart device, not the power of the Internet.

In our consideration of the mobile Internet we will focus on the services and applications that cannot function in airplane mode, in other words that interact with the Internet in delivering their functionality. For example, an app that downloads maps from the Internet to provide driving directions is a good use of the Internet; an app that provides real-time information from the Internet about traffic and road conditions uses the mobile Internet.

Within the topic of the mobile Internet there are two stories that are fundamental to the mission and vision of the Internet Society, which can be viewed separately or as part of a broader whole:



*Full mobility is at the heart of the mobile Internet; built on top of the ubiquitous mobile voice networks, this makes the mobile Internet integral to Internet development around the world. It is often said that mobile access has leap-frogged fixed access; however, just as important, based on the unique attributes of the mobile Internet, mobile services such as mobile money are leapfrogging traditional ones.*

*In addition, the features of the smart device, combined with the increased use of apps, are changing the fundamental nature of the Internet, and introducing new concerns regarding privacy and security.*



# Annex

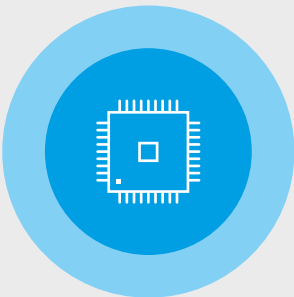
# A number of smart device features are similar to a laptop

Smart devices are now capable of acting as miniaturised laptop computers in many respects. The use of a smart device as a computer has the added benefit of increased portability, with all documents, photos, games and apps available at all times.



## STORAGE

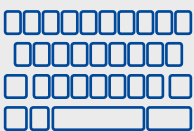
Smart devices are now available with up to 128GB of memory, in the form of a solid-state drive rather than a hard disk, which is more memory than had been developed for any computer until 13 years ago.<sup>13</sup> This allows for an increasing amount of local storage of apps, media, and documents.



## PROCESSOR

Smartphone processor power has increased dramatically since their initial launch. For example, iPhone processor power has more than doubled from the 620MHz processor used in the first-generation iPhones to the 1.4GHz processor used in the iPhone 6, offering download speeds of up to 136Mbit/s.<sup>14</sup>

## Input



## KEYBOARD

With full touchscreen keyboards, it is possible to type on smart devices. In recognition of the small size, devices may offer shortcuts such as autocompletion or autocorrection of words to speed input. Tablets are also able to use external keyboards linked via Bluetooth.

<sup>13</sup> [http://en.wikipedia.org/wiki/History\\_of\\_hard\\_disk\\_drives](http://en.wikipedia.org/wiki/History_of_hard_disk_drives).

<sup>14</sup> <http://www.zdnet.com/article/who-makes-the-fastest-downloading-smartphones-in-the-world-hint-its-not-apple/>.



..... **MICROPHONE**

From the basic phone function of capturing speech, smartphones are able to capture sound, a feature duplicated in tablets as well. Along with communication functions, this enables voice recognition software that allows the spoken word to be transposed to text, or oral commands to be given and understood by smart devices.



..... **SIGHT**

Many smart devices have a camera facing the screen, similar to a laptop, which can be used for video chat. On smart devices, they are particularly popular for self-portraits (also known as selfies) and Google estimates that 93 million of these are taken per day on their devices alone.

In addition, smart devices have front-facing cameras, which are replacing traditional point-and-shoot cameras as the main device for taking photos on the go. The iPhone 6 Plus for example offers 8 megapixel resolution, with image stabilisation, and video capability.

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**Output**



..... **SCREEN**

The screens on smart devices are becoming increasingly high definition, enabling, among other things, the devices to act as video players.



..... **SOUND**

As with laptops, smart devices typically have speakers enabling them to act as speakerphones, among other things. In a nod to the portability of the devices and their historical heritage as music players, select devices such as the LG G2, are capable of delivering 24 bit 192 kHz sound, which is a higher sampling rate and bit depth than CDs.



### SIM, BLUETOOTH, NFC

Smart devices typically resemble many laptops in terms of communications. While all smartphones, by definition, have **SIM** cards to enable access to mobile networks for voice and data services, many laptops and tablets also have the option of a SIM for accessing mobile data networks. In addition, all have Wi-Fi that enables local Internet access, and **Bluetooth** to access peripheral devices such as keyboards and music speakers. Finally, some new smart devices are equipped with **NFC** to enable services using short-range communications, such as payments.

Based on these hardware features, it may be of little surprise to see the rise of smartphones and tablets at the expense of falling or stagnating sales of traditional mobile phones and computers. However, as we note below in Section 4, smart devices may not be optimal for all work normally done on personal computers.

#### SIM

*cards are small circuit boards that are placed into phones or network-connected laptops and tablets that contain information that uniquely identifies that device to the mobile network, allowing the subscriber to use the communication features of the device. The card holds information such as a phone number, security data and billing information that helps the carrier identify the user of the device.*

#### BLUETOOTH

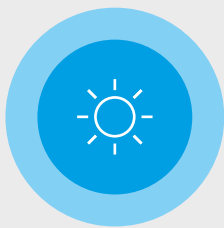
*is a wireless technology standard for exchanging data over short distances between fixed and mobile devices. It operates in unlicensed spectrum between 2.4 – 2.485GHz and was originally conceived as an alternative to data cables.*

#### NFC

*(near field communication) uses short-range, low-power wireless links to transfer small amounts of data between two devices held a few centimetres from each other. Passive NFC 'tags' can be tapped by mobile devices, sending web address, discount vouchers, maps or timetables or receiving instant payments. Both Google and Apple offer contactless "tap to pay" mobile wallet services, Google Wallet and Apple Pay, making NFC payments possible for millions of Android and iPhone 6 users.*

# A smart device has many features not included in a laptop

In addition to its personal computer functionality, a significant number of features are included in a smart device that are not included in a traditional laptop computer. These include:



ENVIRONMENTAL



## BAROMETER

*a number of smartphones include tools capable of measuring atmospheric pressure, which can be useful in augmenting the phone's weather forecasting as well as indicating altitude which can be used for fitness and exercise tracking apps*



## PHOTOMETER

*an instrument for measuring light intensity or optical properties of solutions or surfaces, these can be used by smartphones to augment photography, as well as measuring objects and distances. This also is useful for controlling display brightness based on how much ambient light is present*



## THERMOMETER

*some smartphones contain internal thermometers to measure the temperature of components within the phone (e.g. battery) as well as a secondary thermometer for measuring outside temperatures*



MOTION



## ACCELEROMETER

*these measure acceleration (the rate of change in velocity), which is useful in smartphones to detect changes in orientation and tell the screen to rotate. They are additionally used in smartphone motion sensing games and fitness apps*



## GYROSCOPE

*these devices use the Earth's gravity to help determine orientation, measuring the rate of rotation around a particular axis. These enhance the accelerometer's ability to detect smartphone orientation, particularly when the device is in motion*



## POSITION



### MAGNETOMETER

*these supply phones with information on their orientation in relation to the Earth's magnetic field, enabling a digital compass such that the phone knows which way is North and can auto-rotate digital maps depending on physical orientation*



### PROXIMITY

*these detect the presence of nearby objects, in particular the user's hand or face, and prevent unwanted touch input when the user's ear is near to the phone*



### GPS

*GPS sensors are included in all smartphones and are used to track the device or 'navigate' things by map or picture with the help of GPS satellites*

We note in particular that many of these features provide detailed information to their users, such as the user's location, which is used in many location-based services such as maps and directions.

These features also make smart devices a network of powerful sensors from which data can be aggregated to crowdsource information ranging from weather to health. In this way, the mobile Internet is an early, and potentially critical, part of the emerging Internet of Things.

# Location Technology

The navigational capability for smartphones has been extended beyond on-screen feedback, such as for instance an app and device that causes bicycle handlebars to vibrate in the direction of the turn.<sup>15</sup> Furthermore, location functionality allows data to be collected on travel, for example the use of Baidu apps in China showed that around 80 million people were travelling for Chinese New Year celebrations on 16 February 2015.<sup>16</sup>



## Wi-Fi

Wi-Fi data can be used to identify a handset's location. Companies develop public Wi-Fi location databases that identify the location of hotspots using unique identifying features. For instance, the Google Street View cars also record the locations of all Wi-Fi signals that they pass. The user's position is then calculated based on measuring the intensity of any received Wi-Fi signal(s) and matching it to the public Wi-Fi location database.

## Combination

Most smartphones combine Global Positioning Systems (GPS) with Wi-Fi positioning systems, with Wi-Fi positioning used to compensate for the poor performance of GPS in indoor locations.

## GPS (Global Positioning System)

A space-based satellite navigation system based on time. The satellites carry atomic clocks and the satellite locations are monitored precisely. These GPS satellites transmit data continuously which contains their current time and position. A GPS receiver within a smartphone or other GPS-using device listens to multiple satellites and uses triangulation based on the time taken for the signal to travel from the satellite to the handset to calculate the user's exact location.

## Cell tower positioning

The service provider can derive location using the network provider's infrastructure. The location of the user is calculated based on the radio signal delay of the closest cell-phone towers.

<sup>15</sup> (<http://www.wired.com/2015/01/easy-install-bike-handlebars-buzz-give-directions/>).

<sup>16</sup> <http://news.yahoo.com/heat-map-captures-massive-chinese-migration-093204087.html>.

# Section 2

## Mobile Internet: Trends and Growth



PENETRATION, PRICING,  
AND USAGE

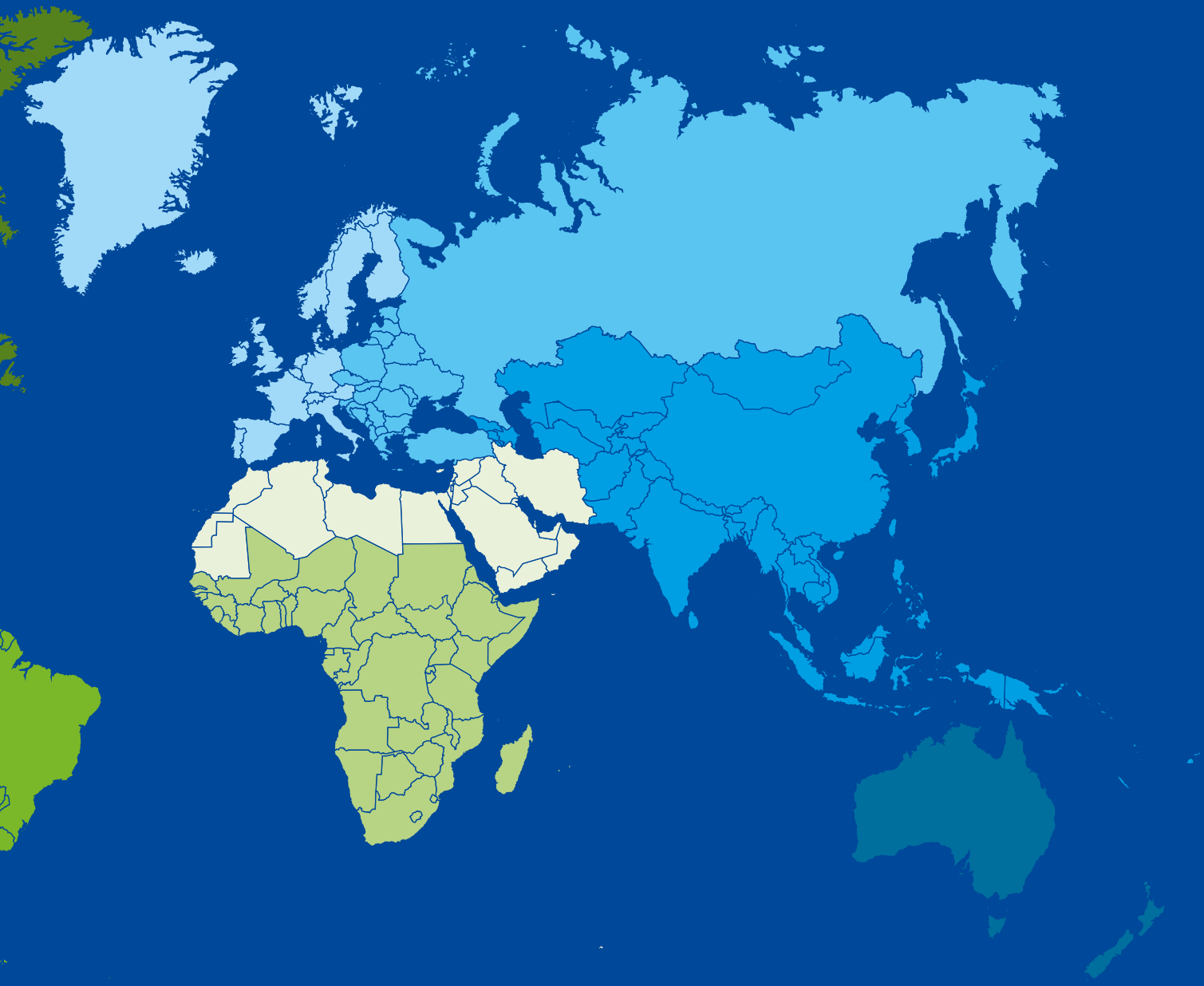


MOBILE NETWORK  
DEPLOYMENTS

APP

DEVICES AND APPS





## DATA PROVIDED BY REGION

**NAM**  
North America

**SSA**  
Sub-Saharan Africa

**CALA**  
Caribbean and Latin America

**MENA**  
Middle East and North Africa

**WE**  
Western Europe

**EMAP**  
Emerging Asia Pacific

**CEE**  
Central and Eastern Europe

**DVAP**  
Developed Asia Pacific

See Annex for the list of countries in each region.

# Penetration, pricing, and usage

The mobile Internet is thoroughly dynamic –prices continue to fall, and usage and penetration continue to rise. The trend that mobile Internet penetration is rising faster than overall Internet penetration highlights the importance of the mobile Internet for users who are increasingly driving Internet growth. Likewise, the traffic generated by these users continues to increase at a faster rate than growth in users, showing that mobile Internet users are trending towards higher bandwidth usage, notably for video.

The impact of the mobile Internet is perhaps greatest in developing regions, where there are few, if any, fixed access options. Starting from low rates of adoption five years ago, growth has outpaced that of the developed regions and is forecast to continue to do so in the near future. Perhaps most strikingly, the growth rate in mobile Internet adoption is outpacing that of mobile phones after they were launched almost 20 years ago, suggesting a very optimistic outlook for mobile adoption in these regions.



## Internet penetration continues to grow worldwide

The global proportion of people using the Internet rose to 38.1% of the global population in 2013, up from 23.2% in 2008, a compound annual growth rate (**CAGR**) of 10% over the period. This represents a global base of Internet users of 2.7 billion in 2013, and the ITU predicted almost 2.9 billion users by the end of 2014, meaning that 3 billion users was likely to have been surpassed in May 2015.

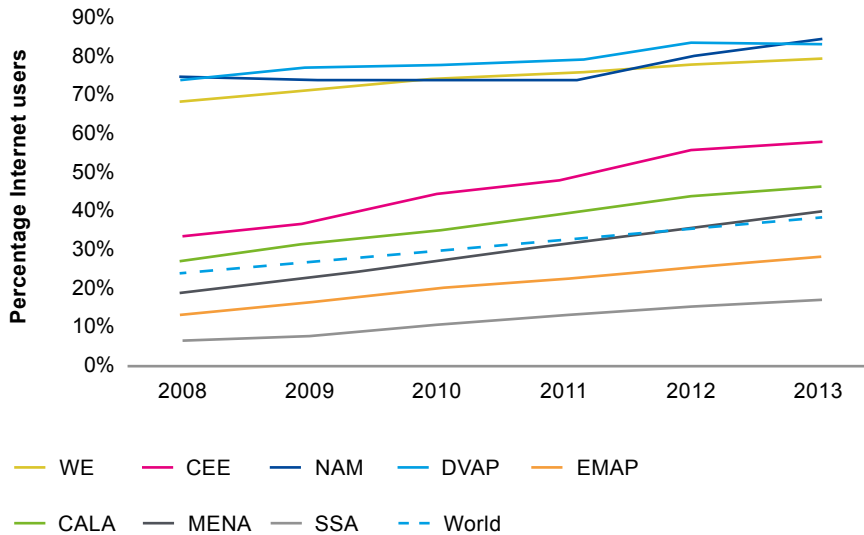


**DATA DEFINITION**

Proportion of individuals in a region using the Internet in the previous 12 month period. Data is based on surveys carried out by individual national statistical offices or extrapolated from information on Internet subscriptions.

The ISOC **Global Internet Maps** provide insight on Internet user numbers in each country.<sup>1</sup>

**Proportion of population using the Internet**



Source: ITU, 2014

**INSIGHT AND REGIONAL DISCUSSION**

While usage continues to be highest in the most developed regions, for example North America where it sits at 84.4%, the increase in usage is most significant in those regions with the lowest penetration in 2008. For example Sub-Saharan Africa has experienced an annual growth rate of 23% over the period, with 17% of the population using the Internet by 2013.

In all other regions, Internet users exceed 25% of the population, including notably in the Emerging Asia Pacific region, with more than 1 billion users, over 630 million of them in China alone.

**CAGR**

The compound annual growth rate, or CAGR, is the year-on-year steady growth rate of the metric over a specific time period.

<sup>1</sup> See <http://www.internetsociety.org/map/global-internet-report/#global-internet-penetration>



## GLOBAL INTERNET MAPS

*The Global Internet Maps<sup>2</sup> were first released to highlight the data in the first Global Internet Report, and since then have been updated and new maps have been added, a number of which relate to the topic of this report.*

### DATA DEFINITION

Mobile Internet device penetration considers the number of mobile Internet devices in a region divided by the population. Our data for mobile Internet access devices includes 3G and 4G capable phones as well as mid-screen device connections, such as via tablets, but excludes 2.5G mobile Internet devices, meaning that it may slightly underestimate the penetration level.

### Mobile Internet penetration is forecast to reach at least 71% by 2019

In 2013 global 3G and 4G capable phone and mid-screen device connections reached 1.97 billion, a penetration of 28%. Global penetration is forecast to grow quickly to 71% in 2019.

Mobile Internet device penetration in the developed Asia-Pacific region already exceeds 100%, indicating that many have multiple subscriptions, while in North America, Western Europe and Central and Latin America it is expected to rise above 100% by 2017. In Central and Eastern Europe a level of 98% is forecast by 2019.

In developing regions, penetration is significantly lower, but individuals or households may share access to devices. In addition, growth rates are forecast to outpace developed regions. Of particular note is the forecast growth rate of mobile Internet penetration in Central and Latin America, where an annual growth rate of 23% is expected.



## UNIQUE SUBSCRIPTIONS

*The number of mobile connections, or SIMs, in the market does not necessarily equal the number of unique subscribers. Some subscribers have multiple subscriptions, a result of a number of factors including cost minimising decisions to use different subscriptions for different services, maximising coverage by having subscriptions on different networks and/or having subscriptions for different device types (e.g. smartphones and tablets).*

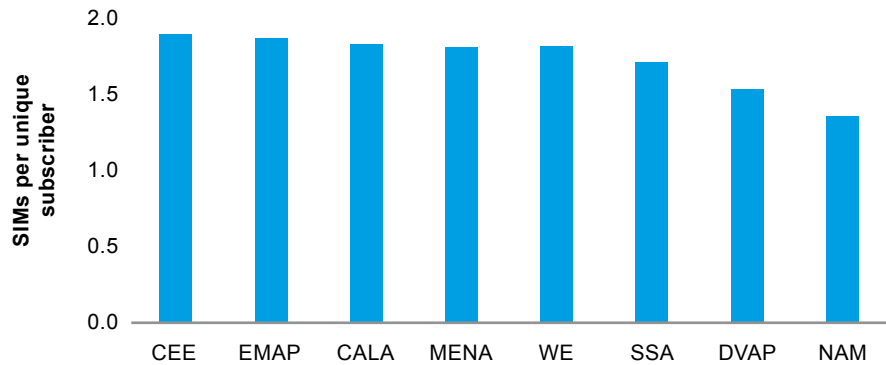
*Such multiple subscriptions are popular and mobile subscribers held an average of 1.78 active SIMs (both voice and non-voice mobile Internet SIM cards) each at year end 2014. Multiple subscriptions are clearly popular for mobile Internet connections, for example, penetration in the Developing Asia Pacific region was around 110% in 2013, implying at least 10% of subscribers hold multiple subscriptions.*

*Other subscribers will share a subscription with other members of their household or community, in particular in developing regions where the cost of a mobile Internet subscription can be very high relative to income.*

<sup>2</sup> <http://www.internetsociety.org/map/global-internet-report/>

## Total mobile SIMs per unique subscriber

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Source: GSMA, Q4 2014

### DATA DEFINITION

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Total annual data traffic originating from mobile Internet devices, 3G and 4G handsets and mid-screen devices.

### Data traffic from mobile Internet devices is forecast to grow rapidly

Mobile data traffic is forecast to grow rapidly across all geographies, at a faster rate than that of mobile connections. This is due to significant increases in mobile traffic per device. While globally traffic will grow at a CAGR of 52% out to 2019, countries in which mobile Internet is already well entrenched will experience slower overall traffic growth than those in regions in which it is less developed, such as the emerging Asia Pacific where the growth rate is expected to be 72%.

### DATA DEFINITION

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Monthly data traffic carried by the average mobile Internet device.

### Data traffic on the average mobile Internet device is forecast to more than treble between 2014 and 2019

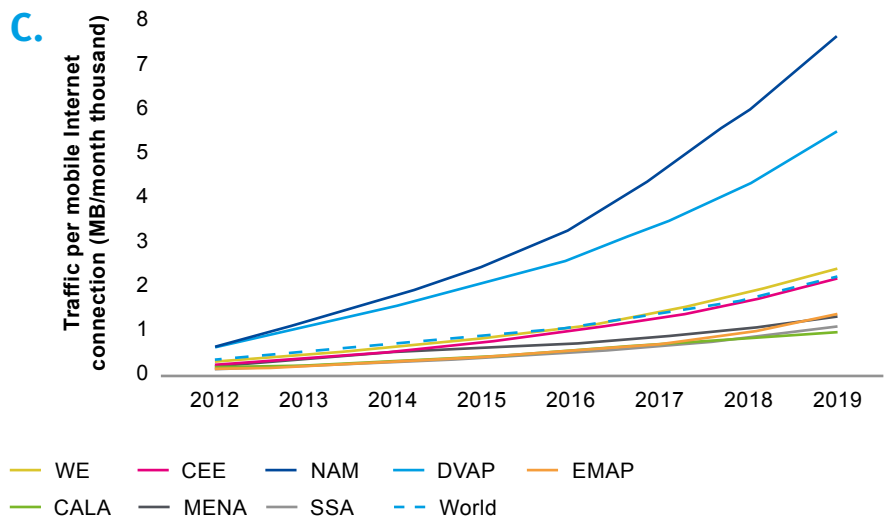
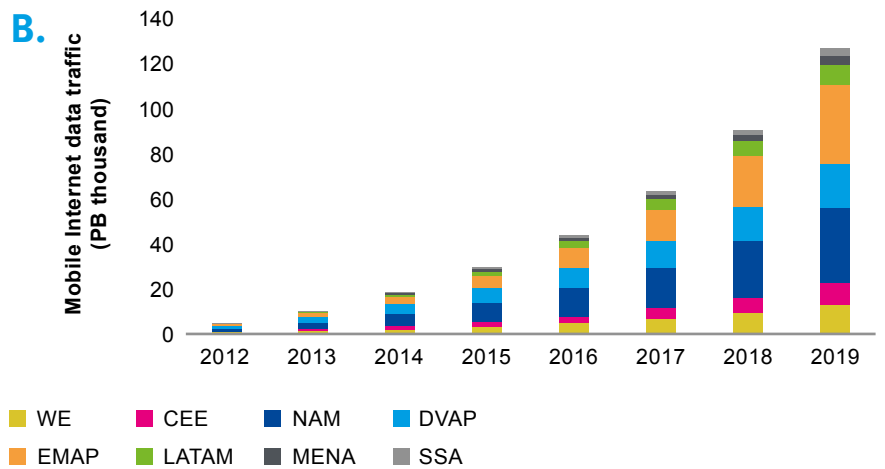
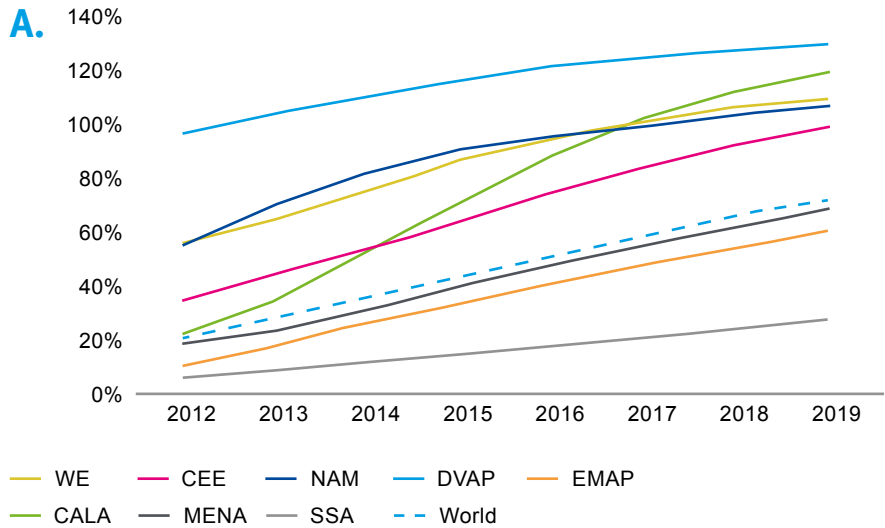
Mobile Internet traffic is not just growing because there are more users – it is also growing because each user is generating more traffic on average based on new multimedia content. This chart shows that traffic per mobile Internet device is predicted to grow significantly across all regions, with a global CAGR of 27% expected between 2014 and 2019.

While all regions are expected to experience growth rates in data traffic per device of at least roughly 25%, the difference in data traffic per connection across regions is forecast to persist. The developed regions with the most traffic per connection today will continue to have the most in the forecast future.

