

Chapter 1

Overview

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Mobile communication has arguably had a bigger impact on humankind in a shorter period of time than any other invention in human history. As noted by Jeffrey Sachs (2008), who directed the United Nations Millennium Project: “Mobile phones and wireless internet end isolation, and will therefore prove to be the most transformative technology of economic development of our time.”

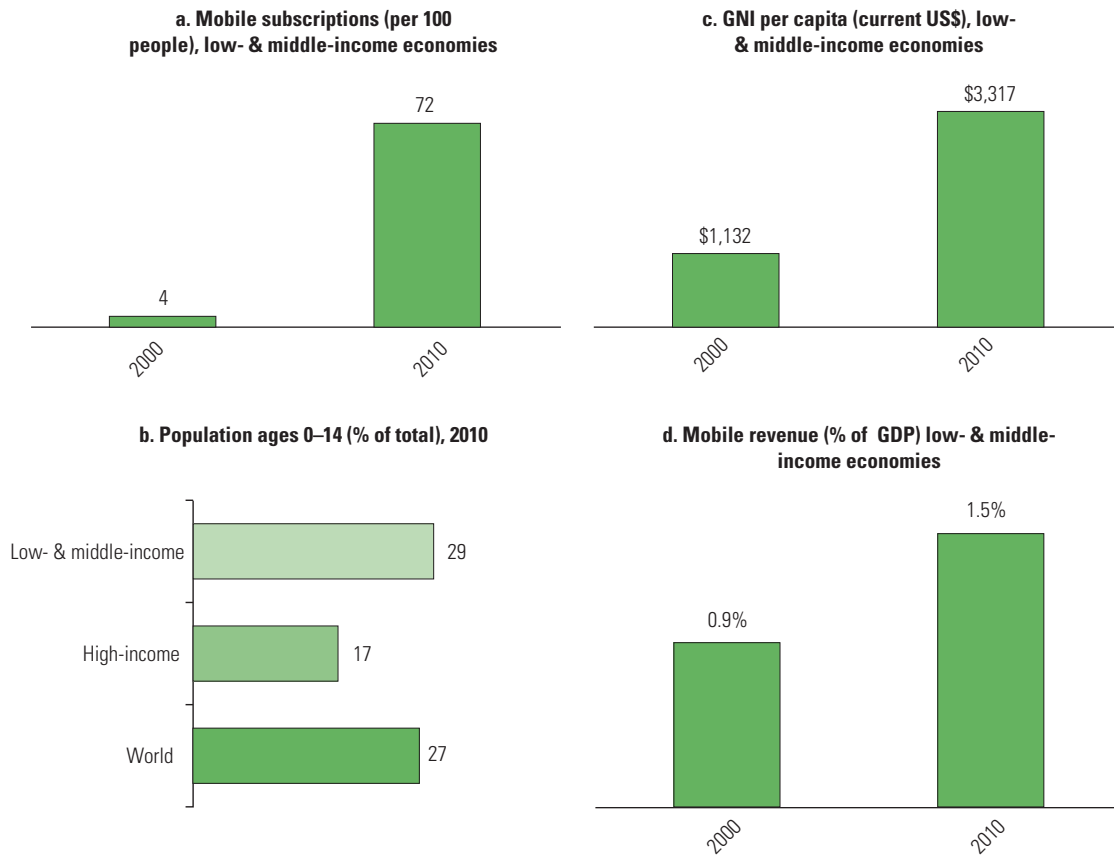
The mobile phone has evolved from a simple voice device to a multimedia communications tool capable of downloading and uploading text, data, audio, and video—from text messages to social network updates to breaking news, the latest hit song, or the latest viral video. A mobile handset can be used as a wallet, a compass, or a television, as well as an alarm clock, calculator, address book, newspaper, and camera.

Mobiles are also contributing to social, economic, and political transformation. Farmers in Africa obtain pricing information via text messages, saving time and travel and making them better informed about where to sell their products, thereby raising their incomes (World Bank 2011a, 353). In India barbers who do not have a bank account can use mobiles to send money to relatives in villages, saving costs and increasing security (Adler and Uppal 2008, 25). Elections are monitored and unpopular regimes toppled with the help of mobile phones (Brisson and Krontiris 2012, 75). Texting and tweeting have become part of the vocabulary (Glotz, Bertschi, and Locke 2005, 199).