## A. Mobile Internet device penetration

## B. Annual global Mobile Internet traffic

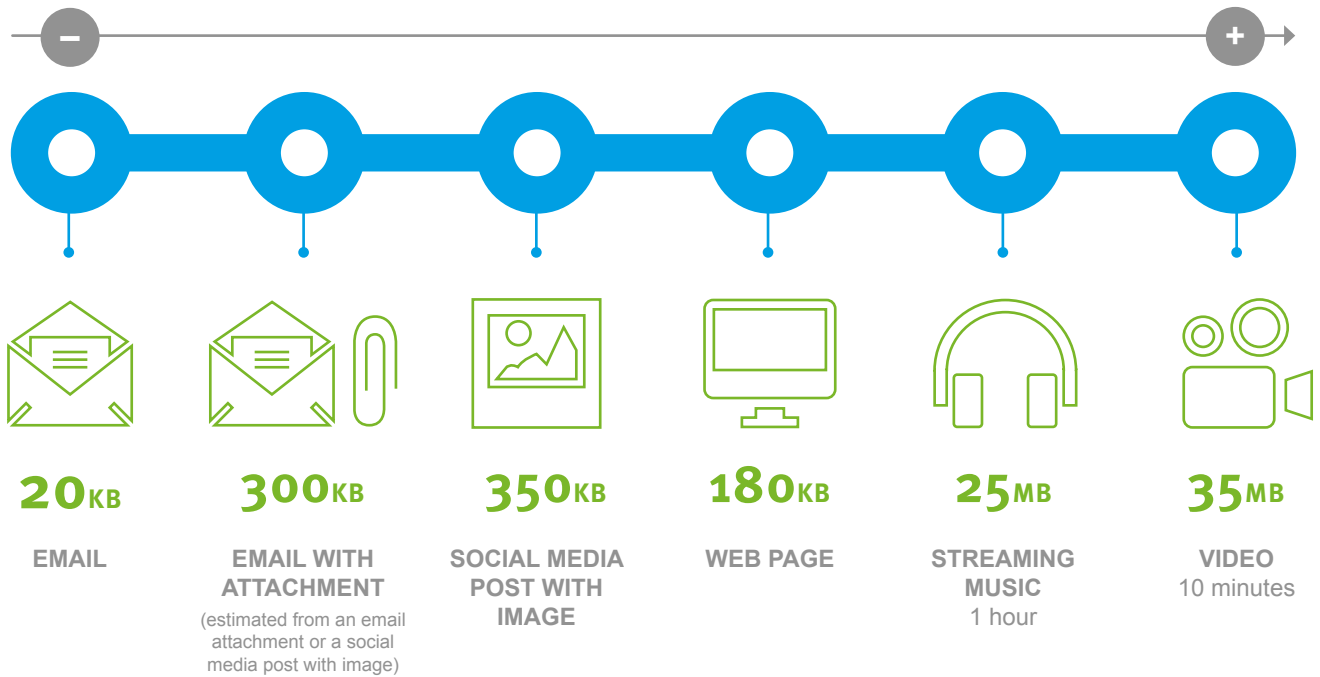
## C. Monthly traffic per mobile Internet connection



Source: Analysys Mason, 2015

The rise in popularity of relatively data heavy multimedia applications, such as YouTube, in combination with the general trend for increased usage of mobile devices for less data-heavy activities is responsible for the growth in mobile Internet traffic per connection.

The graph below shows how different applications generate increased amounts of traffic as audio, and then video, are added.<sup>3</sup>



Source: SaskTel

### Affordability is critical to mobile Internet uptake

One factor impacting usage is the affordability of services, which we show across individual countries in our Global Internet Maps. (LINK <http://www.internetsociety.org/map/global-internet-report/#affordability-mobile-broadband>). Affordability here is measured as the percentage of per capita GDP that is required for a mobile Internet subscription (which, according to the ITU, is at least 3G).

According to the ITU numbers, out of the 129 countries with reported numbers, there are 30 where a subscription costs less than 1% of per capita GDP and 81 countries where a subscription is below the UN Broadband Commission target of 5% of per capita GDP.<sup>4</sup> That still leaves a number of countries over 10% of per capita GDP, which puts a subscription out of reach for many, and in two countries the cost of a subscription is more than 100% of per capita GDP.

<sup>3</sup> These numbers are taken from the SaskTel data usage calculator, meant to help customers determine which wireless plan to choose. The numbers presented here are based on average downloads to a smartphone. For downloads to a tablet with a larger screen, the averages are higher, in some cases double or even more. See <http://www.sasktel.com/wps/wcm/connect/content/Home/Tools/datacalculator>

<sup>4</sup> See [http://www.broadbandcommission.org/Documents/Broadband\\_Targets.pdf](http://www.broadbandcommission.org/Documents/Broadband_Targets.pdf)

## Device costs have a significant impact on affordability

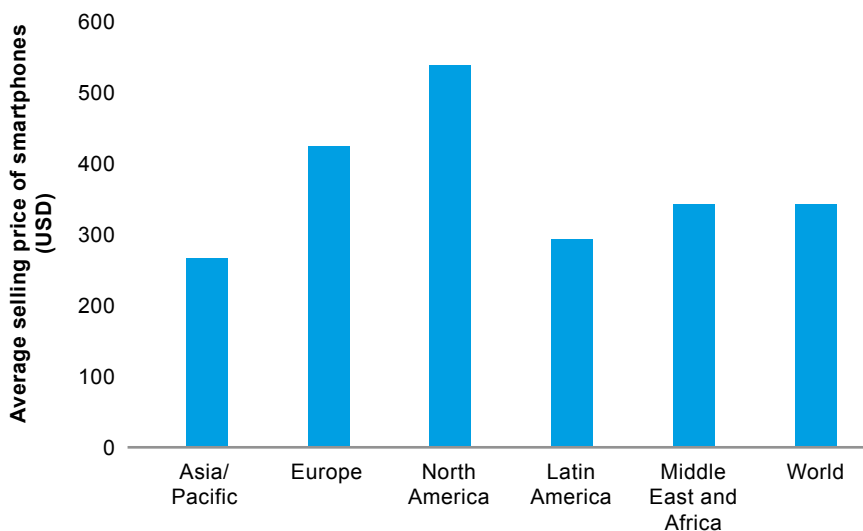
In 2013, global smartphone average selling prices (ASPs) were USD 337, down 12.8% from USD387 in 2012. ASPs in North America and Europe are relatively high, reflecting the popularity of more high-end smartphones in these geographies.

This reduction in ASPs will enable more users to afford smartphones for the first time, satisfying the demand for affordable data consumption in developing regions.

### DATA DEFINITION

The average selling price for smartphone handsets is calculated by region as the total spend on smartphones divided by the total number of units sold.

## Average selling price of smartphones



Source: IDC, 2015

## INSIGHT AND REGIONAL DISCUSSION

*In part this global reduction in ASPs is a result of the entry to the smartphone market of new handset manufacturers focused on low-cost devices. These new manufacturers have been enabled by the growth of Android as well as more open-source operating systems such as Firefox. Traditional device manufacturers such as Motorola and Nokia have released budget smartphones priced at under GBP150, such as the Motorola Moto G 2014 and the Nokia Lumia 735. In developing regions, new entrants to the device market are releasing smartphones with lower specifications at much cheaper prices, for example Mozilla launched its Firefox OS smartphones in India priced at USD25<sup>5</sup> and the Chinese equipment company ZTE sells its ZTE Blade Q Mini device for less than GBP50.*

<sup>5</sup> See <http://www.ibtimes.co.uk/ultra-low-cost-mozilla-firefox-smartphones-hit-budget-conscious-india-soon-1452243>



# The impressive growth in mobile broadband subscriptions easily outpaces the already amazing mobile phone adoption rates experienced in the regions in which mobile has ‘leap-frogged’ fixed

## DATA DEFINITION

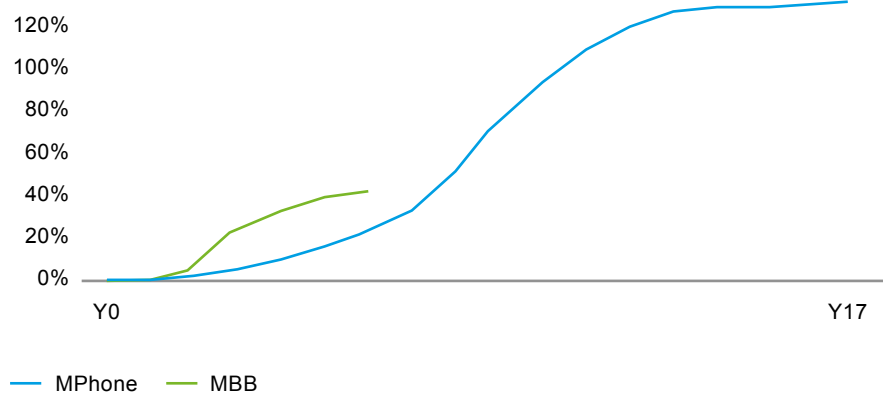
We have compared the growth in mobile broadband subscriptions to the growth of mobile cellular subscriptions per 100 inhabitants for the regions in which mobile can be considered the dominant method of Internet access. Y0 on the chart indicates the year in which the respective services launched in that region; for example in Central and Eastern Europe, mobile phones launched in 1996 while mobile broadband launched in 2007.

Both mobile cellular and mobile broadband subscriptions continue to grow across all regions, with the penetration of mobile broadband devices accelerating away from the growth rates previously seen for mobile phones at the same time following the launch of services.

The regional growth rates in mobile broadband population penetration appear to be significantly higher than the already high corresponding historical growth in mobile cellular penetration, which themselves beat predictions significantly. Within six years of introduction (which corresponds to 2013 for the mobile broadband data), mobile broadband penetration exceeded cellular penetration at the same stage of introduction by between 4 and 20 percentage points across regions.

This faster uptake can be attributed to two factors, the increased awareness by potential customers of mobile services and the lower costs to the service provider of upgrading their service to be mobile broadband capable relative to the original costs of deploying their mobile cellular network.

## MBB and mobile phone penetration CEE

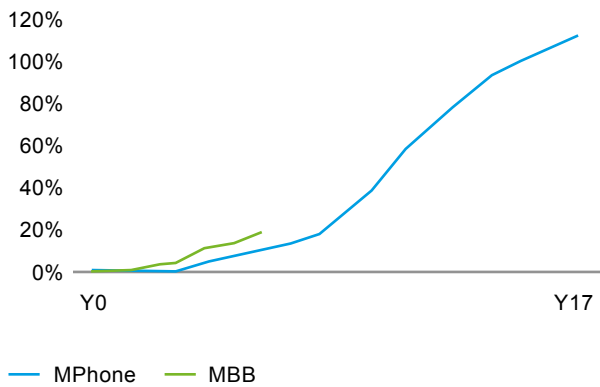


Source: ITU, 2014

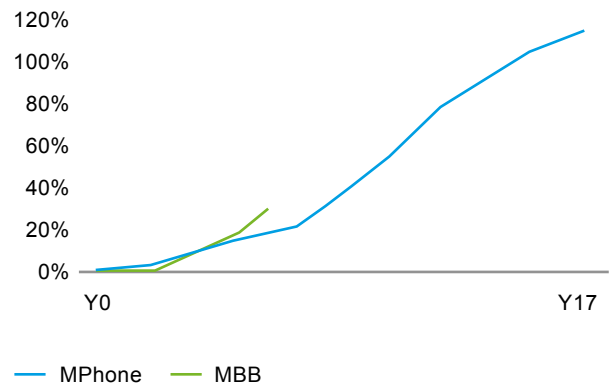
## INSIGHT

Mobile phone adoption was one of the fastest of any technological service in history and its current penetration far exceeds that predicted at the early stages of its deployment. In 1999, for example, Safaricom projected that Kenya as a whole would have a total of three million mobile subscriptions by 2020. And yet, that number was surpassed by the end of 2004, and by September 2014 there were 32.8 million subscribers in Kenya, ten times higher than predicted by Safaricom.

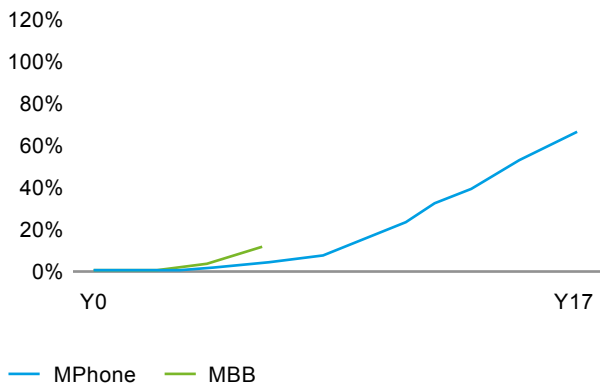
## MBB and mobile phone penetration MENA



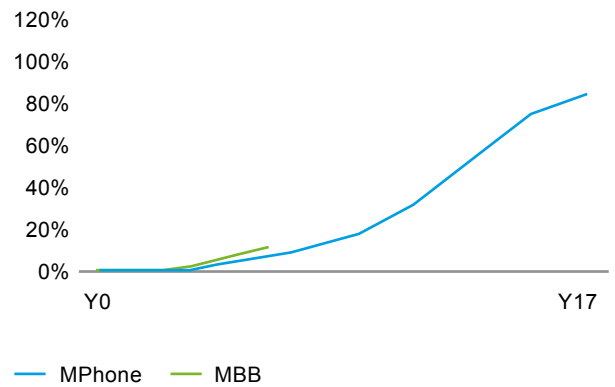
## MBB and mobile phone penetration CALA



## MBB and mobile phone penetration SSA



## MBB and mobile phone penetration EMAP



Source: ITU, 2014

# Mobile network deployments

Prior to the advent of the mobile Internet, the legacy fixed telephone network in a country acted to limit Internet penetration to a significant degree – in areas of the country where the fixed network was not deployed, or not upgraded to enable Internet access, then there were limited options for people to go online. Thus, at this point, the digital divide was often characterized by access – those who wanted to go online, and could afford to do so, could not if they were not reached by the fixed network. The cost of extending coverage of the fixed network, in turn, was high because of the cost of deploying a line to each and every residence.

Access to mobile telephony quickly overtook fixed telephony in many countries, even where there was an extensive fixed network, because of the nature of the costs. In extending a mobile network, once a tower is in place, anyone within radio reach of that tower was covered, both on the move and within their residences. Further, the cost of **upgrading** the network to offer mobile Internet was incremental, and the upgrade reached everyone within coverage of the network. As usage increases, additional costs are required to increase capacity – however, the additional usage generates the revenue to cover the corresponding increases in capacity.

As a result, in many developed countries the coverage for mobile telephony, and then mobile Internet, quickly approached 100% of the population, while in developing countries the coverage quickly surpassed the fixed coverage, and is trending up above 50% for voice, and increasingly Internet. As new generations of mobile networks become available, such as most recently 4G, the coverage can quickly extend throughout the network to all of the population, representing significant increases in bandwidth speed for the user, and capacity for the operators.



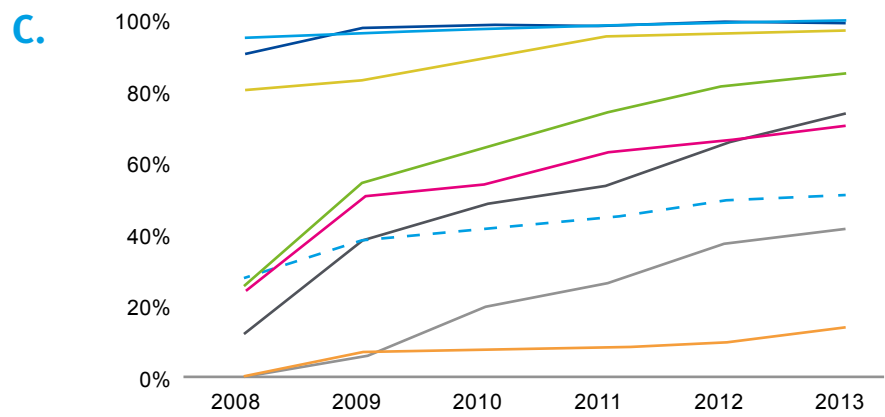
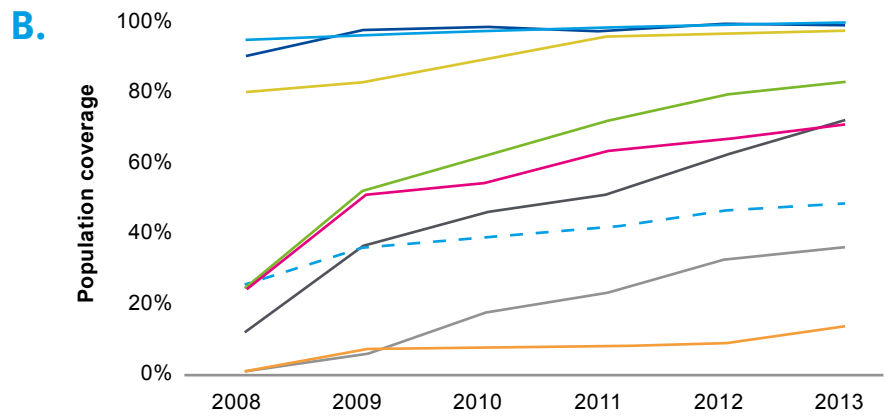
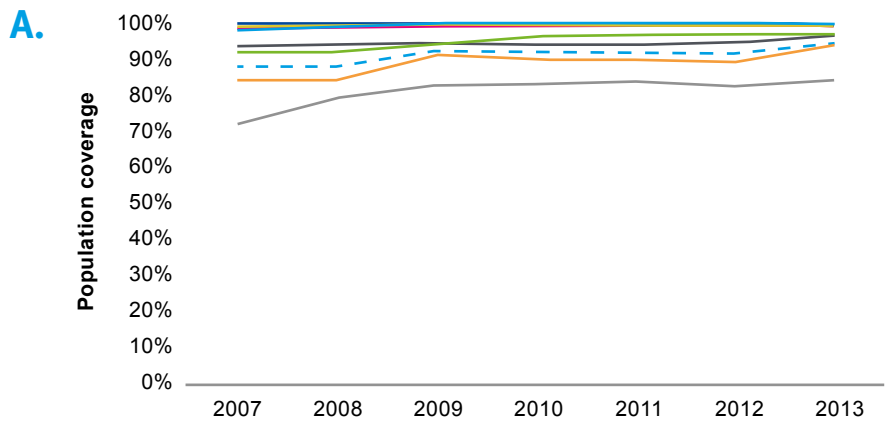
## UPGRADING

*The majority of cellular network coverage areas have at least 2G services deployed. Given that upgrading services from 2G to 2.5G requires minimal costs relative to the original network roll-out costs, as the majority of fixed network costs such as infrastructure are shared, the move from mobile to mobile Internet services has been rapid. We would estimate that the costs of such a network upgrade would be less than 10% of the initial roll-out costs. This is in part responsible for the more rapid uptake (leap-frog) of mobile Internet than mobile cellular devices and networks.*

**A. Proportion of population covered by a mobile cellular network**

**B. Proportion of population covered by at least 3G**

**C. 3G population coverage as % of mobile cellular population coverage**



— WE    — CEE    — NAM    - - DVAP    — EMAP  
— CALA    — MENA    — SSA    - - World

Source: ITU, 2014

## DATA DEFINITION

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Percentage of the population covered by a mobile-cellular network refers to the percentage of inhabitants within range of a mobile-cellular signal, irrespective of whether or not they are subscribers or users.

## DATA DEFINITION

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The ITU data here focuses on 3G coverage as an indicator for the coverage of mobile broadband services. This is a narrower definition of mobile Internet services than our definition, which includes 2.5G services such as GPRS and EDGE. Thus, these numbers understate the proportion of population which is covered by the mobile Internet.

## DATA DEFINITION

---

We have calculated the proportion of the population covered by mobile-Internet-capable 3G services divided by the proportion of population covered by any mobile cellular services.

## The proportion of the global population in mobile-cellular coverage areas continues to rise

Mobile cellular networks covered 94% of global population in 2013, with coverage in certain regions (such as Western Europe, Central and Eastern Europe, developed Asia Pacific and North America) having been close to a 100% saturation point for many years. Even in those regions with lower levels of deployment of mobile cellular networks, population coverage is growing and has now reached above 83% in all regions. The cellular network coverage is important because it represents the upper limit of mobile Internet coverage, given the relatively low cost of upgrading mobile networks to provide Internet access.

## Availability of mobile Internet service is critical to adoption

While lower than the level of mobile cellular coverage, the proportion of the global population in 3G coverage areas continues to rise, reaching 48% in 2013.

However, the global growth rate in coverage has declined from a CAGR of 36% in 2008-2012 to 6% in 2012-2013. This is a result of the coverage in the developed Asia-Pacific, North America and Western Europe reaching close to 100% and having little scope for further growth.

Regions in which population coverage is lower continue to experience growth, in particular the emerging Asia Pacific where coverage has grown at a CAGR of 57% between 2012-2013 from 8% to 13%

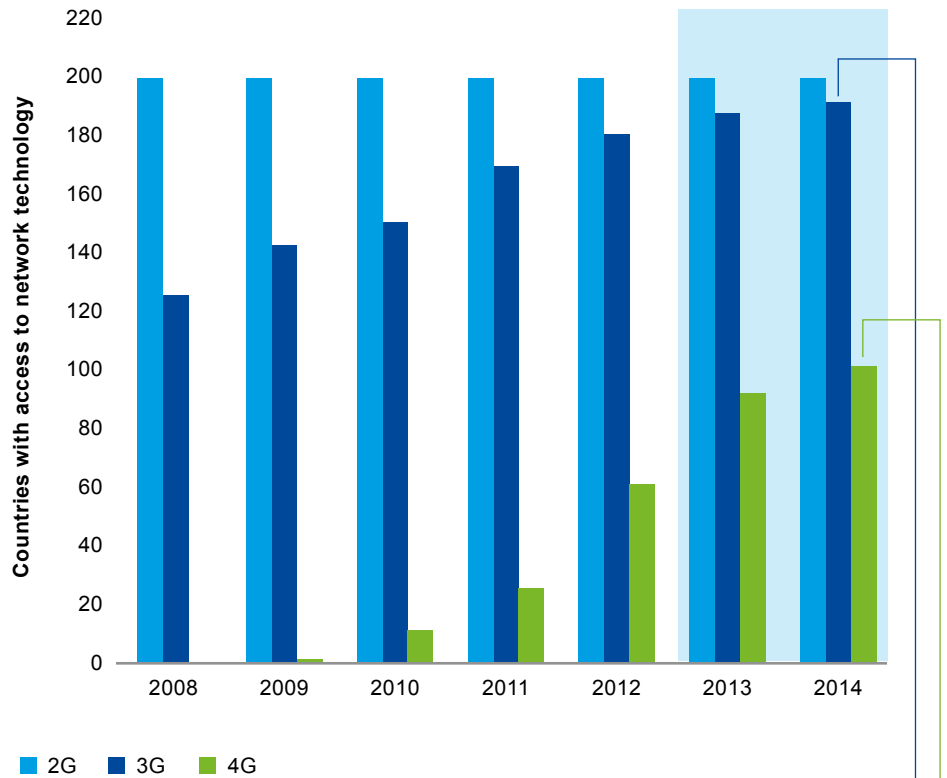
A view of 3G coverage by country can be found on our Global Internet Maps (<http://www.internetsociety.org/map/global-internet-report/#3g-coverage>)

## Mobile Internet deployment has not fully caught up to mobile cellular deployment

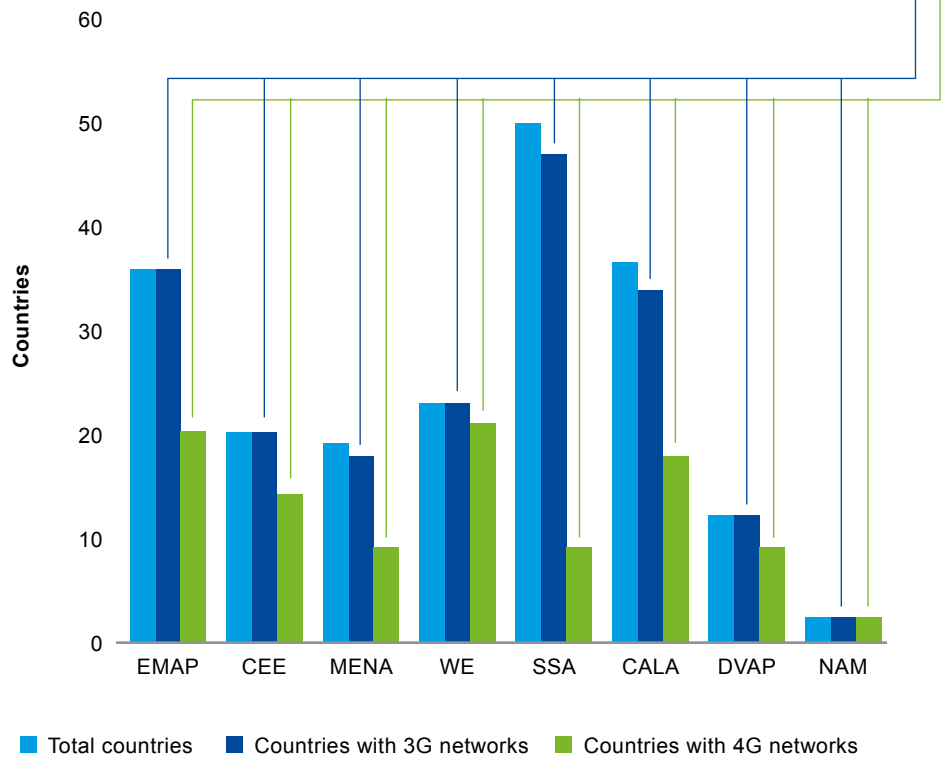
While mobile-cellular population coverage is looking healthy, the relationship between this and 3G coverage suggests that operators are yet to deploy mobile-Internet-capable networks as widely as those for mobile voice services. In particular, 3G population coverage in the Emerging Asia Pacific and Sub Saharan Africa remain at 14% and 42% respectively of the level of mobile-cellular networks. Similarly, globally 3G coverage is only 51% of mobile cellular coverage.

While 3G coverage is growing and catching up to the cellular coverage levels, there is still a long way to go with network deployments before mobile Internet services are as accessible as those for mobile voice.

## Number of countries with mobile network deployments using different technologies

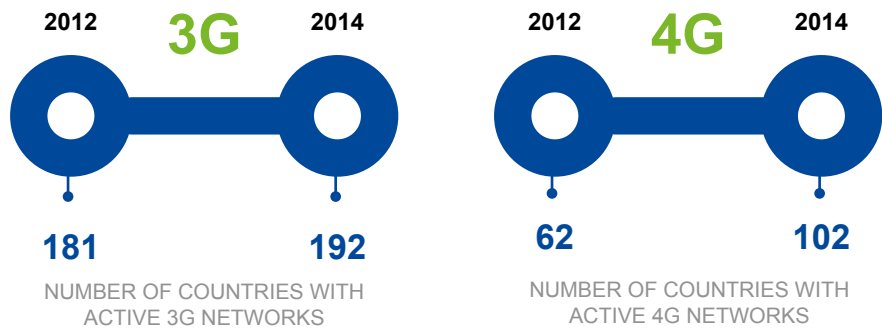


## 3G and 4G deployments by region in 2014



Source: TeleGeography, 2015

### 3G and 4G network deployment is increasing



New 3G network deployments have occurred in less developed regions, including in Algeria, Anguilla and St Lucia. Countries with new 4G deployments are spread across the globe and include the Bahamas, Bulgaria, Ireland, New Zealand and Peru

The descriptions of 2G, 3G and 4G services are found in section 1.

These upgraded mobile networks are clustered across certain regions. Already in 2012, 100% of Western European, North American, and developed Asia-Pacific countries have operators with active 3G networks. However, by 2014, all countries in Central and Eastern Europe and emerging Asia-Pacific also all contain at least one 3G network.

More than 55% of countries in these regions also contain 4G networks, with this proportion reaching over 75% in Western European, North American, and developed Asia-Pacific countries.

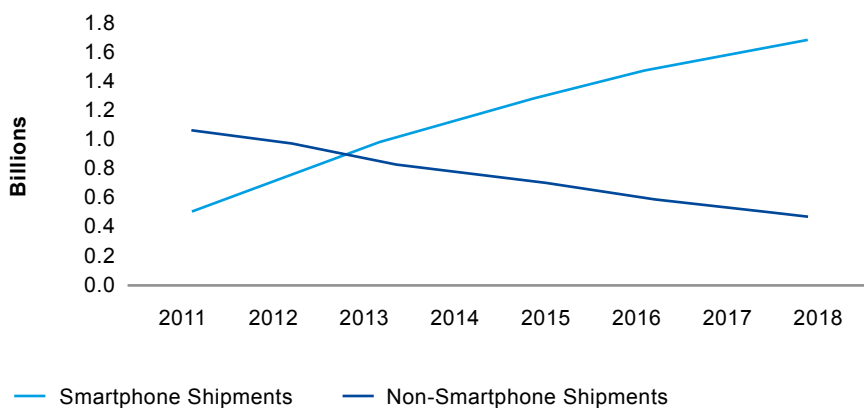
A lower proportion of Middle-Eastern and North African, sub-Saharan African and Latin American countries have rolled out 3G and 4G networks. However 3G roll-outs stand at over 90% and close to 50% of Middle-Eastern and North African and Latin American countries have rolled out 4G networks.

# Devices and apps

The growth of smart devices has been significant, and has already overtaken traditional devices; since 2013 smartphones have outsold other mobile devices, while tablets have outsold desktop PCs and laptop PCs respectively. These devices are characterized by their operating system as well as their vendor, and in this regard, Android has become the most popular operating system on smartphones, offered by numerous vendors.

While smart devices offer open access to the Internet via a browser, they are predominantly used with apps. In this regard, the availability of apps is important, and led by Apple and Google Play, offering Android apps. As we will see, this level of app usage is one of the significant benefits of the mobile Internet for users, but also leads to many of its challenges.

## Global shipments of handsets



Source: Analysys Mason, 2015



### Smartphone shipments continue to increase

The Analysys Mason forecasts show that while total handset shipments continue to grow, there has been a change in handset technology, with smartphones making up the majority of mobile handsets shipped since September 2013 globally, and even in developing countries since September 2014.

The difference between smartphone and non-smartphone handset shipments is expected to increase, with shipments of smartphones forecast to reach 1.67 billion in 2018 at which point other handset shipments will stand at only 0.47 billion.



## INSIGHT

*This migration of users to devices more suited to mobile data, such as smartphones, is partially responsible for the increase in mobile traffic per device.*

August  
**2013**

### Tablet shipments have been growing rapidly in recent years

Tablet sales have exceeded those of laptops in August 2013. In 2014 tablet shipments reached 287 million, approximately 90% of the total 318 million laptops and desktops shipped.

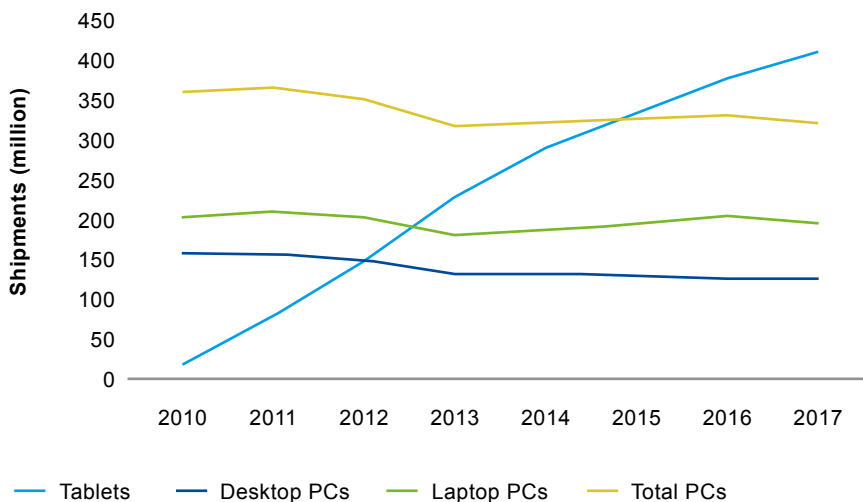
October  
**2015**

While the gap between total PC and tablet sales is expected to continue to decline, with tablet shipments in fact expected to overtake these in October 2015, the growth rate of tablet sales is reducing. This is in part a result of the extended lifetime of tablets, with software upgrades keeping them current. Additionally the ability for tablets to be used by multiple household members may restrict the total market size.

## DATA DEFINITION

Beyond smartphones, we are also interested in the move from PCs (both desktop and laptop) to tablets because tablets have greater mobile capabilities, including access to the App stores, and potential for integrated SIMs.

### Global shipments of tablets and PCs



Source: Statista, 2015

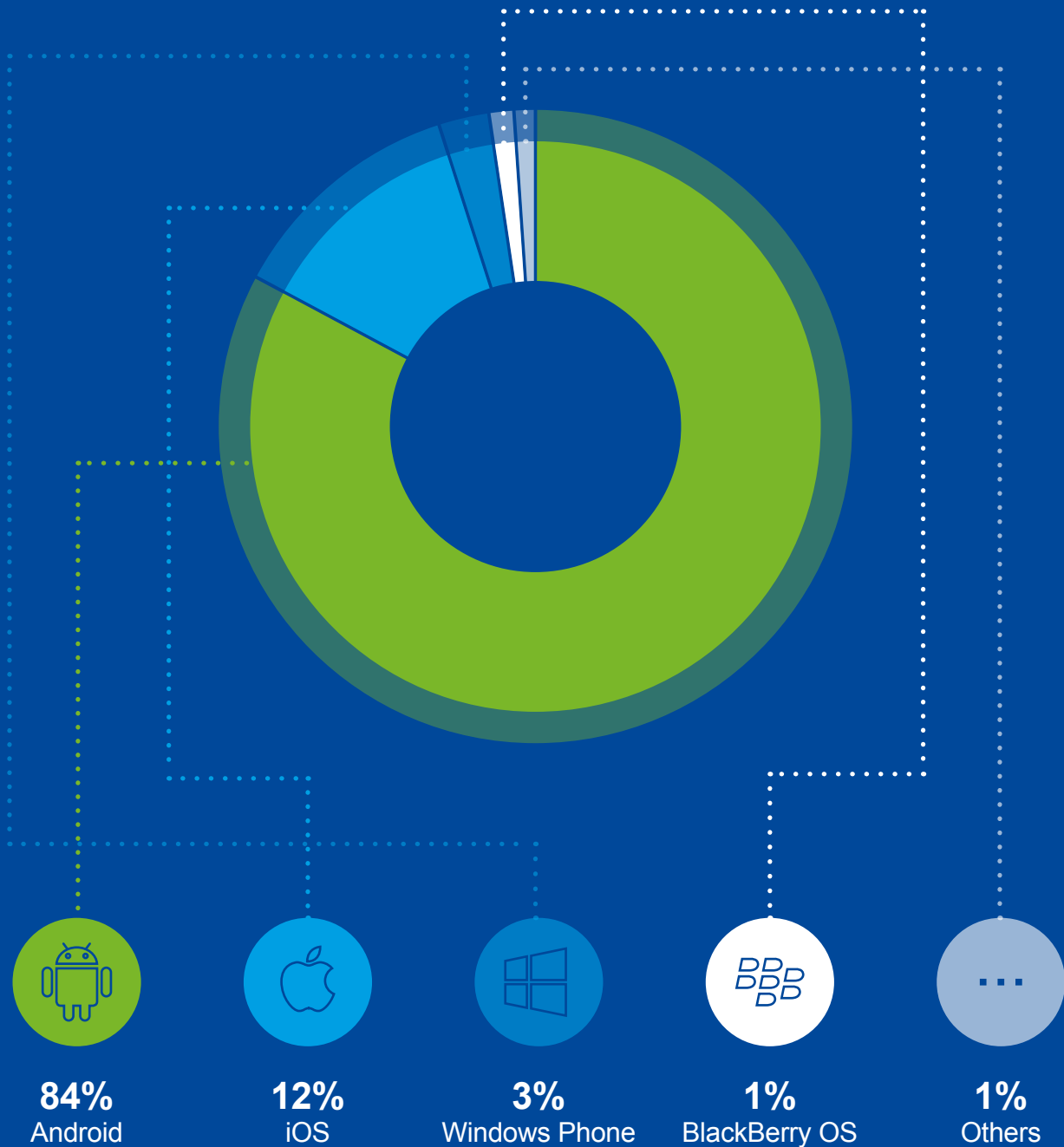
### A number of vendors provide competing mobile operating systems

Android's share of the operating system market for smartphones has risen sharply, from 57% in Q3 2011 to 84% in Q3 2014.<sup>6</sup> This growth in market share has been at the expense of other platforms, in particular BlackBerry OS, which fell from a 10% market share in Q3 2011 to just 1% in Q3 2014. Similarly Android's share of the operating system market for tablets has grown from 29% in Q3 2011 to 72% in Q3 2014.<sup>7</sup>

<sup>6</sup> With respect to tablet sales, in the last quarter of 2014, data show Android selling the majority as with smartphones, albeit not with as great a market share (66%), with Apple second (27%) and Windows Phone third (7%), and no other alternatives sold. See <http://www.statista.com/statistics/273268/worldwide-tablet-sales-by-operating-system-since-2nd-quarter-2010/>

<sup>7</sup> See <http://www.ibtimes.co.uk/ultra-low-cost-mozilla-firefox-smartphones-hit-budget-conscious-india-soon-1452243>

# Market share of unit shipments of smartphone operating systems



Source: IDC, Q3 2014

Android's market leading position has strengthened, in part due to the declining popularity of operating systems such as BlackBerry and in part due to competitive pricing strategies, with a USD230 average selling price for Android devices in Q3 2014, down from USD267 in Q3 2013.

Amongst the manufacturers using Android OS, the dominance of Samsung may be threatened by the emergence of Chinese vendors, such as Xiaomi and Lenovo.

## INSIGHT

*We note that Android now has a high share of the market for both smartphones and tablets. While it is true that Android is free open source software, which indeed helps to explain its adoption by smart device vendors, this nonetheless gives Android, and the associated Google Play app store, a gatekeeper role over a large part of the ecosystem. We explain further the gatekeeper role of the platforms below in section 4.*



September  
**2008**

October  
**2008**

A number of vendors have created mobile operating systems – we highlight a selection here.

### ..... **ANDROID**

Android is an OS developed by Google Inc. and unveiled in September 2008, followed by the launch of the Android Market in October 2008.<sup>8</sup> It is available for free as open source software to any smart device vendor, and has the largest installed base worldwide on smartphones. However a large amount of software on Android devices (such as Play Store and Google Music) are proprietary. Most major mobile service providers carry an Android device.

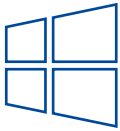
Android is available to device vendors under two models, either a direct relationship with Google for 'compatibility-tested' devices or via the Android Open Source Project. Under the first of these, vendors are allowed to offer Google Mobile Services, which includes the Google Play Store, Google Search, and Google Play Services, while at the same time qualifying for future releases of the operating system. Vendors that take advantage of the Open Source Project have access to the Android source code, available under an Apache license, which allows a large degree of flexibility to customise the software. However, such customisation means that the devices no longer qualify as 'compatibility-tested' and they no longer have access to Google Apps or future updates of Android.



### ..... **IOS**

iOS is a mobile operating system developed by Apple Inc., originally unveiled in 2007 for the Apple iPhone, and distributed exclusively for Apple hardware. It has the second largest installed base worldwide on smartphones behind Android. It is closed source and proprietary and built on open source Darwin core OS. Native third party applications were not officially supported until the release of iOS 2.0 on July 11, 2008. Before this, "jailbreaking" allowed third party applications to be installed, and this method is still available.

<sup>8</sup> Android Market started as an app store, and as other media such as music and videos were added, it was renamed Google Play in 2012.



October  
**2010**

..... **WINDOWS PHONE**

Windows Phone is from Microsoft, it was first launched in October 2010 with its own app store. It is closed source and proprietary. It has the third largest installed base on smartphones behind Android and iOS.



April  
**2009**

..... **BLACKBERRY**

BlackBerry 10 (based on the QNX OS) is from BlackBerry. As a smart phone OS, it is closed source and proprietary. BlackBerry 10 is the next generation platform for BlackBerry smartphones and tablets, whose app store was launched in April 2009. All phones and tablets are manufactured by BlackBerry itself. Once one of the dominant platforms in the world, its global market share has been reduced to less than 1% in late 2014.



April  
**2013**

..... **FIREFOX**

Firefox OS is developed by Mozilla and was released in April 2013. It is open source and uses Mozilla Public License. On July 2, 2013, Telefónica launched the first commercial Firefox OS based phone, ZTE Open, in Spain. As of December 16, 2014, Firefox OS phones are offered by 14 operators in 28 countries throughout the world.



..... **AMAZON**

Amazon devices, their Fire Phone and Kindle Fire in particular, operate on the Fire OS, a customised version of Android. These devices are exclusively tied to Amazon's software and content systems and do not offer those found on other Android devices, such as the Google Play store.

**More than one million apps are now available**

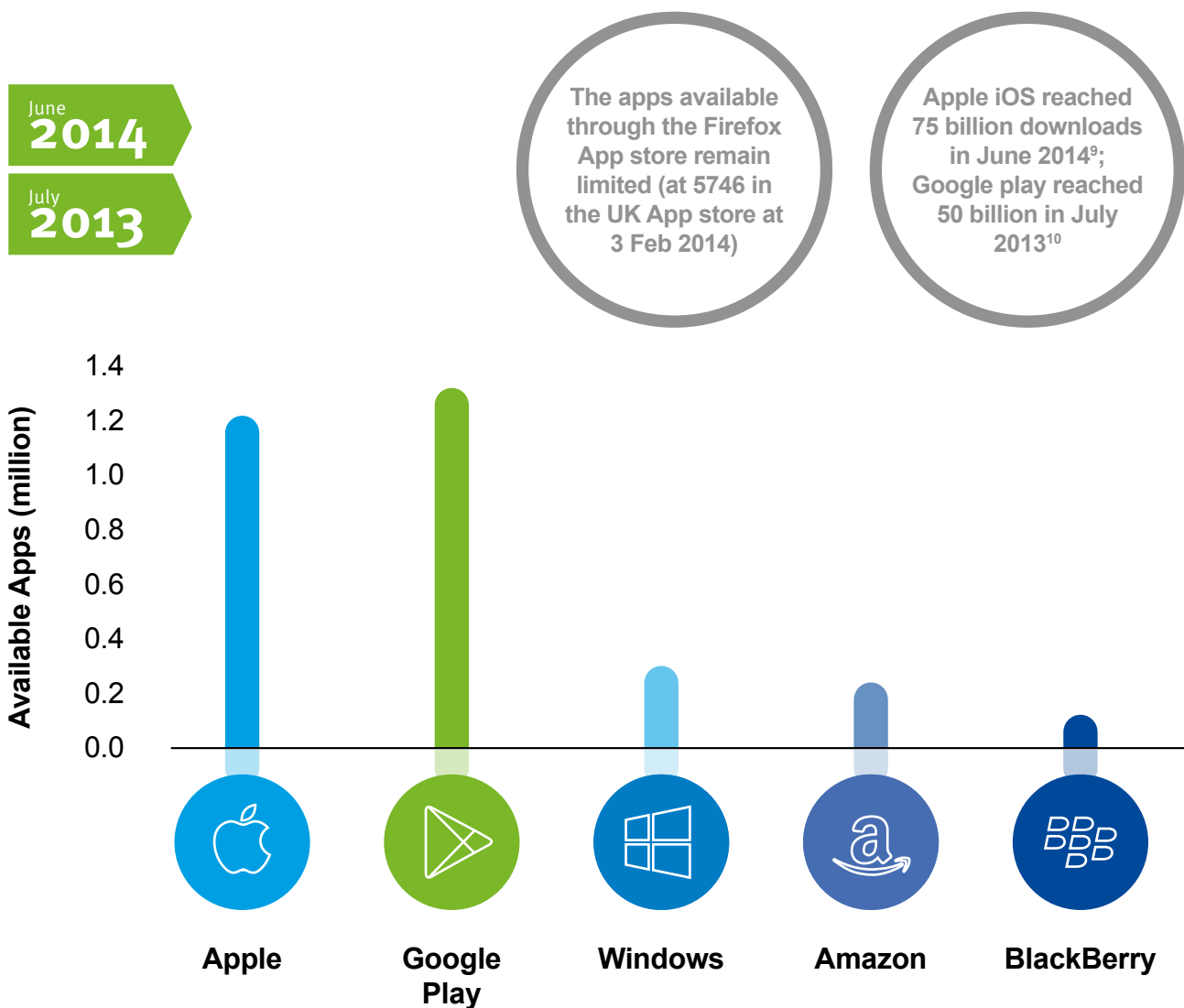
The Apple App Store launched in July 2008 at the same time as the iPhone 2.0 in order to distribute third-party apps to the platform. The popularity of Apple's App Store led to the introduction of equivalent marketplaces by competing mobile operating systems.

Apple benefitted from its early launch of its app store; however it places a large number of restrictions on app developers. The more limited restrictions imposed by Google Play and other app platforms are attractive to app developers. This in combination with the relatively larger potential market (Google Play apps are compatible with Android phones), has meant that Apple no longer has an advantage in terms of app availability.

## INSIGHT

When the number of apps available relative to the market share of the platform is considered it becomes apparent that, compared to Google/Android, Apple has a much higher relative number of apps. This suggests that Apple's market size is above a critical level at which close to all apps are developed for that platform. The platforms with lower market shares offer significantly lower numbers of apps, suggesting that they fall below the market size necessary to trigger close to universal app development

## Apps available in various app stores



Source: Statista, 2015<sup>11</sup>

<sup>9</sup> <http://www.statista.com/statistics/263794/number-of-downloads-from-the-apple-app-store/>

<sup>10</sup> <http://www.statista.com/statistics/281106/number-of-android-app-downloads-from-google-play/>

<sup>11</sup> <http://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/>

**DATA DEFINITION**

Different App stores have agreements allowing them to sell their apps to consumers in different countries.

**DATA DEFINITION**

The share of time spent engaging with digital media in the United States, both mobile and fixed.



**App store availability**

The app store creates an international market for both free and paid apps, largely free of the licensing restrictions that pertain to existing content such as movies, which typically are licensed on a geographic basis. As a result, distribution of apps tends to be broad, but it is not yet global, as can be seen by the different number of countries where each app store is available.

The differences appear to come from the ability to sell paid apps in a country, as opposed to enabling the download of free apps that do not require a payment infrastructure. Google Play and the Apple store numbers in the graph both relate to paid apps, while it appears that the other stores include the ability to provide free apps in their list of countries.

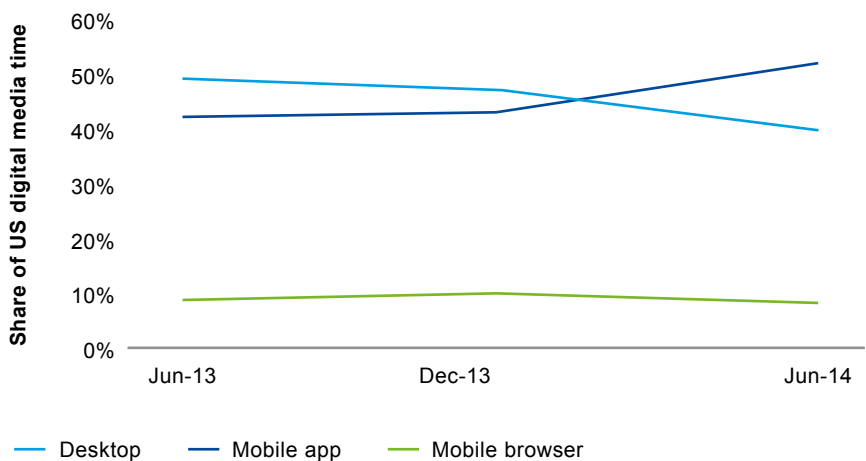
Furthermore, due to restrictions based on national legislation, the apps available to users in different countries are not uniform. This means that in certain countries it is not possible to download the full app library – however, we do not have detailed data on the differences.

**Apps are the preferred way to access the Internet in the US**

Application usage is responsible for a significant amount of time spent on mobile devices and in engagement with the mobile Internet. As mobile becomes a more dominant technology for engaging with digital media, this is also resulting in mobile apps making up an increased share of the total digital market, both fixed and mobile.

In the 12 months June 2013-June 2014, mobile grew from 51% to 60% of digital media time in the United States, with the share of this time from app usage also growing. In early 2014, time spent engaging with mobile apps exceeded that spent on desktop computers, such that by June 2014 mobile app time made up over half (52%) of all US digital engagement.

**Share of time spent using digital media in the United States**



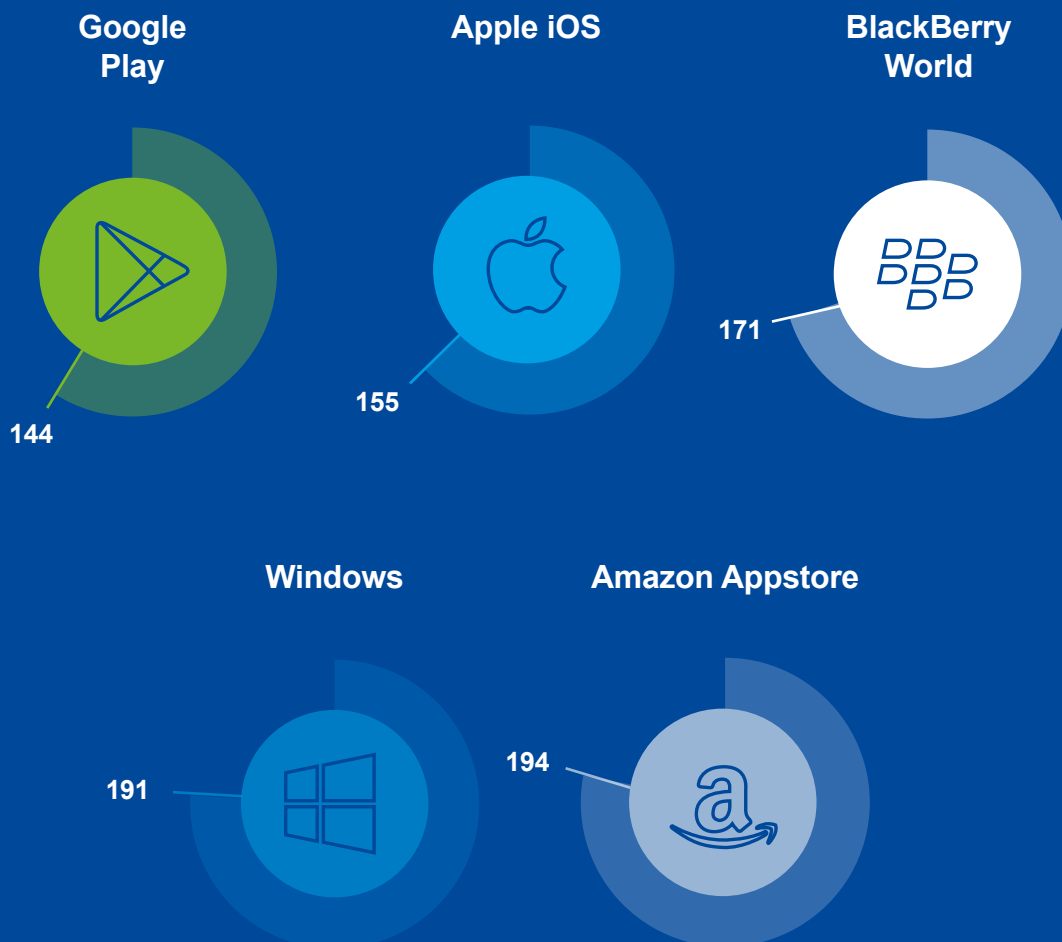
Source: ComScore, 2014

# Availability of app stores across countries

**FEBRUARY**  
2015

Again, due to the recent launch of the Firefox OS and its corresponding marketplace, it is currently available in only 14 countries

## Number of countries with App store available



Source: App store websites<sup>12</sup>

<sup>12</sup> o Apple – iTunes  
o BlackBerry - [http://www.blackberry.com/app\\_includes/devicesoftware/appworld/appworld\\_availability\\_en.html](http://www.blackberry.com/app_includes/devicesoftware/appworld/appworld_availability_en.html)  
o Windows - <https://msdn.microsoft.com/en-us/library/windows/apps/jj863494.aspx>  
o Amazon - <http://www.amazon.co.uk/gp/help/customer/display.html?nodeId=201357480>  
o Google Play - <https://support.google.com/googleplay/answer/2843119?hl=en-GB>

## INSIGHT AND REGIONAL DISCUSSION

*This growth in app usage is reflected in the value of the app economy. This has grown from USD53 billion in 2012, 18% of the combined revenue from the app economy and handsets, to USD86 billion in 2014. The value is forecast to rise to USD143 billion in 2016, at which point it will comprise 33% of the combined app economy and handset revenue.*



### APP ECONOMY

*The app economy is defined as all sources of value associated with the app ecosystem, including not only revenues from app stores and advertising, but also economic activity generated via sources such as in-app purchases, services for app developed and commissioned app development.*

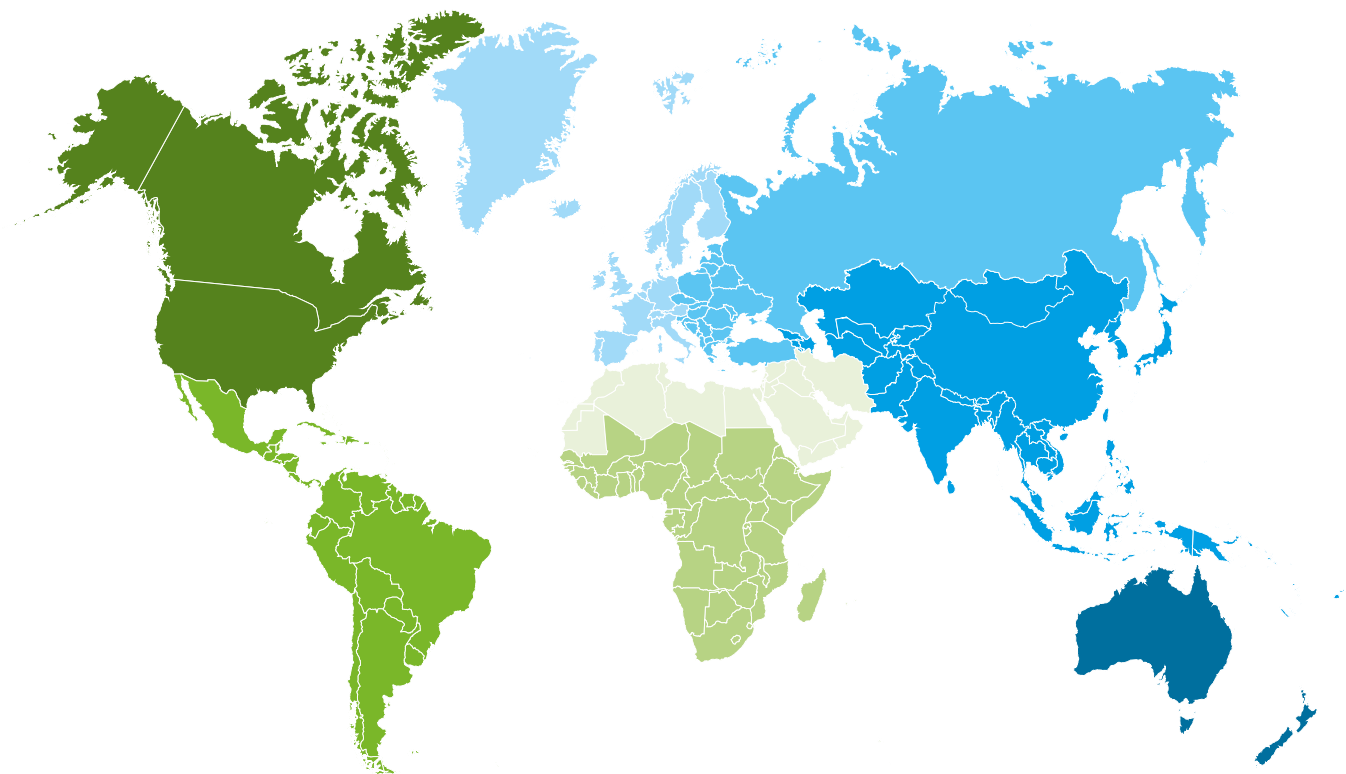
## Conclusion

Over the past 8 years since the iPhone was released, there has been a virtuous circle of growth involving a variety of stakeholders: operators have begun to deploy faster generations of networks in more countries, covering more of the population; more vendors have released smart device platforms, as developers create more and more apps; while users have increased their adoption and usage of the devices and their apps. As we will see in the following sections, the increased use of smart devices, in combination with full mobility, has led to significant benefits for users, as well as challenges to overcome to ensure that the mobile Internet continues to deliver benefits to existing users and the next billions who will come online.



## Data provided global and broken into regions

---



### **NAM**

#### North America

Internet users: **84%**

Mobile Internet penetration: **69%**

3G Population Coverage: **99%**

### **SSA**

#### Sub-Saharan Africa

Internet users: **17%**

Mobile Internet penetration: **8%**

3G Population Coverage: **35%**

### **CALA**

#### Caribbean and Latin America

Internet users: **47%**

Mobile Internet penetration: **34%**

3G Population Coverage: **83%**

### **MENA**

#### Middle East and North Africa

Internet users: **39%**

Mobile Internet penetration: **23%**

3G Population Coverage: **72%**

### **WE**

#### Western Europe

Internet users: **79%**

Mobile internet penetration: **64%**

3G Population Coverage: **97%**

### **EMAP**

#### Emerging Asia Pacific

Internet users: **28%**

Mobile Internet penetration: **17%**

3G Population Coverage: **13%**

### **CEE**

#### Central and Eastern Europe

Internet users: **57%**

Mobile Internet penetration: **44%**

3G Population Coverage: **70%**

### **DVAP**

#### Developed Asia Pacific

Internet users: **84%**

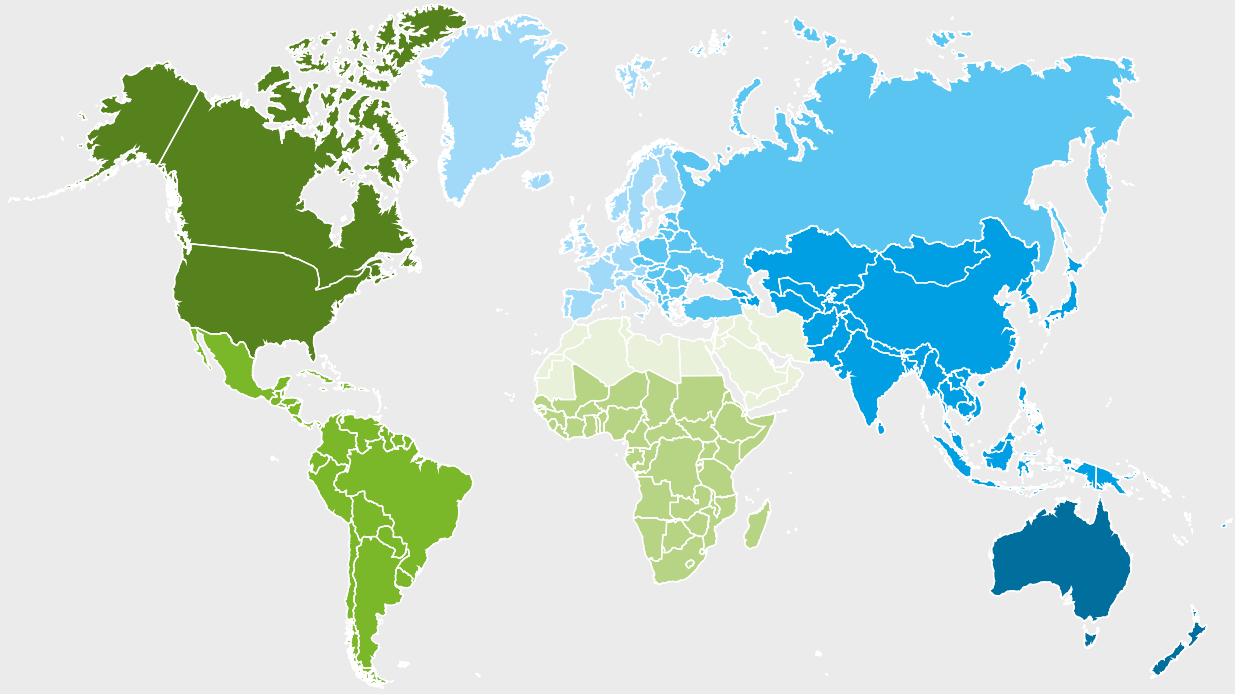
Mobile Internet penetration: **103%**

3G Population Coverage: **99%**

Source: Internet users, ITU 2014; Mobile Internet penetration, Analysys Mason Research 2014; 3G population coverage, ITU 2013  
Note as discussed above that mobile Internet coverage, which includes 2.5G, is not available, and is thus understated by using 3G population coverage.

# Annex

# Definition of world regions



## WESTERN EUROPE

- Andorra
- Austria
- Belgium
- Cyprus
- Denmark
- Finland
- France
- Germany
- Greece
- Iceland
- Ireland
- Italy
- Liechtenstein
- Luxembourg
- Malta
- Monaco
- Netherlands
- Norway
- Portugal
- San Marino
- Spain
- Sweden
- Switzerland
- United Kingdom

## CENTRAL AND EASTERN EUROPE

- Albania
- Belarus
- Bosnia and Herzegovina
- Bulgaria
- Croatia
- Czech Republic
- Estonia
- Hungary
- Latvia
- Lithuania
- T.F.Y.R. Macedonia
- Moldova (Rep. of)
- Montenegro

- Poland
- Romania
- Russian Federation
- Serbia
- Slovakia
- Slovenia
- Turkey
- Ukraine

## NORTH AMERICA

- Canada
- United States of America

## DEVELOPED ASIA-PACIFIC

- Australia
- Brunei Darussalam
- French Polynesia
- Guam
- Hong Kong (S.A.R.)
- Japan
- Macao (S.A.R.)
- New Caledonia
- New Zealand
- Northern Marianas Islands
- Singapore
- Korea (Rep. of)
- Taiwan, Province of China

## EMERGING ASIA-PACIFIC

- Afghanistan
- American Samoa
- Armenia
- Azerbaijan
- Bangladesh
- Bhutan
- Cambodia

- China
- Cook Islands
- Fiji
- Georgia
- India
- Indonesia
- Kazakhstan
- Kiribati
- Kyrgyzstan
- Lao P.D.R.
- Malaysia
- Maldives
- Marshall Islands
- Micronesia (Fed. States of)
- Mongolia
- Myanmar
- Nauru
- Nepal
- Niue
- Dem. People's Rep. of Korea
- Pakistan
- Palau
- Papua New Guinea
- Philippines
- Samoa
- Solomon Islands
- Sri Lanka
- Tajikistan
- Thailand
- Timor-Leste
- Tonga
- Turkmenistan
- Tuvalu
- Uzbekistan
- Vanuatu
- Viet Nam

## MIDDLE EAST AND NORTH AFRICA

- Algeria

- Bahrain
- Egypt
- Iran (Islamic Rep. of)
- Iraq
- Israel
- Jordan
- Kuwait
- Lebanon
- Libya
- Morocco
- Oman
- Palestine (State of)
- Qatar
- Saudi Arabia
- Syrian Arab Republic
- Tunisia
- United Arab Emirates
- Yemen

## CARIBBEAN AND LATIN AMERICA

- Anguilla
- Antigua and Barbuda
- Netherlands Antilles
- Argentina
- Aruba
- Bahamas
- Barbados
- Belize
- Bermuda
- Bolivia (Plurinational State of)
- Brazil
- Cayman Islands
- Chile
- Colombia
- Costa Rica
- Cuba
- Dominica
- Dominican Republic
- Ecuador
- El Salvador
- Grenada

- Guatemala
- Guyana
- Haiti
- Honduras
- Jamaica
- Mexico
- Montserrat
- Nicaragua
- Panama
- Paraguay
- Peru
- Puerto Rico
- Saint Kitts and Nevis
- Saint Lucia
- Saint Vincent and the Grenadines
- Suriname
- Trinidad and Tobago
- Turks and Caicos Islands
- Uruguay
- Venezuela (Bolivarian Republic of)
- Virgin Islands (British)
- Virgin Islands (US)

## SUB-SAHARAN AFRICA

- Angola
- Benin
- Botswana
- Burkina Faso
- Burundi
- Cameroon
- Cabo Verde
- Central African Republic
- Chad
- Comoros
- Congo
- Côte d'Ivoire
- Congo (Dem. Rep. of the)
- Djibouti
- Equatorial Guinea
- Eritrea
- Ethiopia
- Gabon
- Gambia
- Ghana
- Guinea
- Guinea-Bissau
- Kenya
- Lesotho
- Liberia
- Madagascar
- Malawi
- Mali
- Mauritania
- Mauritius
- Mayotte
- Mozambique
- Namibia
- Niger
- Nigeria
- Réunion
- Rwanda
- Sao Tome and Principe
- Senegal
- Seychelles
- Sierra Leone
- Somalia
- South Africa
- Saint Helena
- Sudan
- Swaziland
- Tanzania (United Rep. of)
- Togo
- Uganda
- Zambia
- Zimbabwe

# Section 3

## Benefits of the Mobile Internet



The mobile Internet has grown to be a significant economic sector in its own right, generating significant revenues across the value chain including the network, devices, and apps. According to the Boston Consulting Group (BCG), across 13 countries accountable for 70% of global GDP\*, 2013 revenues directly related to the Mobile Internet were EUR512 billion.<sup>1</sup>

However, this severely understates the impact of the mobile Internet, not just on the broader economy, but on users around the world. As we show in this section, the mobile Internet has been adopted across almost all sectors, including government, healthcare, and entertainment, with a variety of innovations that take advantage of both full mobility and the features of smart devices.

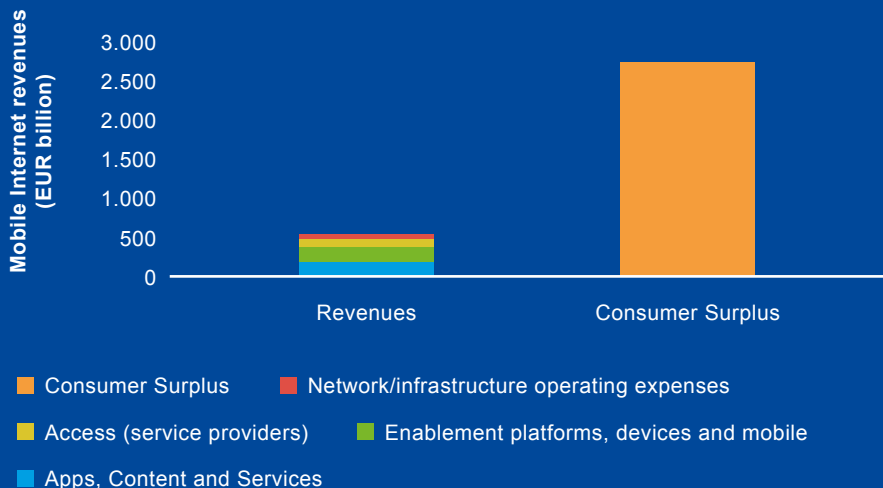
As a result, the mobile Internet has become an integral part of users' lives, not just enabling us to communicate with our friends and family, but track our health, interact with our government, entertain ourselves, and even help earning a living. As a result, in a 2014 survey BCG estimated the **consumer surplus** of the mobile Internet to be at EUR2,764 billion across the set of 13 countries\*, a multiple of 500% of mobile Internet revenues alone.



## CONSUMER SURPLUS

*Consumer surplus is the economic value to consumers for goods and services (also known as the willingness to pay), above what they actually paid for them.*

### 2013 Mobile Internet revenues



Source: BCG, 2014

\* The 13 countries are Australia, Brazil, Canada, China, France, Germany, India, Italy, Japan, South Korea, Spain, United Kingdom, United States.

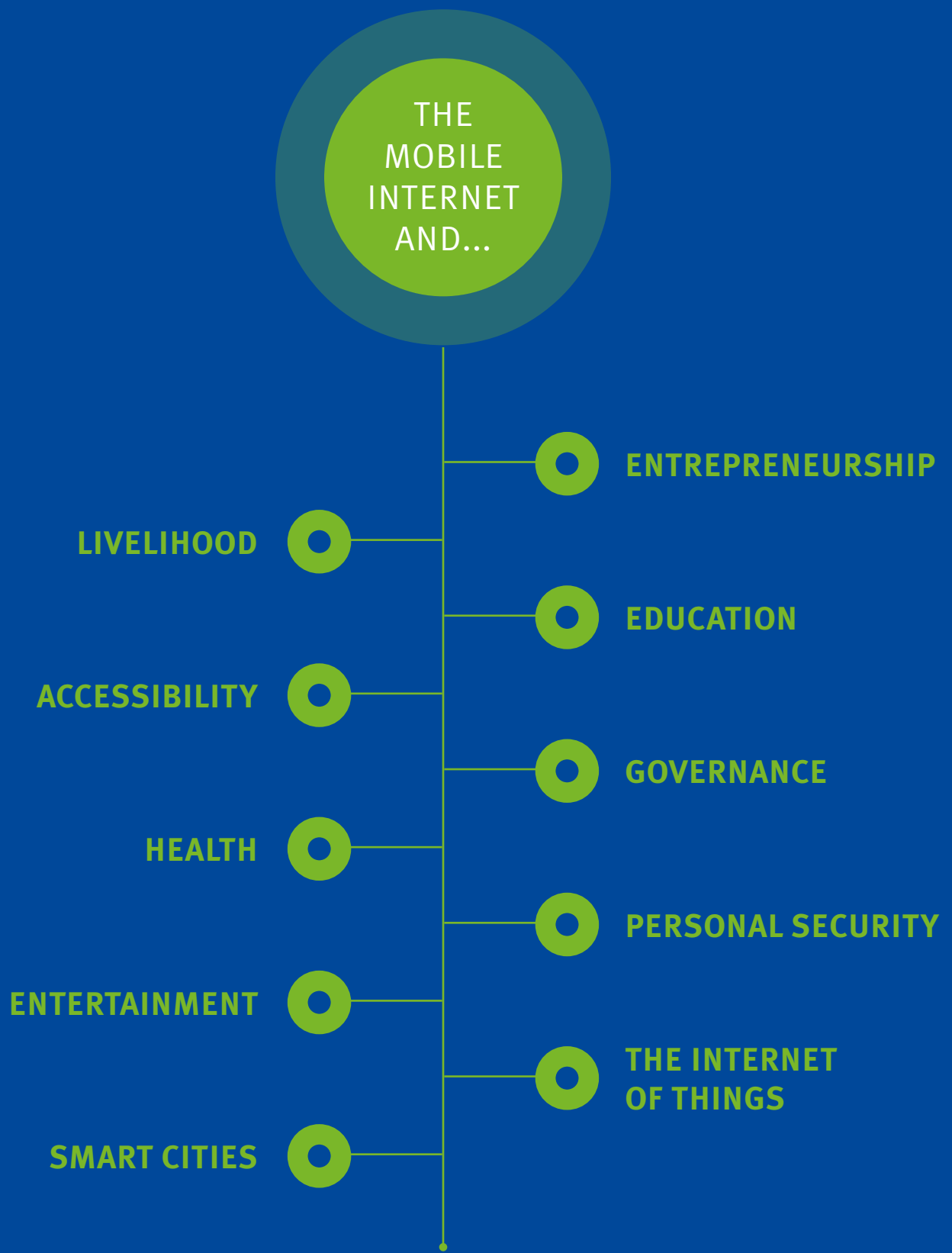
<sup>1</sup> See Source: [https://www.bcgperspectives.com/content/articles/telecommunications\\_digital\\_economy\\_devices\\_mobile\\_internet\\_economy/#chapter1](https://www.bcgperspectives.com/content/articles/telecommunications_digital_economy_devices_mobile_internet_economy/#chapter1)

Just as mobile Internet adoption has leap-frogged that of fixed in many countries, so have the services it enables. While such leap-frogging is typically seen in developing countries, such as in the case of M-Pesa providing payment services for those without previous access to the formal financial system in markets such as Kenya, there is also some element of this taking place in developed countries as well. For example, a 2013 Nielsen study of the US online retail and financial services markets found that over 50% of survey respondents bank exclusively with mobile devices.

In addition to leap-frogging of existing services, mobile Internet services offer new functionality. It is not just that we can access the same services outside of the home or office, but the services themselves are different based on the features of the smart devices and how they interact with the Internet. The smart device can combine video from the camera with crowd knowledge about where we are or where we are going; it can be woken with a movement to analyse our speed and positioning; and, as we look forward to the Internet of things, the smart devices themselves make up an array of billions of advanced sensors that can provide data about our surroundings.

Of course, many of these benefits are only accessible using information that may be personal and sensitive, about where we are, where we are going, and what we are doing. Further, many of these benefits arise through new intermediaries that provide us with the apps that we use and the devices that we use them with. The next section will cover the flip side of the story presented here – describing the challenges that arise directly from the benefits that the mobile Internet is making available.

# Outline



# The Mobile Internet and Entrepreneurship

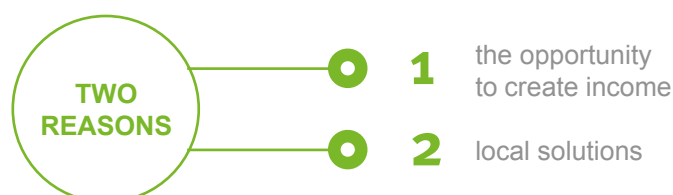
The mobile Internet has created new opportunities for entrepreneurs. We highlight this benefit up front for two reasons. First, the opportunity to create income, and even a fortune, is critical in this age, and the mobile Internet extends this opportunity to millions around the world who may not have formerly had access to the ingredients to innovate, or the marketplace to sell the outcome. Second, many innovations typically address local opportunities and gaps with local solutions, and indeed a number of the services highlighted in the following sections came about through individuals or small groups seeking to improve the lives of those closest to them.

The opportunity (and challenges) created by the mobile Internet for entrepreneurs is well illustrated by the story of Wilfred Mworira, a 22 year old student who greeted the announcement of the Apple App Store in 2008 by developing an app providing details on events in his home city of Nairobi, Kenya. This itself was not remarkable, as he was certainly not alone in anticipating the opportunity – what was remarkable, however, was that he developed and released the app without ever using an iPhone. In an article at the time, he stated that even though he did not have an iPhone, “I can still have a world market for my work”.<sup>2</sup>

Mr. Mworira proved to be as prescient as he was determined. The mobile Internet is now a truly world market of over two billion users with access to app stores. The benefits are not yet fully available, as we note in Section 2 that there are many countries that do not yet have app stores, and thus it is not possible to buy or sell apps there. Nonetheless, total downloads to-date are well over 100 billion apps, and total app revenues are expected to reach 77 billion by 2017.<sup>3</sup>

The mobile Internet is not just a marketplace, however. The mobile Internet also provides access to the ingredients needed to innovate: access to educational resources; tools for research on innovations; access to open source software and services; mentorship platforms to contact business leaders for advice; and crowdfunding platforms to raise money for the innovation.<sup>4</sup>

The mobile Internet has created new opportunities for entrepreneurs.



<sup>2</sup> See [http://www.nytimes.com/2008/07/20/business/worldbusiness/20ping.html?\\_r=0](http://www.nytimes.com/2008/07/20/business/worldbusiness/20ping.html?_r=0).

<sup>3</sup> See <http://www.businessinsider.com/gartner-mobile-apps-will-generate-77-billion-in-revenue-by-2017-2014-1?IR=T>.

<sup>4</sup> See Kende, Michael, "ICTs for Inclusive Growth: E-Entrepreneurship on the Open Internet", World Economic Forum Global Information Technology Report 2015, April 2015, <http://reports.weforum.org/global-information-technology-report-2015/1-4-icts-for-inclusive-growth-e-entrepreneurship-on-the-open-internet/>.



2009



**WhatsApp**  
instant messaging application

WAS  
PURCHASED  
BY



**Facebook**  
for USD 19 billion in 2014,  
when it reached 500 million users

The results have been astonishing. WhatsApp, an instant messaging application, introduced in 2009 was purchased by Facebook for USD 19 billion in 2014, when it reached 500 million users. One of the top grossing video apps, Puzzles & Dragons, earned more than USD 2.5 billion in its first two years after release.

While these apps generate significant notice and attract more developers to reach their rewards, it is worth looking beyond the headlines. In particular, these Apps benefit from a **'winner takes all'** phenomenon, where there is little incentive to use the second most popular messaging service or game, when there is no limit on using the first one.

Relatedly, these apps are also not the job generators that we might all wish for, particularly as many economies are developing and/or growing out of the aftermath of the fiscal crisis of the last decade. For instance, WhatsApp has 55 employees, while the developer of Puzzles & Dragons, GungHo Online Entertainment, has 333 employees, not all working on the game. The economics are simple – unlike traditional products requiring more workers to produce more output, downloading new copies of Instagram does not depend on more new employees.

However, as we see in the next section, income from the mobile Internet does not just come from the latest app, but brings benefits to even the most traditional of livelihoods.

EMPLOYEES



WhatsApp  
**55**



Puzzles & Dragons  
**333**



## WINNER TAKES ALL

*The Winner Takes All phenomenon arises when there are few, if any, constraints to meet all demand. While the second-best restaurant in a town will have good prospects because the best restaurant will fill up, the best or most popular app in a category will never reach capacity, and thus there are few guarantees for the second-best app.*

# The Mobile Internet and Livelihood

The effects of the mobile Internet on livelihoods around the globe can be life-changing, impacting those whose daily lives are otherwise little touched by access to modern technology. Mobile technology is unique in helping to reach people in the remotest areas and giving them access to the kind of support and structure that can enable them to improve their livelihood and move beyond a subsistence way of living. For instance, farmers can learn the latest information about how to raise their crops or cattle, and also pricing information for which they formerly had to rely on an intermediary.

Given the obstacles that can occur on a day to day basis during ordinary working life, these apps have created unique solutions to directly address pressing problems. Ultimately they help compensate for existing gaps in support in rural areas and level the playing field and improve the competitiveness of farmers, fisherman, and others directly impacted. However, as discussed in the previous section, local solutions typically require local knowledge, and even entrepreneurs within a country may be more focused on their own more urban environment.

*An example of the importance of local solutions is highlighted in the LIFE APPs television series on Aljazeera English, which challenges young app developers to visit the remotest villages, experience the obstacles and struggles faced by the inhabitants in their daily lives, and develop apps helping to combat some of these issues.<sup>5</sup> This is happening in Kenya, Rio's Favelas, Uganda, India and Namibia.<sup>6</sup>*

<sup>5</sup> See <http://www.aljazeera.com/programmes/life-apps/> and <http://www.screenafrica.com/page/news/africa/1637254-Life-Apps-Helping-Kenyas-subsistence-farmers#.VST4YxOUdfw>.

<sup>6</sup> See <https://www.youtube.com/watch?v=7-CYjaNK-q8>.

## Transition from SMS to Mobile apps

In order to address the widest possible market, and given the overwhelming traditional prevalence of basic and feature phones, particularly in rural and low income areas, many livelihood services originated using SMS, which limited the information provided to short simple messages.

Recently, with the growth of the mobile Internet, and leap-frogging of smartphones, these services are now branching out and taking advantage of the app environment and capabilities of smart devices, to provide more details as well as more visual interaction to overcome literacy challenges.<sup>7</sup>

For instance, **iCow**, which started as an SMS-based messaging service, now has a mobile app which features video content. According to statistics provided by iCow, (from a survey of 100 random users in Kenya) over 60% of phone types bought in the last 3 years were now smartphones.



### ICOW

*Is a service in Kenya aimed at small-scale dairy farmers. iCow essentially acts as a guide to cow rearing for local farmers. The app provides information on animal nutrition, milk production and gestation as well as helping farmers track the estrus stages of their cows.*

*One of those who benefited almost immediately from the app is Rachel from Nyanhuru Kenya, who owns 5 cows. Since using iCow, her milk yield has increased, with some cows going from 10-12 liters up to 18 liters per day, while she has been able to improve hygiene and raise healthier animals. Due to this app, what once could be a financial liability is now a viable source of income for Rachel.*



### ONLINE MARKETPLACE

## M-Farm

For a substantial number of low-income farmers, the only accessible avenue for information on market rates are potential buyers or 'middlemen'. This creates a problem, as with each participant trying to get the best deal, only one side is privy to the relevant information, giving all the power to middlemen and potential buyers.

M-Farm is an app in Kenya that addresses this imbalance between seller and buyer. The app gives daily crop prices and provides price trends in order to enable farmers to make informed decisions about when to plant, how to price and where to sell.<sup>8</sup> M-farm also features an online marketplace for farmers, which gives them the chance to collaborate and essentially cut out the middle man.

M-Farm has expanded outside Kenya to a number of African countries where the app has helped to revitalize the agricultural industry. As Bawa Yamusah,<sup>9</sup> a farmer from Ghana testifies, the app has had an immense benefit on his livelihood, enabling him to pay for his family's education and health needs.

<sup>7</sup> See <http://www.voanews.com/content/reu-icow-m-farm-smartphones-reboot-african-agriculture/2702106.html>.

<sup>8</sup> See <http://www.new-ag.info/en/developments/devItem.php?a=2909>.

<sup>9</sup> See <http://www.news24.com/Green/News/Mobile-app-helps-African-farmers-turn-a-profit-20140728>.

*Originating as an SMS based app, M-farm has evolved into taking full advantage of smartphone capabilities and now features an online marketplace, further benefiting low-volume farmers.*



**LOCATION**

### **Fisher Friend Mobile Application**

The 2004 tsunami had a major impact in southern India, with many rural villages affected. In addition to the immediate impact on lives and property, the tsunami illustrated how exposed the livelihoods of those in fishing villages were to the mercy of the elements. In order to increase the technological capacity of these fishermen, the Fisher Friend Mobile Application was created, to provide real time data on weather and sea conditions and pinpoint emergencies, but also to help locate promising concentrations of fish.<sup>10</sup>

Sakthivel, a 33-year-old craft fisherman from T.R. Pattinacherry in Karaikal, Pondicherry, illustrates the benefits of this app. Sakthivel uses the app to identify rocky areas at sea, helping to avoid dangerous routes and cut down the time and fuel needed, resulting in a decrease in cost. Using location information to find fish, Sakthivel has now made a profit of Rs. 5000 on capturing oil sardine fish. As well as benefiting himself, he has also been broadcasting information on the dangerous routes to help his friends.

Fisher Friend makes fishing more profitable as well as safer for more than 500 fishermen to date. And for them, aside from the increase in revenue and profits, this app allows them to take control of their livelihoods without being a victim of environmental conditions.

## **The Mobile Internet and Education**

The mobile Internet does not just directly impact livelihood, but also indirectly can help with the education needed to learn a trade, as well as general education. New tools are being developed that allow the exploitation of the features of the mobile Internet to enhance learning experiences, a service sometimes called m-learning. For example, downloadable podcasts of lectures and instant messaging interactions with peers or teachers are tools that can be used away from traditional learning spaces.

<sup>10</sup> See <http://www.mssrf.org/content/stories-transformation> and <http://www.oecd.org/aidfortrade/48367406.pdf>.

M-learning has proven to be particularly popular in developing countries, where it is used both to support more traditional classroom experiences as well as stand alone. In 2014, survey data showed that 24% of people in developing countries were regularly using the mobile Internet for educational purposes, alongside 12% of those in developed markets.

Appreciation for the benefits of m-learning is also higher in emerging markets, where a different survey found that 68% of respondents in Nigeria and 66% of those in Kenya felt that using the mobile Internet for online learning provided a “great improvement” to their lives, while 44% of those in the UK shared this sentiment. This is not surprising, as there are significantly more traditional educational alternatives in developed countries that pre-date m-learning.

## MAGIC PENCIL



BOOK

### WHAT IS IT?



An interactive education tool providing both instructor-led and collaborative learning, offering university course content via video lectures, case studies, articles and blogs anytime and anywhere with mobile Internet connectivity.

### WHERE DID IT ORIGINATE?



Mumbai, India

### WHY IS IT IMPORTANT?



Allows flexibility for both students and teachers, enabling students to study at their own pace and providing teachers with a tool through which to plan and structure their courses. The app offers the benefit of easy peer-to-peer and student-teacher interaction as well as use of interactive content and study tools, making learning more engaging.

# The Mobile Internet and Accessibility

The mobile Internet is important for everyone, not least those with disabilities. Users with disability may in fact rely more on mobile services. For example they may have greater reliance on online shopping or banking services if they find these more accessible than physically visiting retail outlets.

The mobile Internet can help those who experience speech, hearing or other types of communication disabilities to communicate more efficiently than before, for instance by adding video to calls. Additional tools, taking advantage of smart device capabilities to send sound, location data and images, have been developed for use via app or mobile web browser to help persons with disabilities. Features such as the iPhone's VoiceOver, which enables people with vision impairment to operate the device with synthetic speech and touch-based interface, are proving hugely beneficial in opening up the mobile Internet to blind people.

Both the nature of the mobile Internet and the tools developed are encouraging mobile adoption among people with disability. A March 2013 research conducted by Web Accessibility in Mind has found that 58% of those surveyed with a motor disability use mobile access to the Internet, 36% of whom take advantage of mobile accessibility settings on their phone. Take-up by people with low vision is even higher, at 80% of those surveyed (with 13% using mobile as their primary Internet-access device and 63% using accessibility settings).<sup>11</sup>

When accessibility is built into mainstream devices, people with disability can gain the benefit from the mobile Internet just like anyone else. There are thousands of apps for people with disability – we highlight a select few here as examples.<sup>12</sup>

## BE MY EYES



CAMERA

### WHAT IS IT?



An app that connects blind people with volunteer helpers from around the world via live video chat to assist with tasks from knowing the expiry date on the milk to navigating new surroundings.

### WHERE DID IT ORIGINATE?



Copenhagen, Denmark

### WHY IS IT IMPORTANT?



Within 12 days of launch, the app attracted 99,000 helpers worldwide, while 8,000 blind people signed up seeking help. The fact that the app uses volunteers allows the service to be provided for free, supporting blind users in handling big and small tasks as and when required in an easy and informal way.

<sup>11</sup> See <http://webaim.org/projects/>.

<sup>12</sup> For a broader, but by no means definitive, sample of such apps, see <http://www.callscotland.org.uk/Common-Assets/ckfinder/userfiles/files/iPad-Apps-for-Complex-Communication-Support-Needs.pdf>.  
<https://www.yahoo.com/tech/harvard-scientists-send-the-first-transatlantic-smell-89078729859.html>

## TURKCELL MY DREAM PARTNER

### WHAT IS IT?



The app offers access to daily news, thousands of books, location services, education and entertainment content in audio format. Through its speech-to-text technology, users of the service can take and share notes independently.

### WHERE DID IT ORIGINATE?



Turkey

### WHY IS IT IMPORTANT?



Of the 800 thousand visually disabled people in turkey, only 5% have completed education due to challenges disseminating information to the blind. The app enables independent learning as well as access to news for the country's blind population. In 2014, the app served 6,250 subscribers with an average of 7,500-minutes-a-day total listening time. By 2015 the number of subscribers had risen to 110,000.

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## AXS MAPS



LOCATION

### WHAT IS IT?



An app that uses crowd-sourced information to help identify places accessible to people using canes, walkers, wheelchairs or families with strollers. The app uses a competitive "mapathon" format to encourage the inputting of data.

### WHERE DID IT ORIGINATE?



USA

### WHY IS IT IMPORTANT?



The App gives users on-the-go information on the accessibility of routes and locations, allowing them to efficiently plan travel.

## WHAT IS IT?



This app is designed by a father after his daughter was diagnosed with cerebral palsy to ease everyday conversations through the use of pictures and sound clips

## WHERE DID IT ORIGINATE?



USA

## WHY IS IT IMPORTANT?



The app is helpful with pre-speech toddlers or children with certain communication impairments, allowing the child to indicate their needs by looking at one of four panels and selecting which panel they'd like from the set. The app has the additional benefit that users add their own pictures and voice to heighten child engagement.

# The Mobile Internet and Governance

The Mobile Internet is increasingly being adopted by local and national governments to conduct elements of governance and service management. The Mobile Internet has the benefit of being able to make public information and government services available on an “anytime, anywhere” basis. These services can be delivered to citizens, businesses, government employees and within the government.

The use of the Mobile Internet in service delivery may be particularly important in emerging markets, where the take-up of mobile relative to, for example, fixed internet is high and poor fixed communications infrastructure has limited government communications initiatives in the past.

Use of the online government services is migrating to mobile even when no mobile-specific applications have been developed. In the UK, the government is documenting the shift in visits to its websites from computers to smart devices. The effect on the government’s e-petition service has been perhaps most striking, with visits from mobile devices up from 25% of all visits in January 2012 to 73% by January 2014. The UK government is now requiring that all its websites be designed to accommodate a broad range of devices and screen sizes.<sup>13</sup>

As shown below, a number of governments are also using the mobile Internet to create a ‘Smart City’ that runs more efficiently than before.

<sup>13</sup> See <https://www.gov.uk/service-manual/user-centred-design/browsers-and-devices.html>.



## CITIZEN'S CONNECT

### WHAT IS IT?

The app allows users to complete tasks including checking and paying outstanding or advance property tax, obtain birth and death certificates, register complaints, check business registration certificate details and checking recruitment advertisements

### WHERE DID IT ORIGINATE?

Surat, India

### WHY IS IT IMPORTANT?

This app helps increase efficiency, saving citizens' time and had 50 thousand downloads at year end 2014

## ESTONIAN DIGITAL SOCIETY

### WHAT IS IT?

Estonia has developed the first "digital society", allowing tasks such as business registration, taxation, medical prescriptions and voting to be carried out online. Within this system are a number of mobile components, including parking, mobile ID and mobile payments.

### WHERE DID IT ORIGINATE?

Estonia

### WHY IS IT IMPORTANT?

The Estonian mobile ID card serves as proof of ID when utilising online services, it can be used for accessing secure e-services and digitally signing documents, but has the advantage over the e-ID card previously rolled out in Estonia of not requiring a card reader. It additionally uses its authentication tools to allow participation in voting.



ID

# The Mobile Internet and Health

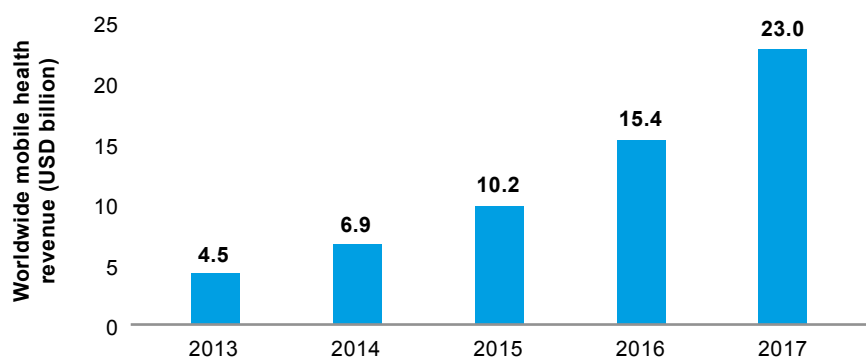
The advancement of mobile technology is enabling healthcare delivery via smart devices. Mobile healthcare, or mHealth, applications comprise a variety of services, from those that encourage the adoption and tracking of “healthy” habits, such as fitness tracking apps, to those that help diagnosis or monitor health parameters such as heart rate and blood glucose data for remote patients. Such service have been growing in popularity, with the GSMA reporting 1125 deployed mHealth products and services as of February 2015.

While mHealth popularity and applications are universal, the services enabled are particularly popular in countries where access to traditional healthcare is less advanced and smartphone penetration is rising rapidly. According to PWC, 59% of patients in emerging markets in 2012 were using mHealth, compared to 35% in developed markets.

The popularity of mHealth service is expected to continue to grow rapidly, with revenues forecast to more than triple from 2014 to 2017, as shown on right as shown below.

*Smartphones have a number of inbuilt features that enable them to act as diagnostic tools. These include their ability to connect to sensors worn on the body to monitor vital signs as well as the use of the phone camera to analyse the colour of test strips and apps allowing patients to track changes in their eyesight from home using the large screens to provide a shape discrimination test.*

## Worldwide mobile health revenue



Source: “Touching lives through mobile health: Assessment of the global market opportunity”, GSMA report by pwc, February 2012

## SANA MOBILE HEALTH PLATFORM



CAMERA

### WHAT IS IT?



The Sana app connects community health workers and medical specialists, allowing the transmission of medical data.

### WHERE DID IT ORIGINATE?



Based out of MIT, USA with projects in areas such as India, Mexico, Greece and Philippines.

### WHY IS IT IMPORTANT?



The ability to transfer data allows for real time support from remote specialists in clinical decisions. This app is open source and customisable and has been used for purposes such as early detection of oral cancer in rural India as well as treatment of diabetes in Greece, acting both as the eyes and ears of clinicians and as a portable medical record for patients.

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## HEALTH ON iOS8



WATCH/  
ALARM CLOCK



LOCATION

### WHAT IS IT?



An app automatically available on Apple iPhones that is designed to improve users health, using the iPhones motion sensors and location data to monitor physical activity as well as aggregate third-party health and fitness apps.

### WHERE DID IT ORIGINATE?



USA

### WHY IS IT IMPORTANT?



The App aggregates all of the user's personal health information using different apps and fitness devices into one place. This both allows information sharing across apps as well as acting as an emergency medical ID.

# The Mobile Internet and Personal Security



LOCATION

There is perhaps no more valuable use of the power of the mobile Internet than for ensuring the safety of ourselves, families, and neighbors.

In Malaysia, James Khoo's sister was missing for several days with no contact, having been in a serious car accident. He then realized that a smartphone could be programmed to send out its location if the owner did not arrive at a pre-announced location within a pre-set time, and created a personal safety app to do that called Watch Over Me. He was joined by Chin Xin-Ci as a co-founder, who had narrowly escaped a kidnapping attempt, leading to a new feature allowing the user to simply shake the phone, which turned on the video automatically and sent it along with the location to family or friends to help rescue the victim and identify the perpetrator.

Similarly, in Kenya, when violence broke out following the election in 2007, several developers set out to use mobility to gain strength from numbers. The result was Ushahidi, a program allowing users to provide the location where violence was occurring through their phones, enabling others to avoid it. Ushahidi is now an open source software for crowdmapping, and has been adapted around the world for disaster relief following earthquakes in Haiti and Japan, and even to track the progress of snowplows in Washington DC.

# The Mobile Internet and Entertainment

Entertainment apps constitute a significant portion of the overall usage of apps on Android and IOS platforms, and gaming constitutes a large portion of entertainment, based on time spent and revenue, accounting for 79% of Apple's App Store revenue and 92% of Google Play's.<sup>14</sup>

One of the major successes in this genre is Dead Trigger 2, which is a first person multiplayer shooter game. Launched in 2013, this app currently has over 40 million downloads<sup>15</sup>. It utilizes real time story development which is influenced by the participation of every player. Ultimately this app, and apps like this, are helping mobile gaming compete more successfully with the sophistication of more traditional console gaming, while being more convenient due to its portability.

<sup>14</sup> See <http://www.forbes.com/sites/chuckjones/2013/11/01/games-drive-the-most-revenue-on-apples-app-store-and-google-play/>.

<sup>15</sup> See <http://www.148apps.com/app/720063540/>.

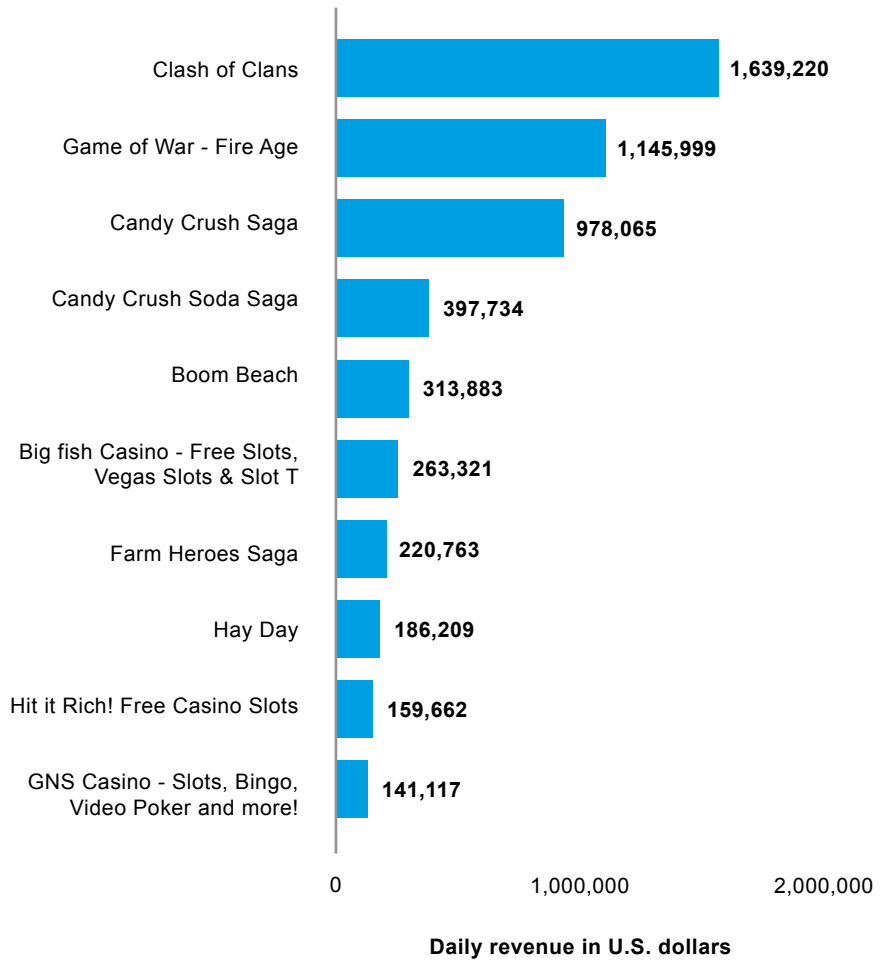


**GAMES**

Another app that also employs the multiplayer feature is Clash of Clans. Again an emphasis of this game is to interact globally with other players in order to further heighten the gaming experience. At the forefront of 2014's billion dollar mobile games<sup>16</sup>, Clash of Clans is a strategy game with the aim to build and protect territory. With over a 100 million downloads, and a daily revenue of 1,639,220 USD in the US alone, the popularity of this game and games like it, constitute a significant use of the mobile Internet.

### Top grossing iOS mobile gaming apps in the United States as of February 2015

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Source: Statista, 2015<sup>17</sup>

*An emerging trend in the mobile gaming sphere is bringing beloved family games onto the mobile internet, using the multiplayer app platform, introducing a new generation to these timeless games. Essentially these mobile apps could be classed as bridging the gap between old and new, and making the mobile internet accessible to a larger audience.*

<sup>16</sup> See graph below.

<sup>17</sup> See <http://www.statista.com/statistics/263988/top-grossing-mobile-ios-gaming-apps-ranked-by-daily-revenue/>.



## SCRABBLE

One classic game which has made a move to the mobile screen is Scrabble, which also belongs to the online multi player genre. Being promoted as a way to “connect with friends” anywhere, it also enables one to learn from the game what the best word would have been.

# The Mobile Internet of Things

In addition to the mobile Internet, enabling users to connect to the Internet using smart devices, wireless technology enables smart devices to become part of the Internet of Things.

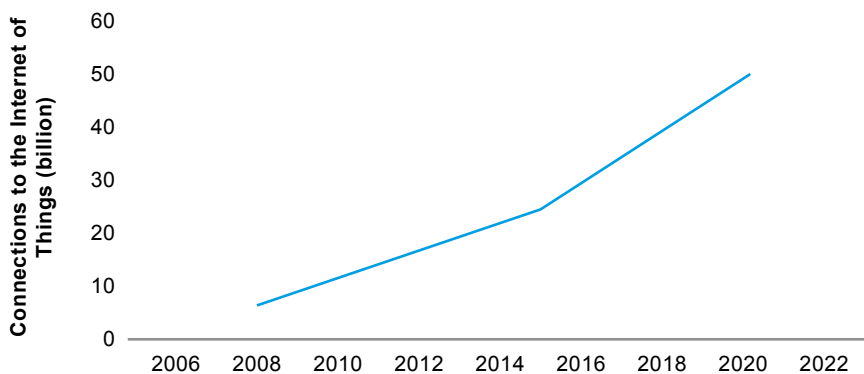


## INTERNET OF THINGS

*The Internet of Things, also known as M2M, or Machine to Machine, involves both everyday and industrial objects such as watches, keys, household appliances, vehicles, machinery and buildings to be embedded with chips and sensors, allowing them to “think”, “feel”, and “talk” with each other, communicate with people and enable us to monitor and control them anytime and anywhere.*

*The total number of “things” connected to the Internet is growing rapidly, having first exceeded the global population in 2008 and is forecast to rise to exceed 50 billion in 2020. It is expected that eventually 99% of everything produced will be connected to the Internet. This growth in connectivity is projected to result in connected device revenues of USD1.2 trillion in 2020, 6× the USD200 million revenues in 2013.*

## Connections to the Internet of Things



Source: Cisco, 2015

In particular, based on the functions built into the smart devices, anyone carrying a smart device is potentially part of a worldwide network of sensors that can gather information based on their surroundings, and aggregate them into accurate information about health, traffic, and even weather.

*In the mHealth section we discussed how the sensors in smart devices could be used to track the fitness and assess the health of the owner. This requires the direct involvement of the user, interacting with the app. In addition, work by MIT professor Alex Pentland has shown that it is possible to use mobile phone records to diagnose flu and track outbreaks, by aggregating background information from many users, without their direct engagement, potentially allowing early intervention by health care professionals to stop the spread.*

## SUNSHINE APP



LOCATION



WEATHER



BAROMETER

### WHAT IS IT?



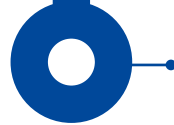
An interactive smartphone app that uses smartphone sensors to provide localized weather conditions.<sup>18</sup> Also in newer Android and IOS models which include barometers, the phones can be used to measure atmospheric pressure at the user's location, which can then signal changes in the weather. It was due to be released in April 2015.

### WHERE DID IT ORIGINATE?



USA, co-founded by Katerina Stropiati, it is currently in beta testing stage around the San Francisco bay area, New York and in the Dallas area.

### WHY IS IT IMPORTANT?



The app makes use of community data to keep it interactive and locally based. This means that greater accuracy can be gained because of the localized nature of the updates.

<sup>18</sup> See <http://www.technologyreview.com/news/535761/how-the-weather-there-crowdsourcing-app-promises-better-forecasts/>.

# WAZE

## WHAT IS IT?



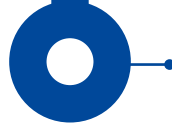
A community based location-based navigation app which provides real time traffic information for drivers. This also includes Waze community edited maps and live routing. A driver will switch on the app while driving, which will passively collect road data. This includes any hindrances on the road, such as traffic etc. However, one can also update on any sudden occurrences such as accidents or emergency road blocks in order to update other drivers. The app also uses online map editors, who update frequently. It currently has over 50 million downloads.

## WHERE DID IT ORIGINATE?



Israel, cofounded by Amir Shinar, Uri Levine and Ehud Shabtai. Acquired by Google in 2013.

## WHY IS IT IMPORTANT?



This app lays emphasis on creating a community of drivers to share information. Not only is its real time data invaluable for daily drivers/commuters, but its framework fosters local networks which is much more accurate for a driver. This results in journeys being potentially shortened, saving time and money.

Waze has also been instrumental in monitoring and alleviating heavy traffic arising from high profile events, such as the recent visit of Pope Francis to the Philippines in January 2015.



LOCATION



# The Mobile Internet and Smart Cities



## LOCATION

One focused use of the capabilities of the mobile Internet of Things relates to the creation of smart cities. Smart cities is a term used to describe cities that have adopted digital technologies, including mobile networks, to enhance the performance of infrastructure related services, reduce costs and develop more effective communication channels with citizens. While early smart city developments used fixed technologies, mobile is becoming increasingly popular due to a number of benefits it has beyond other communication channels:

- the popularity of mobile allows for more citizens to be involved, both in data gathering and accessing the smart city services using their existing devices and access
- mobility allowing service to be delivered to citizens anytime and anywhere, rather than when users are at a fixed terminal
- the inbuilt features of smartphones allowing them to be used as a network of sensors, providing information based on the location of the user.

Key smart sectors include transport, such as ticketing applications and traffic monitoring systems. In one interesting example, Orange released 5 months of anonymised mobile data from the Ivory Coast as part of an initiative called Data for Development. IBM used the data to analyse commuting patterns in the capital, Abidjan, and designed a more efficient bus system that would save up to 10% on average travel times.<sup>19</sup>

*This use of mobile devices to access other bits of technology has been illustrated as part of the Royal Institute of Science's 2014 Christmas Lecture series, with the windows of the Shell Centre, a London skyscraper, transformed into a playable Tetris-style game.<sup>20</sup>*

<sup>19</sup> See <http://www.technologyreview.com/news/514211/african-bus-routes-redrawn-using-cell-phone-data/>.

<sup>20</sup> See <http://www.rigb.org/about/news/winter-2014/london-skyscraper-comes-alive-with-computer-game>

## QLUE



LOCATION

### WHAT IS IT?



Qlue is a government sponsored mobile app that allows Jakarta residents to find and provide real time information about traffic conditions, weather and threat alerts, based on their location. Additionally, the platform enables a chat feature with neighbouring users and relevant government employees and access to a live CCTV feed to monitor the local area.

### WHERE DID IT ORIGINATE?



Jakarta, Indonesia

### WHY IS IT IMPORTANT?



This app is an early step in the local government making use of communication technology and working with local technology start-ups to increase the accountability and transparency in the local administration. As of February 2015 the app had 15,000 registered users and city council staff are making use of the crowd sourced data to improve city services

## STREET BUMP



LOCATION

### WHAT IS IT?



An app that once downloaded uses the smartphone's inbuilt motions sensors, accelerometer, and location-awareness to collect conditions on roads driven by the user.

### WHERE DID IT ORIGINATE?



Boston

### WHY IS IT IMPORTANT?



If three or more bumps occur at the same location, the city will inspect the obstacle and assign it to a queue for short-term repair or record its location to assist with long-term repair planning. This streamlined method of pothole reporting has a huge advantage over the traditional need to call a hotline or find and submit an online form.

# Conclusion

The mobile Internet is a general purpose technology, which impacts all manners of business, government, and social activities. While the revenues surrounding the delivery and usage of the mobile Internet are large, and growing, they understate the true benefits in monetary terms, and miss the non-monetary benefits of the technology.

The mobile Internet impacts our livelihoods, offers opportunities to innovate, monitor our health and safety, become educated, interact with government, keep in touch with family and friends, provide access for people with disabilities, and not least entertain ourselves. These benefits are perhaps nowhere more felt than in developing countries, where mobile technology has long since leap-frogged fixed, enabling mobile Internet services to provide key services to those otherwise un- or under-served.




# Section 4

## Challenges of the Mobile Internet





We have seen the growth of the mobile Internet and increased use worldwide, based on the benefits that it brings to users as more services and applications become available. Here, we examine five challenges presented by the introduction of mobility and advanced features of the smart device, in terms of the resulting evolution of the Internet and the impact on development:

## EVOLUTION

-  **Smart devices enable services such as location awareness and include features such as cameras; the flip side of the coin is increased privacy issues**
-  **Usage of the mobile Internet depends on a number of wireless interfaces and access to apps; these lead to heightened security issues**
-  **Apps provide convenient access to the advanced features of the phone such as the GPS or camera; but app stores create costs for developers and customers and may limit competition**

## DEVELOPMENT

-  **More users are doing more with the mobile Internet; is there enough spectrum available?**
-  **Mobile Internet is the way the next billion are going to get online; will this close the digital divide?**



**EVOLUTION**

# ① Privacy

The mobile Internet brings significant benefits to users, as seen in **Section 3**. However, the downside is that there are increased privacy concerns based on the additional information generated by these new uses.



Of course, **privacy** has always been an issue surrounding the Internet, growing in prominence in step with our increased usage and reliance on the Internet as part of our daily lives and growing awareness of security risks. However, these concerns are magnified here because of the intrinsic nature of the mobile Internet – as a result of full mobility we can interact with the Internet for more of the day from virtually anywhere, and the unique features of the smart devices allow for more advanced services.

As a result, we can use the mobile Internet for mHealth, mobile money, interaction with government, and social networking, generating a significant amount of **personal and sensitive data**. In particular, much of this data is new, because many of these services would not be feasible without the mobile Internet.



LOCATION

To highlight some of the new privacy concerns generated by the mobile Internet, we will focus on the example of location-based services (LBS), such as navigation apps that are based on knowing where the device is located. Such services sit at the heart of the mobile Internet; they rely on full mobility, and they are enabled by the **location** awareness of smart devices. Data on where we have been, where we are, and possibly even where we are going is the definition of personal data and, for many, and in many situations, it is also sensitive data. While such services provide significant benefits, as detailed in the previous section, such benefits must be weighed against privacy concerns.



As an example, the UK Data Protection Act has the following definition of personal and sensitive data<sup>1</sup>:



## PERSONAL DATA

*means data which relate to a living individual who can be identified –*

- *from those data, or*
- *from those data and other information which is in the possession of, or is likely to come into the possession of, the data controller,*
- *and includes any expression of opinion about the individual and any indication of the intentions of the data controller or any other person in respect of the individual.*



## SENSITIVE PERSONAL DATA

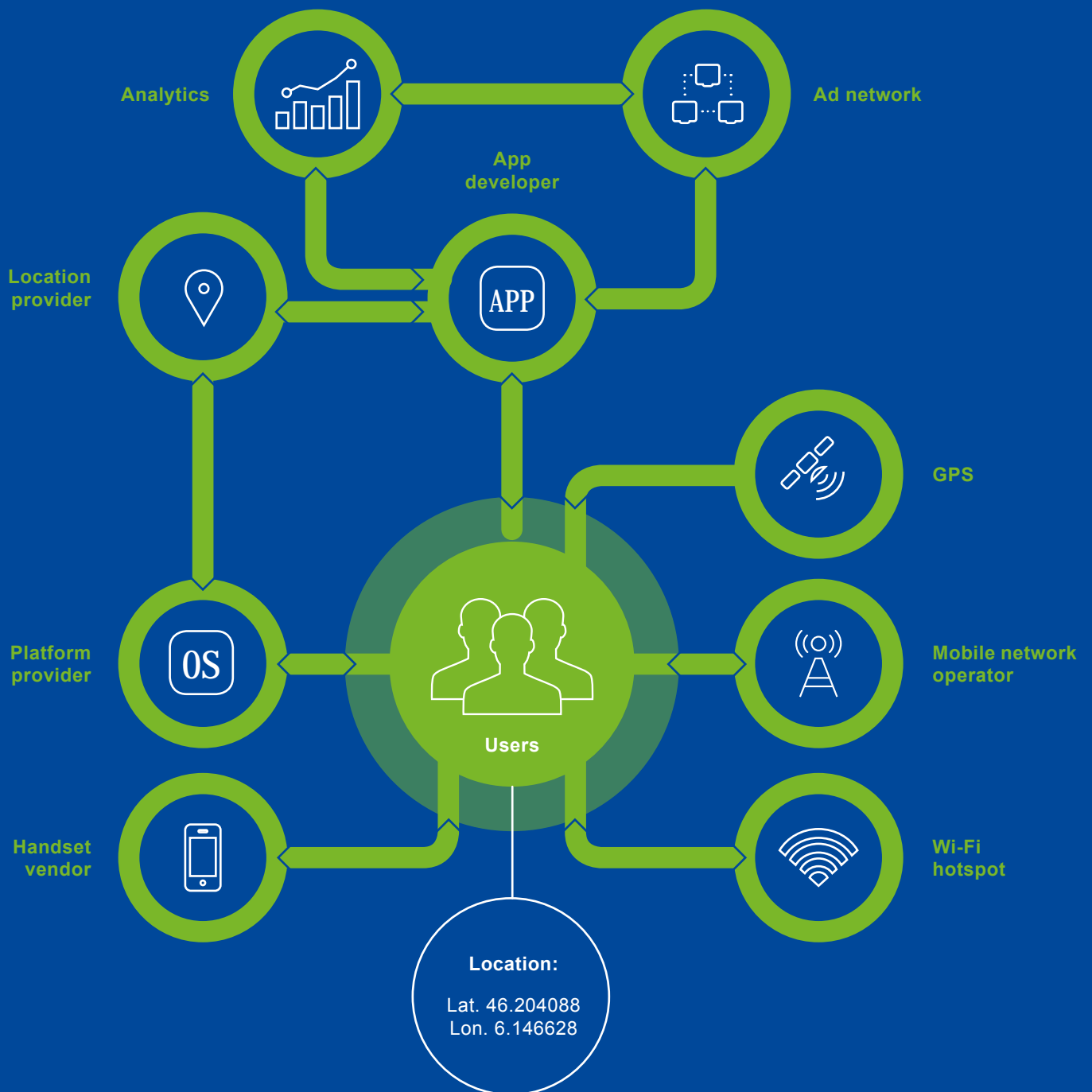
*means personal data consisting of information as to -*

- *the racial or ethnic origin of the data subject,*
- *his political opinions,*
- *his religious beliefs or other beliefs of a similar nature,*
- *whether he is a member of a trade union (within the meaning of the Trade Union and Labour Relations (Consolidation) Act 1992),*
- *his physical or mental health or condition,*
- *his sexual life,*
- *the commission or alleged commission by him of any offence, or*
- *any proceedings for any offence committed or alleged to have been committed by him, the disposal of such proceedings or the sentence of any court in such proceedings.*

<sup>1</sup> <https://ico.org.uk/for-organisations/guide-to-data-protection/key-definitions>.

# Who knows where you are?

A wide range of companies have access to location data. In some cases, they can identify the individual at the location, in others they only receive anonymised or aggregated data on users' locations.



Direction of information flow

The following types of companies may be involved in providing location-based services. We note that some companies play multiple roles, such as providing the platform, handset, location, and apps, so here we present the various roles that one or more companies can play in providing the services.



### **PLATFORM PROVIDER**

Provides the operating system and the app store (although there are third party app stores as well). Depending on the company, and settings, the location data may be stored on the device only, or available on the cloud.



### **LOCATION PROVIDER**

Determines the location based on information from the GPS, towers, or Wi-Fi signals, and makes the location available to apps and/or the platform.



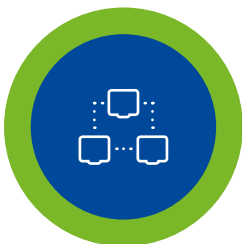
### **HANDSET VENDOR**

May be separate from the platform provider, such as Samsung using Android, and is able to track the device, at the least in case it is lost or stolen.



### **APP DEVELOPER**

Provides the location-based app – must receive location in order to provide the service, such as navigation.



### **AD NETWORK**

May provide location-based ads, within an app – again must receive location in order to provide the appropriate ad, and may know characteristics of the user in order to target the ad.



### **ANALYTICS**

May provide aggregated marketing data to retailers or others based on subscriber information and the locations visited.



### **GPS**

Provides the satellite signal to locate the subscriber – there is no direct reverse transmission path to receive any information about users or their locations.



### **MOBILE NETWORK OPERATOR**

As discussed below, the mobile operator must know the location to provide voice or data services, but typically operates under strict privacy restrictions.



### **Wi-Fi**

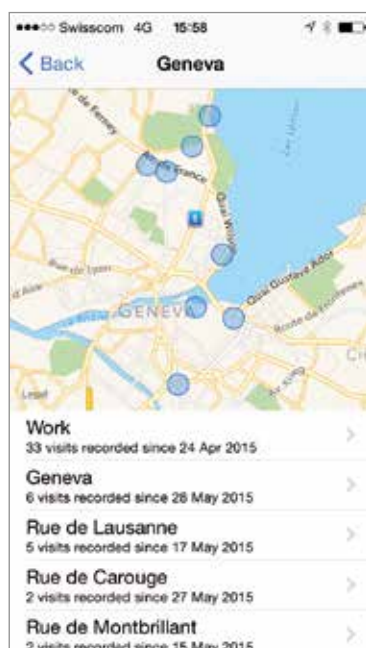
A number of companies provide Wi-Fi location data, as third parties or the platform providers themselves. Hotspot operators will receive information about devices that are in range of their Wi-Fi.

The mobile network operator (MNO) has always had the ability to locate subscribers, even before the introduction of Internet services, in order to originate or terminate a call. On the other hand, the MNO is also typically subject to strict privacy regulations as a historical matter, covering not just location but also call information, and these regulations extend to mobile Internet services. Such regulations do not automatically extend to other companies in the location value chain, however, over whom regulation is typically lower or non-existent, and who may or may not receive only anonymised data about location.

A recent study showed that under certain conditions, anonymous data on location could be linked back to individual users. The researchers had 15 months worth of location data from 1.5 million users in a small European country. Based on this data, they showed that with just four random location points, they could identify 95% of the users. With 11 location points, they could identify all of the users. This shows that our location patterns are very unique, and even a small amount of data can reveal a significant amount of information about the identity, not to mention the habits, of a user.<sup>1</sup>

<sup>1</sup> See <http://www.nature.com/srep/2013/130325/srep01376/full/srep01376.html#affil-auth> for more details.

Users are in a difficult position with respect to location-based services. First, many may not be aware about the collection of data, including on location, or even if aware, may not know the extent of data or number of companies collecting such data. The issue is not restricted to location of course, as all the various sensors in phones may be on, and not just collecting information, but also combining it to learn more about us.



Users who are aware and concerned may limit what data is collected, and by whom, but this is not necessarily straightforward either. Each app has its own privacy policy discussing how it uses data, and access to location data must be controlled separately for each app, unless the use of location data is turned off globally, which limits the benefits of the mobile Internet. Further, across platforms the granularity of privacy settings varies, in terms of what the user can control.

Finally, the parameters may change with new versions of the operating system, surprising users who are not fully vigilant with their privacy settings.

*Some phones track and compile frequent locations – a feature which is relatively new and has been called ‘a divorce lawyer’s dream’.<sup>2</sup> The snapshot at left, centered on ISOC’s Geneva offices, was taken from the surprised author’s phone.<sup>3</sup>*

## ② Security

Mobile Internet devices and usage patterns may introduce new security issues. These issues relate both to reading of **personal and sensitive data** off of the devices as well as placing unwanted data or programs on the devices. The threat of these security issues is heightened by the increased amount of private information available to smart devices.

First, there are a number of communication channels – mobile, Wi-Fi, Bluetooth, and NFC – that can be intercepted or monitored. Furthermore, mobility brings victims in proximity with hackers, instead of the hackers having to seek out victims. For instance, Wi-Fi does not just relate to mobile devices, but it is easier to get access to Wi-Fi traffic near a public hotspot than it is to get access to the traffic near a private hotspot in a home or business.

Likewise, Bluetooth was vulnerable in the early days to ‘bluesnarfing’, in which information could be downloaded from a user’s phone over Bluetooth without their knowledge within the 10 meter range of Bluetooth, a flaw that has been corrected, while ‘bluejacking’, the ability to send contact information to another phone without consent, may still be possible on some phones.

<sup>2</sup> <http://metro.co.uk/2014/09/28/how-your-iphone-has-been-tracking-your-every-move-in-secret-4884687>.

<sup>3</sup> On an iPhone this feature can be found at Settings -> Privacy -> Location Services -> System Services -> Frequent Locations, where the history can be seen and a map is generated when any of the entries are pressed, the feature can be turned off, and the history can be cleared.

On an Android device, the feature can be turned off at Settings -> Location -> Google Location Reporting. The maps can be viewed on Google Maps from any browser when logged into Google, at <https://maps.google.com/locationhistory/>.

Many of us store personal and valuable data including contacts and photos on our smart devices, associated storage (such as SIM cards or SD cards) or in the cloud, namely using apps that sync to a cloud service. As small portable devices they are particularly vulnerable to loss or theft, and users may have weak or no password protection allowing for easy access to the data.

The screen size also introduces its own challenges, as apps or the browser typically do not indicate whether data is stored or transmitted, what level of security is offered or what security measures are used. For instance, the secure sockets layer (SSL) padlock indicator common in PC browsers is not usually displayed in apps.

Finally, installing apps allows for introducing malware to the device, which has always been a risk when installing software on a computing device. App stores may provide varying levels of protection, either screening apps before making them available, or disabling apps after any problems have been found.<sup>4</sup> Users may be able to install apps outside of the default app store – either by design or by removing built-in restrictions (also known as jailbreaking) – either way, the user then loses any protection otherwise afforded by the store.

## ③ App challenges

We have seen that there is now an **availability of over one million apps**, and **app usage** accounts for significant online usage, creating an app economy providing opportunities for entrepreneurs worldwide. The emergence of this new app economy is based on the ease of use of apps and the ability of the apps to access the advanced features of smart devices. We also noted in the previous challenge that app stores can increase security by screening apps for malware.

However, there is a downside to this ease of use and convenience. Currently, the vast majority of apps are native to a particular proprietary mobile platform, such as Android or Apple, and thus subject to access afforded by the underlying mobile OS and the corresponding app store. The impact of this on the user experience can best be explained by comparing online activities using a web browser on a personal computer with using native apps on a smart device.

On a PC, broadly speaking one can download any browser, and using that browser search for, and access any available websites. From a website one can then follow links to other websites.<sup>5</sup> Finally, if a user switched operating systems, all websites will still be available through a browser running under that new operating system.

On a smart device using native apps, however, the experience is completely different. First, users cannot easily search between apps, or easily move between them as with websites. Further, typically the user can only download what is available in an app store, and it may not be possible to switch app stores. Finally, if a user switches operating systems, he or she will have to re-access all of their apps, if they are all even available on the new platform.

We now go through these points in greater detail.

<sup>4</sup> <http://googlemobile.blogspot.com/2012/02/android-and-security.html>.

<sup>5</sup> Of course, there may be government or commercial limits to what is available in a particular country, as discussed in detail in the Global Internet Report 2014, Section 4. See <http://www.internetsociety.org/doc/global-internet-report>. Nonetheless, for these purposes, any content that is available in a country can be accessed through any browser.

# App challenges

## a. App search and linking

Users cannot easily search or link across apps

## b. Openness

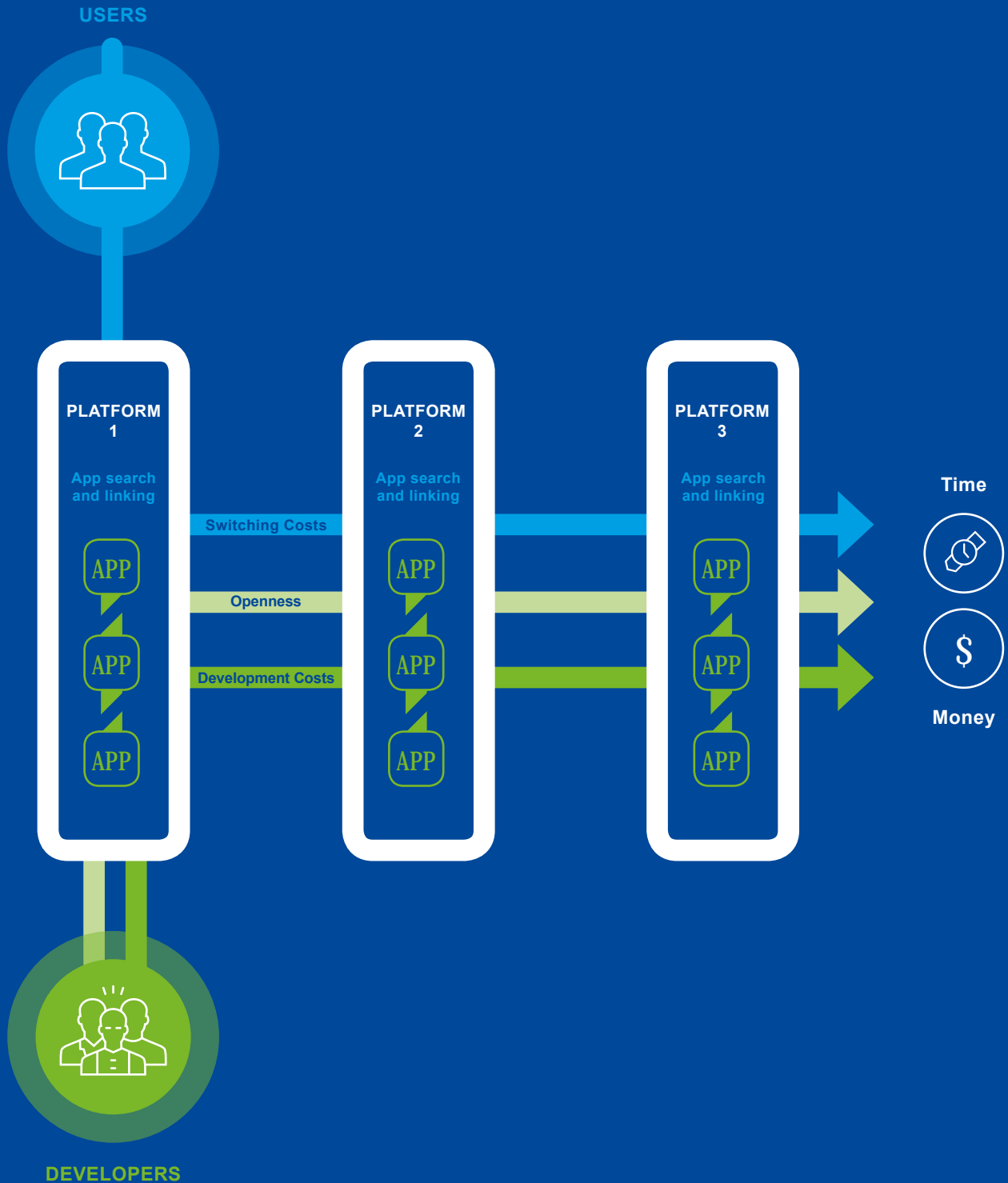
App stores control the openness of their platform to developers

## c. Development costs

Developers face costs in making their apps available on each platform

## d. Switching costs

Users face costs in switching between platforms



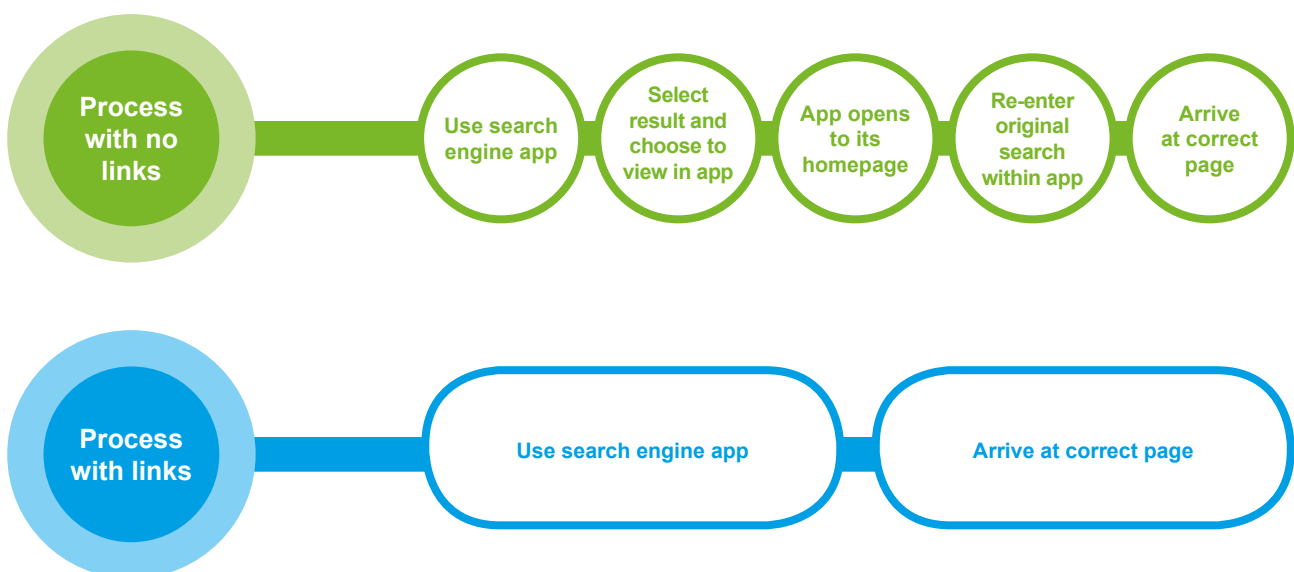
## Ⓐ App Search and Linking

While the number of websites available to users continues to grow, searching and linking across websites has become increasingly straightforward, thanks to tools such as the web browser and search engines. While these tools are available on mobile browsers, the majority of mobile data is viewed via apps. However, such apps are standalone tools, with no web addresses and, apart from a few recent innovations, no deep links. This means that information found via an app, be that discount hotel offers or train times, cannot always be easily shared and that users cannot move directly between apps.

A number of developers have begun to search for methods to enable deep linking between apps, for example by assigning each app a uniform resource identifier (URI) that will allow it to be opened directly in place of the standard web interface. Such linking has first been adopted across individual developers' apps, for example the Facebook app linking easily to Facebook messenger. The greatest benefit of such mobile deep linking will be the ability for users to be brought directly to a specific location within an app with a dedicated link. Just as deep links made the web more user friendly and navigable, mobile deep links are likely to do the same for mobile apps.

### Illustration of how linking between apps can streamline user experience

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However, while much progress has been made there are still stumbling blocks in the full adoption of deep linking, with such connections often negotiated one-to-one between apps or through a company's individual approach.

In particular, issues arise due to a lack of interoperability, with different mobile platforms often adopting different formats. This causes a confusing user experience because different sets of links are required to access the same app on a different mobile operating system.

An open access, cross-platform approach to deep linking will increase the benefits of the app environment for all users.

## **b** Openness

The owners of App stores exert control over what is available to varying degrees. While this may help prevent downloading or use of apps with malware, improving security along with helping maintain the privacy of customers (see the first two challenges in this section), this can also limit expression and consumer choice.

A number of app stores, including those of the Apple and Windows platforms, require developers to submit their apps for review and approval before the platform operator will publish them. The **guidelines** for which apps will be accepted and which will be rejected can be imprecise, and can add uncertainty to app investments.

Such generalisations in guidelines for approval allow app stores to act as a **gatekeeper**, having complete control over the content published, potentially restricting **permissionless innovation** and freedom of expression.

*For example, Apple **guidelines** include requirements for apps to be “useful, unique or provide some form of lasting entertainment” as well as not including “any content or behavior that we believe is over the line”, with no details given of either what constitutes useful or where this hypothetical line is drawn. Similarly Windows requires apps to “offer customers unique, creative value or utility” with no further details of what this would entail provided.*

*This **gatekeeper** function has resulted in magazines self-censoring in order to be available on the Apple Newsstand, with content ultimately being omitted in order to ensure that the publication meets the standards of the App store, which may differ from those held by the original publication. In December 2009, Apple withheld approval of NewsToons, a cartoon app by Mark Fiore, on the grounds it “ridiculed public figures”. However following Fiore’s 2010 award of the Pulitzer prize for these same cartoons, Apple asked Fiore to resubmit the app, and it was subsequently accepted despite no change in content.*

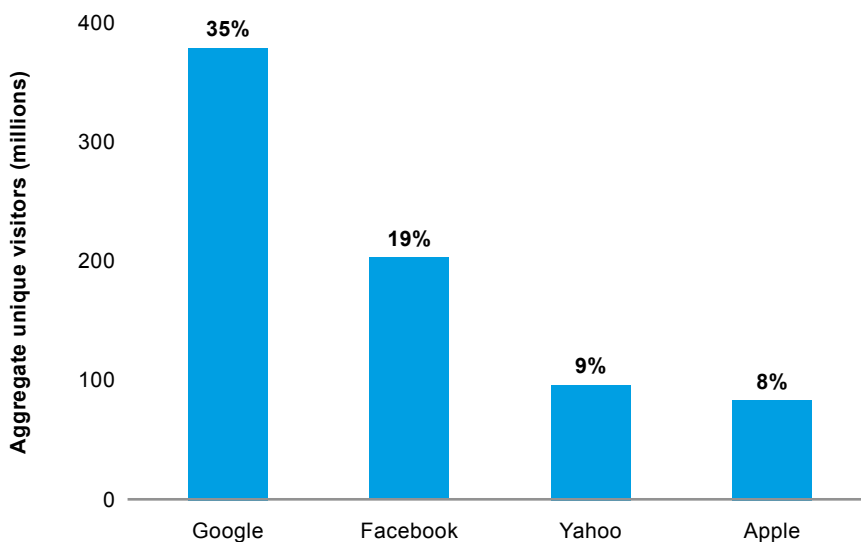
Once accepted, apps are still subject to decisions made by app stores. There are currently upwards of 1.3 million apps available to download, leading potential customers to often rely on app rankings and content promoted by the store via “featured lists” to decide on which to download. This can mean that unless an app already has a large audience or is selected for endorsement it is unlikely to be discovered, making it hard for developers of new apps to get noticed.

The result is that the vast majority of traffic is on apps owned by large developers, for example 71% of unique visitors to the top 25 US mobile apps in June 2014 were to apps owned by just four developers. This differs from the desktop browser situation, where the dominance of the top four digital media properties is roughly half of that on apps, making up just 36% of aggregate unique visitors in August 2014.<sup>6</sup>

App stores are attempting to offer developers methods through which to generate app discovery, for example the use of sponsored search results on Google Play, thereby driving awareness.<sup>7</sup> However, there are issues with this solution in that it may be the wealthier, more established developers that are able to afford this service and the divide may increase, with truly innovative new apps never achieving visibility.

### Aggregate unique visitors to US top 25 apps by ownership (June 2014)

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Source: ComScore, 2014<sup>8</sup>

<sup>6</sup> <http://www.comscore.com/Insights/Market-Rankings/comScore-Ranks-the-Top-50-US-Digital-Media-Properties-for-August-2014>.

<sup>7</sup> <http://android-developers.blogspot.co.uk/2015/02/a-new-way-to-promote-your-app-on-google.html>.

<sup>8</sup> [https://www.comscore.com/Insights/Press-Releases/2014/8/comScore-s-US-Mobile-App-Report-Available-for-Download?\\_ga=1.47283424.613095484.1407802489](https://www.comscore.com/Insights/Press-Releases/2014/8/comScore-s-US-Mobile-App-Report-Available-for-Download?_ga=1.47283424.613095484.1407802489).

## © Development costs

Mobile platforms exist as stand-alone closed ecosystems, with apps needing to be developed specifically for each platform in order to be used on non-standardised devices. This requires developers to create multiple variations of their apps in order to reach the maximum audience in terms of device owners. For most small to mid-sized businesses, the budget for app development is a serious consideration, with the median cost for app development between USD37 913 and USD171 450.<sup>9</sup>

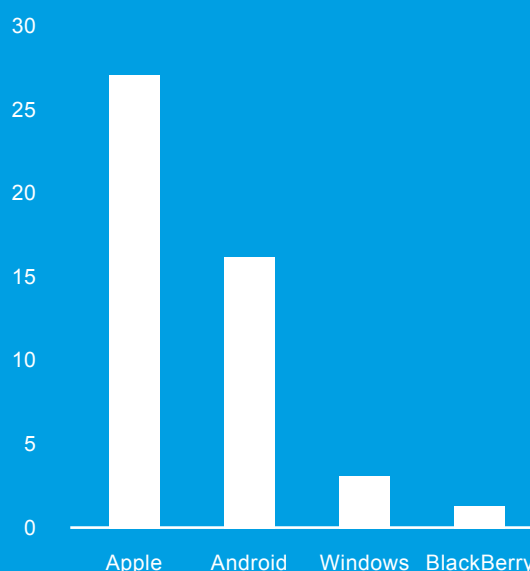
As a result, the development of mobile apps 'personalised' for multiple operating systems can be expensive and resource-intensive. These costs increase with the need to update the apps as the underlying mobile OS is updated. Furthermore, as more and more of our devices become 'smart', including our TVs, our e-book readers, and even our watches, this can require further development to adapt apps to these new platforms.

One can see the results in the numbers of **apps available on each platform**, where after Apple and Android there is a steep decline in the number available for the other platforms. We note that even **governments** may not develop official apps for all platforms, adding to the challenge of new platforms and restricting the options for users of those platforms.

*The US government provides an example of selective app development, for example apps related to America's Bureau and Centers for Medicare and Medicaid Services are only available on Android and iOS. Overall, many apps are available on iOS only, many of the rest are only available on Apple and Android, and only a handful are available for BlackBerry or Windows.<sup>10</sup> This availability does not reflect the platform market share in the US, where Android has a market share of 58%.*

*The European Union is also quite selective in which platforms it supports.<sup>11</sup> Of the 27 EU apps, all are available on Apple, just over half are available on Android, three are available for Windows, and only one, regarding the Galileo and EGNOS Satellites, is available for BlackBerry. The predominance of Apple availability is at odds with the market share of Apple – in the five largest EU countries it ranges from 7 to 38%, while Android is not below 50% in any.*

### Availability of EU apps for each platform



<sup>9</sup> Source for costs: <https://clutch.co/app-development/cost-build-mobile-app-survey>.

<sup>10</sup> See the US Federal Government Apps Directory for the choices of app stores that are supported <http://www.usa.gov/mobileapps.shtml>.

<sup>11</sup> See the list of 27 EU Mobile Applications here [http://ec.europa.eu/ipg/plan/mobile/list/index\\_en.htm#section\\_2](http://ec.europa.eu/ipg/plan/mobile/list/index_en.htm#section_2).

## ④ Switching costs

The lack of standardisation between apps and app stores also acts as a barrier for consumers wanting to move between platforms as there are significant costs associated with switching. In particular these costs are associated with the loss of non-transferable apps which will likely need to be re-purchased for the new handset, increasing the relative cost of switching to a new platform. Even for free apps, there is a time cost to switching. Such costs can ultimately impact the decision of whether to switch, and if so, on which platform to switch.

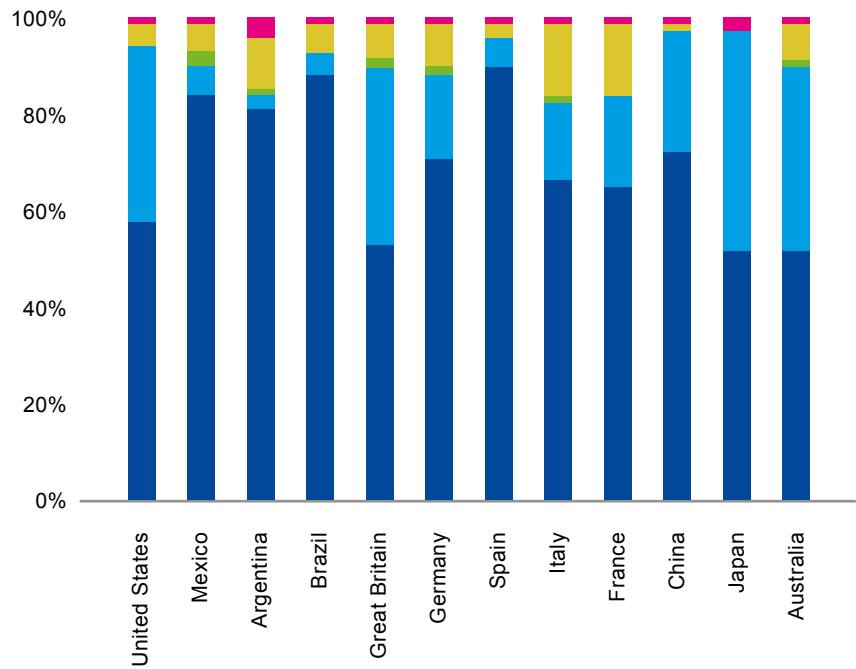
## Summary

The introduction of app stores, typically tied to the platform consisting of the smart device and operating system, has proven popular with users, by making the advanced features of a smart device available through a convenient icon. At the same time, it has created a first-mover advantage that limits platform competition. Users will only invest the cost to switch to a new platform if there are enough apps available, but app developers will only spend the money to adapt their apps to a new platform if there are enough users. The result is less dynamic than the easier switching between PCs accessing the Internet via browsers.

The outcome can be seen in the operating system **market shares across countries**. While the **global market share** for Android is 84%, in the graph one can see a wide range across the countries shown. In no case, however, does Android have less than 50% market share and in several it approaches 90%, while Apple never exceeds 38%, Windows has no more than 14%, BlackBerry no more than 3%, and Other platforms only exceed 1% in one country.

## Market Share Q1 2015

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■ Android ■ iOS ■ BlackBerry ■ Windows ■ Other

Source: Kantar Worldpanel, 2015



**DEVELOPMENT**

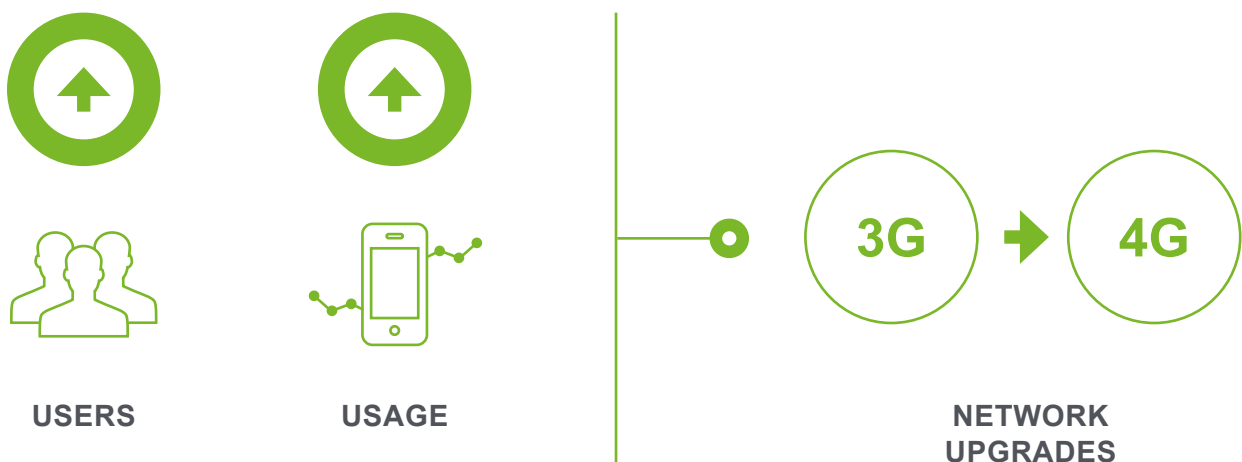
## ④ Spectrum issues

Recent years have seen a surge in mobile data traffic, **based on the increase in the number of users**, and the **increase in the amount of traffic generated by users** taking advantage of all the possibilities of the mobile Internet. Traffic will continue to grow at a fast pace as mobile network deployments expand to cover entire countries, and as networks upgrade to 3G and 4G technologies and beyond.

The availability and growth of mobile Internet services is critically dependent on access to a finite resource – radio frequencies, or **spectrum**<sup>12</sup>. All devices offering mobile Internet operate in a similar way, generating and transmitting a signal at a specific radio frequency. Once transmitted from a device, it is captured by the nearest base station and then transferred to the Internet. Return traffic is transmitted from the base station to the receiving device, which then decodes the signal into the required data.

Spectrum is at the heart of many commercial services, including radio and television, government services including safety networks and military communications, and personal services such as ham radio. In many, but not all, cases a band of frequency must be made available on an exclusive basis for one particular service, and often to individual providers of the service, in order to prevent interference and provide an incentive to invest in the service.

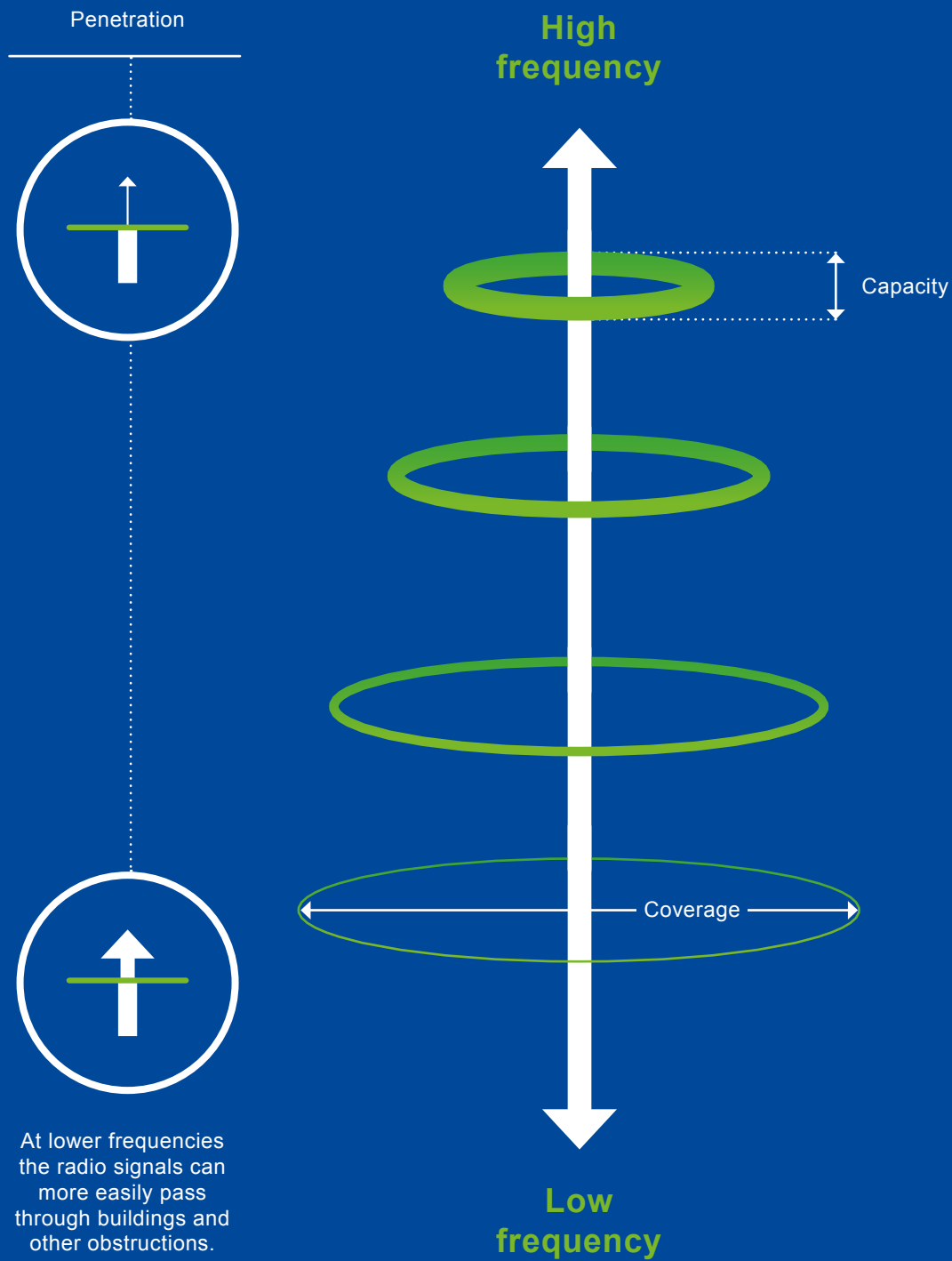
As spectrum is a scarce resource, and given that the spectrum most attractive for mobile cellular and Internet services has often been assigned for other existing services, spectrum management is a critical policy and regulatory issue. The needs for mobile services must be balanced against the needs of other services within a country, and against the international need to coordinate spectrum use and create standards for equipment.



<sup>12</sup> [http://en.wikipedia.org/wiki/Radio\\_spectrum](http://en.wikipedia.org/wiki/Radio_spectrum).



# Characteristics of spectrum frequencies

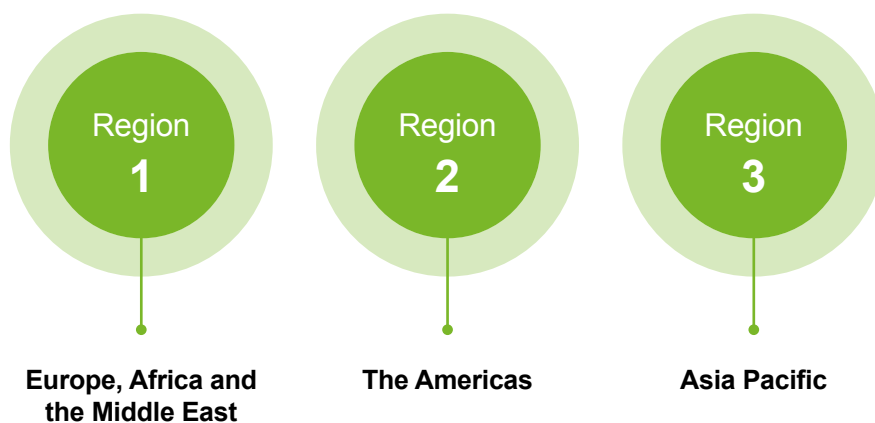


Only a relatively small subset of radio frequency spectrum, between 450MHz and 5GHz, is currently in use for the provision of mobile services, while further spectrum including that upward of 6GHz is being researched for mobile feasibility.

Spectrum is selected for different services according to the **characteristics** associated with each frequency. Lower frequency spectrum is ideal in many circumstances, as it can penetrate buildings in cities, and propagate far in suburban and urban areas. For this reason, however, it is already heavily used, notably for broadcast television.

Attempts are being made to make this popular spectrum more accessible to mobile, notably the **digital switchover**<sup>13</sup> to free up spectrum, and **white space** usage to make existing use more efficient. Given the existing popularity of these bands, lower frequencies are not likely to be able to keep pace with increasing demands, and thus higher frequencies, where more spectrum tends to be available, are typically used to provide more capacity.

Access to radio frequencies is regulated via detailed spectrum management processes, to promote efficient use. Typically day-to-day spectrum management is undertaken by national regulators, however the International Telecommunication Union (ITU) is responsible for identifying harmonised spectrum bands to be released to different services at a regional or global level where possible. This allows for economies of scale in creating equipment and services that can be used widely across regions or globally, and helps to avoid potential interference issues, both between neighbouring countries and neighbouring frequency bands. The ITU coordinates spectrum across three regions:



The ITU hosts a World Radiocommunication Conferences every 3 to 4 years, at which it reviews frequency allocation. The next conference, **WRC-15**,<sup>14</sup> is to be held in November 2015. In the conference preparatory meeting a number of spectrum bands were highlighted as candidate bands for use by mobile services in order to meet future mobile data demands.

<sup>13</sup> [http://en.wikipedia.org/wiki/Digital\\_television\\_transition](http://en.wikipedia.org/wiki/Digital_television_transition).

<sup>14</sup> <http://www.itu.int/en/ITU-R/conferences/wrc/2015/Pages/default.aspx>.

## Candidate bands (shown in blue) for mobile services to be discussed at WRC-15

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At the national level, there are three tools commonly used for managing spectrum access, with spectrum able to be authorised as:

- 1 Dedicated, licensed spectrum
- 2 License-exempt spectrum
- 3 License-shared access spectrum

### 1 Dedicated, licensed spectrum

Dedicated, licensed spectrum is used for the provision of mobile cellular services around the world and, while the bands are co-ordinated by the ITU, national regulators assign this spectrum to individual operators through processes such as competitive auctions and beauty contests. Mobile operators must make significant investment in network infrastructure in order to provide services, and in order to make this investment worthwhile require dedicated spectrum assignments, allowing for no interference from other uses, and licensed for a sufficient period to recoup the investment.

Spectrum bands are allocated to mobile operators in different ways across the three ITU regions, however some of the more recently released bands, such as the 2.6GHz band are assigned more uniformly. Additionally within these regions there is significant variation in the **amount of spectrum assigned** by regulators for mobile use.



## SPECTRUM ASSIGNED FOR MOBILE

The amount of spectrum assigned for mobile can vary significantly by country. For example, in Europe, Albania has assigned a total of 360MHz of spectrum to mobile while Austria has assigned 805MHz. Similar phenomena can be seen in the Asia Pacific, where Australia has assigned 658MHz and Vietnam only 340MHz.

By contrast, the ITU has predicted that by 2020 average spectrum requirements for the provision of mobile services will be between 1340-1960MHz, while GSMA has predicted that between 1600-1800MHz will be needed. This highlights the spectrum challenges facing the international community at the upcoming WRC and the challenges facing policymakers at the national level.

### Summary of spectrum band allocation to mobile

Spectrum band	Region 1		Region 2		Region 3	
	Allocation	Typical usage	Allocation	Typical usage	Allocation	Typical usage
700MHz	2×30MHz*	LTE	2×35MHz	LTE	2×45MHz	LTE
800MHz	2×30MHz	LTE	N/A		N/A	
850MHz	N/A		2×25MHz	GSM	2×25MHz	GSM
900MHz	2×35MHz	GSM/UMTS	N/A		2×35MHz	GSM/UMTS
1.5GHz**	N/A		N/A		2×35MHz**	LTE
AWS (1.7/2.1GHz)	N/A		2×70MHz	UMTS	N/A	
1.8GHz	2×75MHz	GSM/LTE	N/A		2×75MHz	GSM/LTE
1.9GHz	N/A		2×60MHz	GSM	N/A	
2.1GHz	2×60MHz	UMTS	N/A		2×60MHz	UMTS
2.3 TDD	100MHz	TD-LTE	100MHz	TD-LTE	100MHz	TD-LTE
2.6 TDD	50MHz	TD-LTE	50MHz	TD-LTE	50MHz	TD-LTE
2.6GHz	2×70MHz	LTE	2×70MHz	LTE	2×70MHz	LTE
3.5GHz***	200MHz	TD-LTE	200MHz	TD-LTE	200MHz	TD-LTE

Note that not every country within each region will have assigned all of the allocated spectrum to the mobile operators in that country.

Source: ECO; ITU; Regulator websites

\* Likely allocation and band plan, to be confirmed following WRC-15

\*\* So far this band is only used in an FDD configuration in Japan, but may soon be used for LTE (SDL and TDD) in multiple regions

\*\*\* Band plan not yet finalised so this could also end up being used for LTE with an FDD band plan.

## 2 License-exempt spectrum

Certain bands of spectrum allow wireless services to operate without requiring individual licenses, based on certain technical conditions being met, for example keeping transmission power low and avoiding interference. Services that make use of such spectrum include Bluetooth and a number of Near Field Communication (NFC) technologies, however Wi-Fi is the single largest category of license-exempt spectrum use.

Mobile data on network-connected devices can be offloaded onto these services at the discretion of the operator, to preserve spectrum use where possible, or the consumer who can link their devices to their Wi-Fi hotspot, often to save on data charges. However mobile data traffic from devices without mobile subscriptions, such as some tablets, can also use this spectrum and add to the amount of traffic.

### Wi-Fi

*Wi-Fi, the name given to wireless local area network (WLAN) services using the IEEE 802.11 open standard, uses spectrum in the 2.4GHz (2400-2500MHz) and 5GHz (5100-5800MHz) bands within a limited range or "hotspot". The Wi-Fi access point is able to transmit encoded data in the same way as cellular network base stations.*

*Wi-Fi is supported by devices beyond handsets and mid-screen devices including video game consoles, connected TV sets and is widely used in businesses, schools, and homes as an alternative to a fixed wired local network. In particular, businesses such as airports, hotels, and restaurants offer public access to Wi-Fi networks, either for free or requiring a payment to access via password*

## 3 License-shared spectrum

Spectrum sharing predominantly takes two forms, spectrum competitively assigned for shared use and spectrum where the sharing is actively managed by national regulators. Its purpose is to allow spectrum to be used by another party when not in use or needed by the primary user, thereby making spectrum use more efficient.

Given the nature of spectrum as a finite resource, such innovative regulatory strategies, allowing different types of technology to operate in the same frequency band, are particularly important in meeting demand. This is notably true in the case of **white spaces**, which allow valuable broadcast spectrum to be shared by mobile Internet services.

## White spaces

*White spaces are the name given to parts of the spectrum that are unused in a particular geographic location and at a particular time, for example unused channels in bands for which the primary use is broadcast television. Such open TV channels are particularly common in rural areas and regulators, including the FCC in the USA and Ofcom in the UK, are providing a path to allow Wi-Fi like services using White Space Devices (WSD) to broadcast over unused TV channels. These services would either use dedicated devices, or the functionality would have to be incorporated into mobile devices in the future.*

*The prevalence of white space spectrum in rural areas makes it potentially particularly important in helping bridge the digital divide by providing wireless Internet in rural areas and enabling technology innovation.*

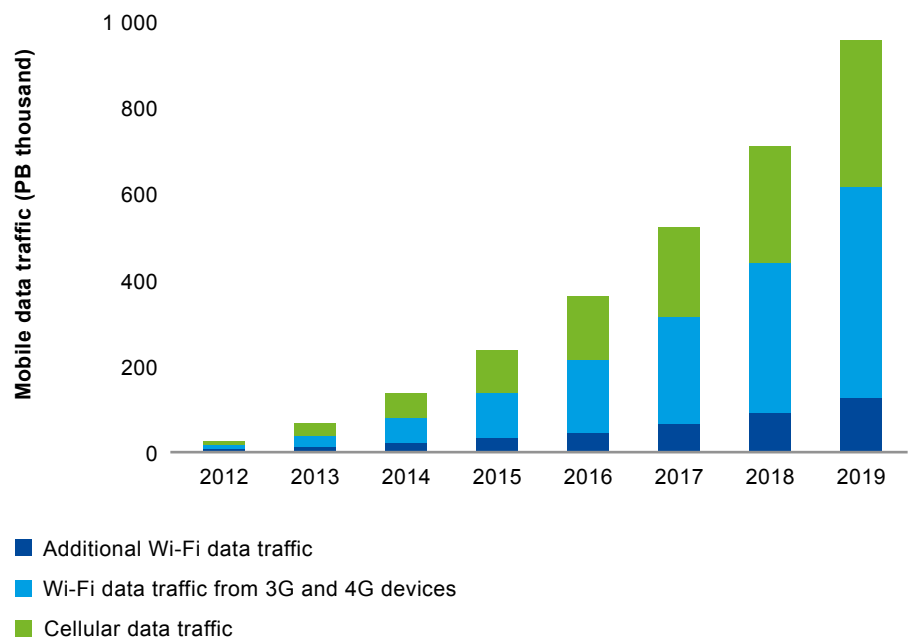
Mobile Internet use will continue to grow as both subscriber numbers and average data consumptions per subscriber grow, increasing **global mobile traffic**.

There are four realistic means to address increasing demand, each with its own potential issues.

1. Build more mobile cell sites in order to increase overall capacity and hence reduce the demand on each site. However, this is expensive, and interference between sites limits the density of the sites as they get closer together.
2. Offload mobile traffic to platforms such as **Wi-Fi** and potentially **white spaces**. However, as shown on the right this would mean a significant increase in Wi-Fi traffic, which may lead to congestion over time.
3. Limit demand using data pricing and/or throttle demand for heavy users. This would have the counterproductive result of limiting the benefits of the mobile Internet that we have explored in **Section 3**.
4. Make additional spectrum available for the mobile Internet, including all types of spectrum – licensed for mobile operators, unlicensed for Wi-Fi, and shared for white spaces.

While country by country needs are likely to vary, particularly between developing and developed countries, the ITU and GSMA predict that on average spectrum requirement for the provision of mobile services in 2020 will be significantly more than **what is assigned today**. This will be a significant challenge at the country level, as the needs of other private and public radio services must be balanced against mobile Internet needs, and at the WRC15 as allocations are made that will impact the future availability across all regions.

## Forecast mobile Internet traffic on both cellular and Wi-Fi offload networks



Source: Analysys Mason Research, 2015

## ⑤ The Digital Divide

The optimistic view of Internet development focuses on the speed at which we have now surpassed 3 billion users, with the mobile Internet playing a significant role in that achievement. However, that still leaves more than half the world's population offline. Given the role that the mobile Internet will play in bringing the next billions online, we focus here on the challenges faced in bringing those users online and allowing them the same opportunity for social and economic inclusion.

As shown on the next chart, there are three challenges to the mobile Internet closing the digital divide.



#### Availability

Users can only access the Internet if it is available to them; building on existing cellular network availability, availability of mobile Internet services outpaces adoption today.



#### Affordability

One reason that availability outpaces adoption today is clearly the cost of service, which for too many is too large an expense.



#### Relevance

Finally, even for those who can afford the Internet, they must have a compelling reason to go online, based on content that is in their language and locally relevant.



## Availability

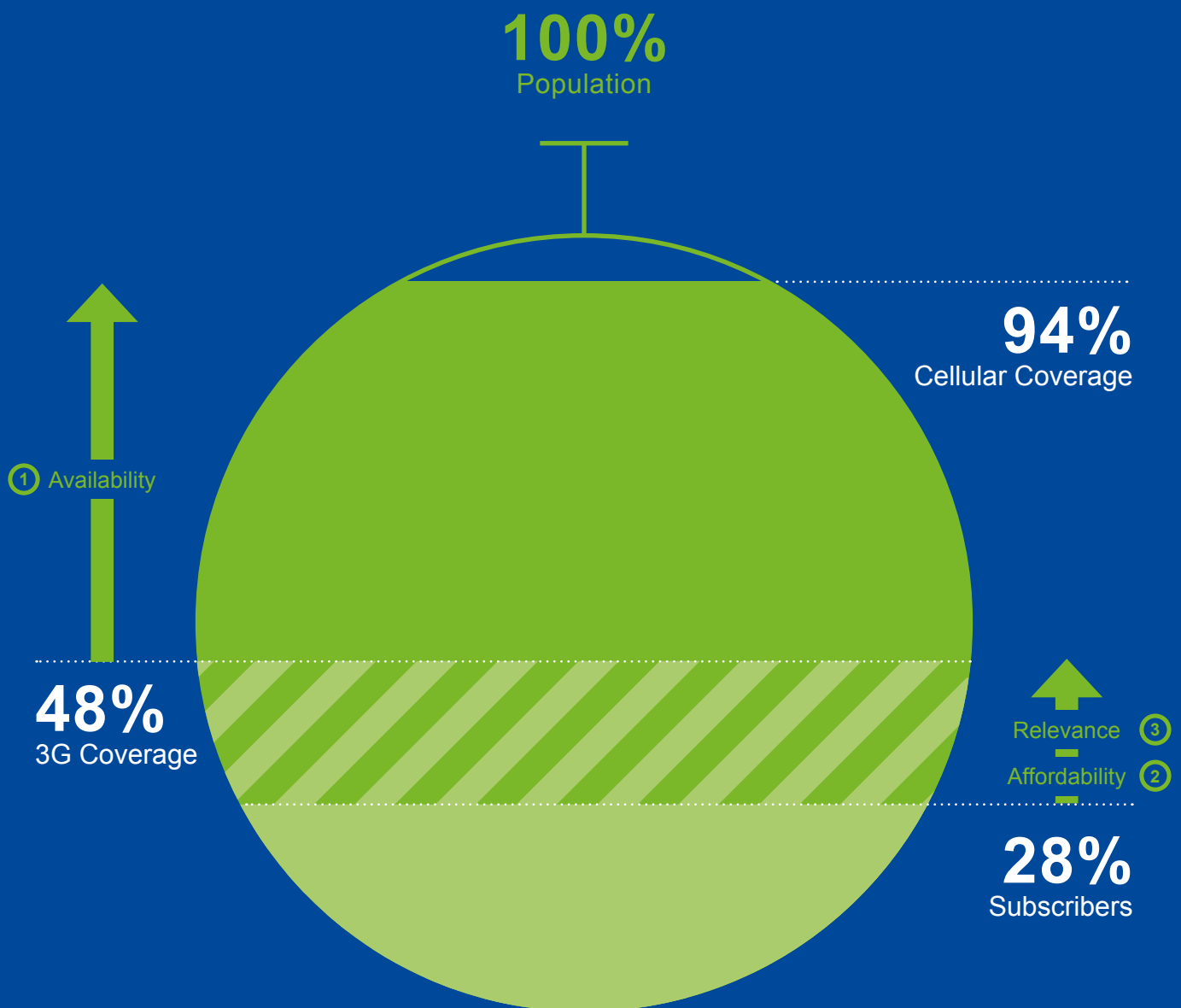
The first challenge is **availability**. The basis for mobile Internet availability is cellular network coverage, and many countries have at or close to 100% of their **population covered by cellular networks**, the global average is 94%, and no region has less than 80% coverage. While the data does not exist that indicate whether these networks are at least 2.5G, and thus able to offer mobile Internet services, the cost to upgrade from 2G is relatively low, and thus could relatively easily be upgraded in the face of increased demand.

While the good news is that almost every country tracked has at least a **3G network deployed**, offering fast Internet connections, the coverage is not yet universal, with some regions having just over 10% coverage, and the worldwide average at **48% of population covered**. This restricts much of the population to older mobile technology, if any, and restricts the mobility of those with 3G service to those parts of the country with coverage.



# The Digital Divide

This chart shows that while 94% of global population is covered by a cellular network, only 48% have 3G coverage, leaving room to increase **availability**. Further, only 28% have subscribed to a mobile Internet service, leaving room to increase adoption by focusing on **affordability** and **relevance**.



Source: ITU, Analysys Mason Research

## 2 Affordability

The second challenge is **affordability**. In most, if not all, countries, the availability of mobile Internet service far outpaces adoption rates, meaning that a significant number of people have access to service, but do not subscribe. One reason for this is affordability, as the cost clearly puts a ceiling on the number who can adopt service, and there is still a large number of countries where the cost is more than 5, or even 10% of average per capita income.

On the other hand, according to a recent study by internet.org,<sup>15</sup> a data package of 250MB would be affordable to 55% of the world's population, for whom this would represent 5% or less of average per capita income. At an entry level, this would allow approximately 12,500 text-based emails, or 1,250 text-based web pages to be browsed. Including multimedia would decrease the amount of usage significantly of course, and thus work still needs to be done to lower the costs to make all services available to everyone.

Nonetheless, these numbers suggest that more people could afford mobile Internet services than the 28% of the population who are currently taking them, suggesting a segment of the population for whom the Internet is available and affordable, but not yet of perceived interest to adopt, based on a variety of factors we consider next.

## 3 Relevance

This suggests that the final challenge is **relevance**. As described in last year's **Global Internet Report 2014**, a far greater percentage of online content is in English compared with the proportion of the global population who can speak English.<sup>16</sup> More specific to the mobile Internet, we have noted that not every country has **access to the major App stores**, which limits the usefulness of a smart device and corresponding mobile Internet subscription.

Access to an App store can provide a market for **entrepreneurs**, many of whom are likely to address gaps in their own market. However, even for those who do have smart devices, there may be limits on productivity. While there are few surveys, one showed that in India, 34% of Internet users only access the Internet via their mobile.<sup>17</sup> In this case, are they limited to mainly consuming content and communicating? **Is it possible to produce, create, innovate?** Or will such users still face some exclusion from fully joining the Internet economy?

<sup>15</sup> "State of Connectivity: 2014, A Report on Global Internet Access", internet.org, February 2015, <http://newsroom.fb.com/news/2015/02/the-state-of-global-connectivity/>.

<sup>16</sup> See the Internet Society Global Internet Report 2014, Section 4, at <http://www.internetsociety.org/doc/global-internet-report>

<sup>17</sup> See Unitus Seed Fund Report at page 45, <http://usf.vc/updates/unitus-seed-fund-releases-new-india-livelihoods-report/>

# Conclusion

In conclusion, many of the benefits of the mobile Internet bring with them their own sets of challenges that need to be addressed to ensure that all users – existing and future– enjoy the full benefits of access to the open Internet.

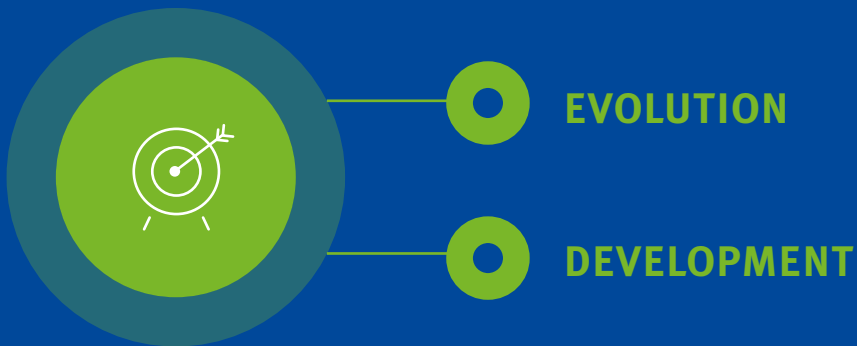
The introduction of smart devices using apps has increased the amount of personal and sensitive data available to a wide range of companies, while mobility has potentially introduced new security concerns based on the ability to intercept transmissions and expose this data to unwanted parties. At the same time, the apps used overwhelmingly to access the Internet via smart devices have created costs that may limit competition.

Nonetheless, the overwhelming benefits of the mobile Internet, and the new services available, have created new demands for spectrum that must be met to continue the fast pace of growth. This growth is particularly significant in developing countries, where the mobile Internet has leap-frogged traditional access, and a number of challenges must be met for the mobile Internet to continue to close the digital divide.

In the final section, we provide recommendations to address these challenges.




# Section 5

## Recommendations





In Section 4 we examined five challenges presented by the introduction of mobility and the advanced features of the smart device, in terms of the resulting evolution of the Internet and the impact on development. These challenges are summarized below. Here we provide recommendations to overcome these challenges in order to protect and promote the benefits of the mobile Internet for current and future users.

## EVOLUTION

-  **Smart devices enable services such as location awareness and include features such as cameras; the flip side of the coin is increased privacy issues**
-  **Usage of the mobile Internet depends on a number of wireless interfaces and access to apps; these lead to heightened security issues**
-  **Apps provide convenient access to the advanced features of the phone such as the GPS or camera; but app stores create costs for developers and customers and may limit competition**

## DEVELOPMENT

-  **More users are doing more with the mobile Internet; is there enough spectrum available?**
-  **Mobile Internet is the way the next billion are going to get online; will this close the digital divide?**



**EVOLUTION**

# ① Privacy



## LOCATION

As we put our smart devices to more uses, in the house, on the move, and at work, the amount of information about us, and the number of companies that have access to at least some of that information, is multiplying. Many, if not most of us, are not fully aware of what is collected, unless confronted directly with the results. For example, many are unaware, and thus surprised, at seeing their own activity mapped in detail with the **frequent location** features of at least the Apple and Android platforms, as discussed in Section 4.

In order to address these issues, it is important that users are given the option to provide consent to access features of smart devices in a fashion that is simple and granular, enabling control over relevant permissions given to each app. At the same time, app developers should provide sufficient privacy choices and refrain from attempting to access information not directly needed by their app. Regulatory intervention is a possibility, to impose guidelines if needed and enforce compliance.

One way to address the complexity of managing many apps and their frequent updates is an agency model. In this model, an intermediary or trusted agent would be given the users' overriding preferences on access to each feature – such as location or contacts – and then implement those permissions for each individual app. According to one prominent academic, after individuals answer a few privacy-related questions it is possible to predict their app privacy preferences with over 90 percent accuracy, showing how such an agent could provide simple and effective guidance.<sup>1</sup>

## Carnegie Mellon Study

In relation to the location-based example we used to highlight privacy concerns, researchers at Carnegie-Mellon recently released an interesting **study**<sup>2</sup>. During this study, they chose 23 subjects and tracked which apps had access to their location and how often the apps accessed their location. They then provided a privacy agent enabling the subjects to control access to location data, and provided the subjects with a 'privacy nudge' alerting them each time an app asked for location.

The results were startling. One user learned that his or her location had been shared with apps 5,398 times over two weeks. When presented with data about the frequency of sharing of their location, many of the study's subjects expressed shock, and having access to a privacy agent, most quickly reset their permissions to limit the use of location. As other research shows, not all apps even have an obvious direct need for location

<sup>1</sup> This is according to Professor Norman Sadeh, from the Carnegie Mellon School of Computer Science's Institute for Software Research. See "Carnegie Mellon Study Shows People Act to Protect Privacy When Told How Often Phone Apps Share Personal Information" by Byron Spice, 23 March 2015, Carnegie Mellon School of Computer Science announcement, at <http://www.cs.cmu.edu/news/carnegie-mellon-study-shows-people-act-protect-privacy-when-told-how-often-phone-apps-share-personal-information>.

<sup>2</sup> See <http://www.cs.cmu.edu/news/carnegie-mellon-study-shows-people-act-protect-privacy-when-told-how-often-phone-apps-share-personal-information>. See also Tim Moynihan, "Apps Snoop on your Location Way More than You Think," March 25, 2015, Wired at <http://www.wired.com/2015/03/apps-snoop-location-way-think/>.



data, which can further compound users' surprise. For instance, one free app that enables a smartphone to be used as a flashlight, appears to also use location data to deliver targeted advertising.<sup>3</sup>

This highlights two aspects of addressing privacy concerns – first, having a simple agent or manager for controlling privacy with sufficient choices offered, and second, having information on which apps access which information, and how often. Together, this enables consumers to realise the benefit of the mobile Internet while providing informed consent about how their private and sensitive data, such as their location, is used.

## ② Security

The Internet Society promotes a **Collaborative Security**<sup>4</sup> approach, which includes the principle that security solutions should be fully integrated with the important objectives of preserving the fundamental properties of the Internet, or the **Internet invariants** as we call them, and fundamental human rights, values and expectations. Our approach stresses that everyone has a collective responsibility for the security of the Internet:

People are what ultimately hold the Internet together. The Internet's development has been based on voluntary cooperation and collaboration. Cooperation and collaboration remain the essential factors for its prosperity and potential.

In the case of the mobile Internet in particular, no one actor can solve security for the mobile Internet – all have a role to play.<sup>5</sup> Among the key players, operators and vendors can act to secure mobile transmissions; mobile platforms and app stores can continue to control apps for malware and provide privacy tools for users; and Wi-Fi hotspot operators can use WPA2 security to protect users. Everyone can work together to implement usable encryption tools on mobile devices, and to develop uniform easy to understand security indicators designed for the small screen environment.

While providers and developers have an important role to play, users also play a key role in safeguarding their private data and interactions with the mobile Internet. This starts with the recognition that their smart devices are powerful computers, and like traditional computers connected to the Internet, subject to a variety of attacks, many of which can spread from their smart device to others indirectly through Wi-Fi or directly by accessing contact data. As a result, users should apply appropriate security tools and caution regarding access to their devices, downloading unfamiliar apps, and in using unknown Wi-Fi hotspots and providing Bluetooth permissions.

<sup>3</sup> Carnegie Mellon's Computer Human Interaction: Mobility Privacy Security (CHIMPS) Lab runs a website that grades free Android Apps on their privacy policies. See <http://www.privacygrade.org>.

<sup>4</sup> <http://www.internetsociety.org/collaborativesecurity>.

<sup>5</sup> For a discussion applicable to the Internet in general, see "Understanding Security and Resilience of the Internet", <http://www.internetsociety.org/sites/default/files/bp-securityandresilience-20130711.pdf>.

## ③ App challenges

As described in **Section 4**, each mobile platform can act as a gatekeeper, resulting in a native app environment that raises the cost of creating apps for each platform, the cost for users switching between platforms, and thereby limits platform competition. The Internet Society notes the remarkable benefits for users and opportunities of the app economy, resulting from existing mobile platforms. However, we also wish to highlight an alternative platform that is emerging, one based on the **OpenStand principles**<sup>6</sup> that we endorse.

October  
2014

The World Wide Web Consortium (W3C), which develops open standards for the Web, has defined an Open Web Platform in order to “enable developers to build rich interactive experiences, powered by vast data stores, that are available on any device.”<sup>7</sup> The cornerstone of the Open Web Platform is HTML5, the latest version of the HyperText Markup Language (HTML) that is used to write web pages, which was recommended as a standard in October 2014.<sup>8</sup> Part of the W3C work in this space is funded by the European Union project HTML5Apps.<sup>9</sup>

The vision for this work is to enable developers to create websites with advanced features that can be installed on a mobile device with an icon, similar to the way that a native app is installed today. The result brings the advantages of the Web to the app environment, based on non-proprietary open standards.

In particular, as web apps in the Open Web Platform are websites with advanced features, deep linking is possible as it is on the Web today, the apps update automatically when the website updates, rather than requiring an update to be downloaded, and the web app can automatically resize for any screen size, unlike native apps that may need to be modified.

Furthermore, as with the Web, the web app environment is intrinsically open to any developer, with lower overall costs as the app does not need to be customized for different platforms. Consumers also benefit, as it is just as easy to switch platforms as it is today to switch between browsers; web apps would not need to be re-purchased and re-downloaded. These advantages, which can increase platform competition, are highlighted in the diagram below in comparison with the challenges identified in **Section 4**.

<sup>6</sup> <https://open-stand.org/about-us/principles/>

<sup>7</sup> <https://open-stand.org/about-us/principles/>

<sup>8</sup> See <http://www.w3.org/2014/10/html5-rec.html.en>

<sup>9</sup> The HTML5Apps project is funded by the European Union through the Seventh Framework Programme (FP7/2013-2015). For more information see <http://html5apps-project.eu/>.

# Open Web Platform

## a. App search and linking

Users can easily search or link across web apps

## b. Openness

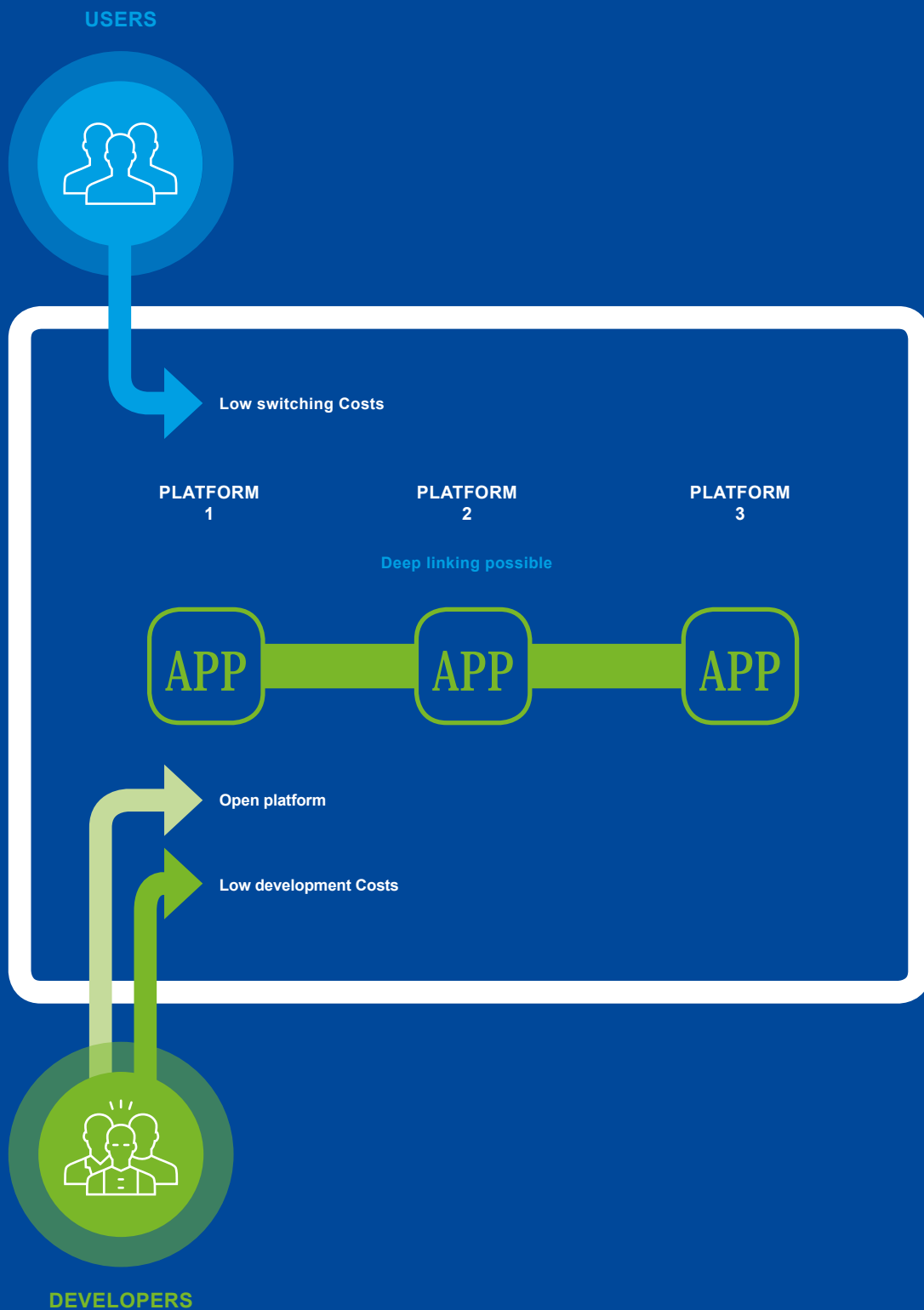
The web app environment is intrinsically open to any developer

## c. Development costs

Web apps do not need to be customized for each platform

## d. Switching costs

It is easy for users to switch between platforms



Examples of this new platform are already emerging. The Financial Times has already made available a web app, which can be installed directly from their website (app.ft.com) on any mobile device, as with the mobile version of this report. Mozilla has gone further and developed the Firefox OS platform with a Marketplace based on web apps, which a number of mobile operators including Telefonica are already supporting.

The aim of the Open Web Platform is to match or surpass the native app environment in a number of ways, including security and privacy, the ability for apps to work offline, allow for payments, and offer a full multimedia experience. However, these capabilities are not yet uniform across all browsers and platforms, which also limits interoperability for developers and users wishing to switch browser or platform.<sup>10</sup>

In recognition of remaining challenges, W3C has initiated a project called Application Foundations, to build on HTML5 and enable the Open Web Platform to meet the needs of developers seeking to create web apps that offer at least as good a user experience as native apps.<sup>11</sup> This approach – while not guaranteed with work still underway – would be consistent with our OpenStand principles, and provide new choices for users and developers.

The OpenStand principles encompass the work of the Open Web Platform and highlight its promise, as described in the statement below. As with the other standards covered by these principles, development and adoption is a multi-stakeholder effort, an effort we endorse. In particular, we encourage content and service providers to input to the Open Web Platform development to incorporate their needs; mobile OS vendors can ensure their browsers are able to fully use web apps; entrepreneurs can leverage the new opportunity, for instance to help users find relevant web apps, which users can then download and try for themselves.

*Over the past several decades, the global economy has realized a huge bounty due to the Internet and the World Wide Web. These could not have been possible without the innovations and standardization of many underlying technologies. This standardization occurred with great speed and effectiveness only because of key characteristics of a modern global standards paradigm. The affirmation below characterizes the principles that have led to this success as a means to ensure acceptance of standards activities that adhere to the principles.*

*We embrace a modern paradigm for standards where the economics of global markets, fueled by technological advancements, drive global deployment of standards regardless of their formal status.*

<sup>10</sup> See "Can the mobile Web win back developers from iOS, Android," Stephen Shankland, CNET, March 15, 2015, at <http://www.cnet.com/news/can-the-mobile-web-win-back-developers-from-ios-android/>.

<sup>11</sup> See "Applications Foundations for the Open Web Platform," Jeff Jaffe, W3C Blog, October 14, 2014, at <http://www.w3.org/blog/2014/10/application-foundations-for-the-open-web-platform/>. The 8 specific Application Foundations are Security and Privacy; Core Web Design and Development; Device Interaction; Application Lifecycle; Media and Real-Time Communications; Performance and Tuning; Usability and Accessibility; and Services. Id.

*In this paradigm, standards support interoperability, foster global competition, are developed through an open participatory process, and are voluntarily adopted globally. These voluntary standards serve as building blocks for products and services targeted at meeting the needs of the market and consumer, thereby driving innovation. Innovation in turn contributes to the creation of new markets and the growth and expansion of existing markets.*

OpenStand Joint Statement of Affirmation, with Inaugural Signatories Internet Society, Internet Engineering Task Force (IETF), Internet Architecture Board (IAB), W3C, and the IEEE Standards Association<sup>12</sup>

In the meantime, websites can be made more accessible, in order to enable user access on platforms where no app may be available. For instance, **governments** should not just support one or two platforms with native apps, but enable users to access relevant websites from any platform. For instance, the UK government has developed guidelines for developing **universally accessible services** regardless of browser or device.<sup>13</sup> Likewise, private content and service providers can make their offerings available through web apps as well as native app stores.

In addition, regardless of the platform, in order for people with disability to gain the most benefit from the mobile Internet, governments and the private sector should design for inclusion, for instance following the recommendations of the W3C Web Accessibility Initiative (WAI), which developed the Web Content Accessibility Guidelines (WCAG) now in their second version.<sup>14</sup> A number of national regulators have introduced accessibility requirements on service providers, and the UN Convention on the Rights of Persons with Disabilities (with 159 signatory UN Member States including the European Union) includes obligations to implement measures to design, develop, produce and distribute accessible ICT.<sup>15</sup>

<sup>12</sup> See <https://open-stand.org/about-us/affirmation/>.

<sup>13</sup> <https://www.gov.uk/service-manual/user-centred-design/browsers-and-devices.html>.

<sup>14</sup> More details on the WAI can be found at <http://www.w3.org/WAI/>, and the WCAG 2.0 recommendations at <http://www.w3.org/TR/2008/REC-WCAG20-20081211/>. The WAI also includes the Authoring Tool Accessibility Guidelines, aimed at helping people with disabilities create their own web content and making sure it also complies with the WCAG recommendations.

<sup>15</sup> More details on the UN Convention can be found at <http://www.un.org/disabilities/default.asp?id=150>, and EU policy at [http://ec.europa.eu/ipg/standards/accessibility/eu\\_policy/index\\_en.htm](http://ec.europa.eu/ipg/standards/accessibility/eu_policy/index_en.htm). See also the ETSI accessibility requirements for public procurement of ICT products and services in Europe at [http://www.etsi.org/deliver/etsi\\_en/301500\\_301599/301549/01.01.01\\_60/en\\_301549v010101p.pdf](http://www.etsi.org/deliver/etsi_en/301500_301599/301549/01.01.01_60/en_301549v010101p.pdf). For an example of the differences in the accessibility of smart devices and apps, see the Global Accessibility Reporting Initiative at <https://www.gari.info>.



**DEVELOPMENT**

## ④ Spectrum issues

In order to ensure sufficient bandwidth, and avoid operators having to raise prices to lower demand and usage, policymakers need to ensure that adequate spectrum will be available for mobile Internet access, at both the international and national levels.

### International level

The upcoming ITU World Radiocommunication Conference 2015 (WRC15) is important for identifying the spectrum bands that will help to meet both capacity and coverage needs for meeting increasing demand for mobile Internet services. Ensuring that these new bands are harmonized by regions, if not globally, will help to create the biggest market and hence the greatest economies of scale for new equipment and services, while also promoting innovation, creating allocations both for licensed and unlicensed uses.

### National level

At the national level, spectrum management is critical to increase availability and affordability of mobile Internet services. Where capacity is needed, efforts to re-assign existing bands, such as are already underway with the digital switchover from broadcasting, along with efforts to rationalize public usage of spectrum will be important to ensure an adequate allocation of spectrum for mobile Internet uses. At the same time, regulators should ensure that assignment of the spectrum does not merely favour incumbent operators or uses, prevents anti-competitive hoarding of spectrum, encourages efficient use by existing holders, and enables innovation. In order to accomplish this, assignments should use a mix of licensed, unlicensed, and shared access.

## ⑤ The Digital Divide

According to the **mobile Internet forecasts** we have used from Analysys Mason, another billion mobile Internet subscriptions will be taken by September 2016. Not all of these new subscriptions will be in the developing world, and some of them will represent multiple subscriptions for the same user. However, based on current trends a significant number of these will not just be new subscriptions, but they will be taken by new Internet users, helping to close the digital divide.

As discussed above, there are three challenges to the mobile Internet helping close the digital divide: availability of access, affordability, and relevance of the Internet to potential users. We address these in turn.



## Availability

With cellular coverage reaching 100% of the population soon, the challenge to increase availability is upgrading the network to offer mobile Internet access, which increasingly means at least 3G technology, possibly in conjunction with Wi-Fi to increase capacity and coverage. In addition, the sufficient national and international capacity will need to be available to be able to meet the increasing usage of the increasing number of users.

Part of the shortfall in mobile Internet availability is likely demand-driven – the operators will upgrade when the demand for services is clear, and this will be addressed by making access more affordable and service more relevant.

In addition, governments can help to lower costs by removing any barriers to connectivity, such as high costs for deploying infrastructure and encouraging sharing of infrastructure. In the last mile, management of spectrum that makes it available when needed, and which allows innovative uses, particularly in reaching un- or under-served rural areas, will increase deployment.

## Affordability

The actions outlined above to increase availability will also act to lower costs, even where mobile Internet services are already offered. Additional actions can include removing taxes on equipment, devices, and services that could act to depress demand. Policies to increase competition at the international gateway, over domestic connectivity, and in the last mile, will also serve to lower prices.

Finally, as shown below, actions to increase the amount of local hosting of content will avoid the use of relatively expensive international capacity to access content, lowering the cost of usage accordingly.

## Relevance

Enabling an Internet environment where content is free of unreasonable legal challenges will help to promote the creation of relevant content. Countries should also create an enabling environment for companies to deploy caches or servers to hold local or international content when it makes sense – this will lower the cost and latency of accessing the content, thereby increasing usage. At the same time, governments can help to promote content creation and usage by developing their own mobile-accessible websites, hosting them locally, and promoting the capacity building to support these activities.

# Conclusion

***WE ALWAYS OVERESTIMATE THE CHANGE THAT WILL OCCUR IN THE NEXT TWO YEARS AND UNDERESTIMATE THE CHANGE THAT WILL OCCUR IN THE NEXT TEN. DON'T LET YOURSELF BE LULLED INTO INACTION.*** .....

Bill Gates

Nowhere can this quote be more true than with respect to the rise of the mobile Internet. Ten years ago, fixed broadband had just surpassed dial-up as the main form of Internet access; one billion users accessed the Internet, the majority from developed countries; and it would be another two years before the iPhone was launched and four years before the first 4G network.

Today, mobile broadband has long surpassed fixed as the main form of Internet access; there are three billion users of whom the majority are in developing countries; and smartphone sales have surpassed the sale of feature phones in developed and developing regions. There are millions of apps available, which have been downloaded billions of times, and apps are the increasingly main way that mobile users interact with the Internet.

These apps, taking advantage of the advanced features of smart devices and the full mobility of users, have provided benefits in every part of our lives – underpinning an app economy creating opportunities for entrepreneurs everywhere; changing the way we interact with our governments, businesses, and each other; and helping to provide us with accessibility, personal security, and entertainment.

Many of us rely on our phones to help us navigate an unfamiliar city, suggest restaurants in the area, summon a taxi, or find constellations in the night sky. However, many of us also are surprised when confronted with the resulting data on our location and movements that is stored and shared among a variety of companies involved in providing location-based services. The same is true for other types of personal, and possibly sensitive data available through our smart devices.

In turn, many of us increasingly rely on apps to access the Internet, and may not realise how the app economy limits our choices of platforms until we contemplate switching platforms. At that point, we may realize that today the leading platform commands a market share of 84% of all smartphones sold, and new platforms have difficulty building up the base of native apps needed to make switching attractive.

Nonetheless, there is no question that bringing the next billion Internet users online will be driven by the mobile Internet, and our collective challenge is to help bridge the digital divide. As these users come online, and all users continue to increase their usage, the necessary spectrum must be made

available, under policies that encourage efficient spectrum use, competition, and innovation.



As we look forward on the challenges that must be met to increase the benefits of the mobile Internet for all, we should be mindful of both parts of Bill Gates' quote; not just that we would have underestimated the change that took place in the past ten years, but that we may overestimate the change that can take place in the next two.

As a result, as we collectively celebrate the changes that have taken place over the past ten years, we should also work hard, together, to make sure that the challenges we have identified are met in order that existing and new users enjoy a mobile Internet that is private and secure, with easy choice between platforms new and old, and that it is available, affordable, and relevant to all users everywhere.

## EVOLUTION

-  **Privacy: It is important to ensure that users have the ability to provide privacy permissions in a way that is simple to understand and implement.**
-  **Security: We should implement a Collaborative Security approach to mobile security, with all players in the ecosystem playing a role in this effort.**
-  **App challenges: We encourage multi-stakeholder support for the Open Web Platform, as a way to increase platform choices for users that is consistent with our OpenStand principles.**

## DEVELOPMENT

-  **Spectrum: Policymakers must ensure that sufficient spectrum is available to meet new demand and ensure that congestion does not throttle demand.**
-  **Digital Divide: Policymakers should ensure that the mobile Internet is available throughout their countries; affordable without undue costs; and relevant to users based on language and content.**