Developing countries are increasingly well situated to exploit the benefits of mobile communications. First and foremost, levels of access are high and rising. The number of mobile subscriptions in low- and middle-income countries increased by more than 1,500 percent between 2000 and 2010, from 4 to 72 per 100 inhabitants (figure 1.1a). Second, the age profile of developing nations is younger than in developed countries, an important advantage in the mobile world where new trends are first taken up by youth.¹ Those under age 15 make up 29 percent of the population in low- and middle-income economies but just 17 percent in high-income nations (figure 1.1b). Third, developing countries are growing richer, so more consumers can afford to use mobile handsets for more than just essential voice calls. Between 2000 and 2010 incomes in low- and middle-income nations tripled (figure 1.1c). Fourth, the mobile sector has become a significant economic force in developing economies. Mobile revenues as a proportion of gross national income (GNI) rose from 0.9 percent in 2000 to 1.5 percent in 2010 (figure 1.1d).

These changes are creating unprecedented opportunities for employment, education, and empowerment in developing countries. Local content portals are springing up to satisfy the hunger for news and other information that previously had been difficult to access. The nature of the mobile industry itself is changing dramatically, opening new opportunities for developing nations in designing mobile

Figure 1.1 The developing world: young and mobile



Sources: Adapted from World Bank 2011b and author's own estimates.

applications and developing content, piloting products and services, and becoming innovation hubs. Trendy mobile products and services may be launched in Silicon Valley or Helsinki, but mobile manufacturing usually takes place elsewhere, creating huge opportunities to service, support, and develop applications locally. While key mobile trends are generally adopted around the world, regions such as East Asia are forging their own path for content and applications. New mobile innovation centers are springing up in Beijing, Seoul, and Tokyo, with expertise in specific markets such as mobile gaming and contactless banking.

The emergence of mobile broadband networks, coupled with computer-like handsets, is causing rapid shifts in the ecosystem of the sector. The bond between mobile operators and users is loosening as computer and internet companies invade the mobile space and handsets increasingly offer Wi-Fi capability. Online stores have created a new way for

consumers to add content and applications to their mobile phones. Mobile operators are struggling to keep pace with an explosion of data, while networks are converging toward Internet Protocol (IP) technologies and relying on content and data to substitute for declining voice revenues. An increasingly hybrid wireless communications ecosystem will evolve over the coming years.

Although mobile communication is rapidly advancing in most parts of the world, a significant segment of the world's population remains unable to use the latest mobile technologies. Mobile broadband coverage is often limited to urban areas, and current smartphone prices are not affordable for many. Nonetheless, developing-country users are using what they have. Text messaging, mobile money, and simple internet access work on many low-end phones. An emerging ecosystem of local developers is supporting narrowband mobile communicating through scaled-down

web browsers, text messaging, social networking, and pay-as-you-go mobile data access. For many users, especially in rural areas, these changes are happening where finding the electricity to recharge a phone is more difficult than purchasing prepaid airtime.

These developments have major implications for the state of access to information and communication technologies (ICTs) in the 21st century. Rich countries have the luxury of both wired and wireless technology, of both personal computers (PCs) and smartphones. Developing countries tend to rely mainly on mobile networks, and phones already vastly outnumber PCs. Applications have to be different to work on small screens and virtual keyboards, while convergence is happening apace. The developed world is also now becoming “more mobile,” with average screen size shrinking; while the developing world is now becoming, “more connected,” forging ahead with the shift from narrowband to broadband networks on a mobile rather than a fixed platform. Demography is on the side of the developing world, and the economies of scale gained from serving these expanding markets may push the ICT industry as a whole in the direction of a post-PC, untethered world.

One of the challenges facing a report of this nature is that the industry is evolving so rapidly. What is written today is often outdated tomorrow. In addition, given the novelty of many developments and a lack of stable definitions and concepts, official data are scarce or fail to address important market trends. Information from secondary sources is often contradictory, inconsistent, or self-serving. Information about mobile culture is particularly scarce in developing countries. Nevertheless, certain trends are visible, and this opening chapter explores key trends shaping and redefining our understanding of the word “mobile” as an entrée to the review of different sectors in the chapters that follow.

How mobile phones are used

Voice

With all the attention given to mobile broadband, smartphones, and mobile applications, it is sometimes easy to forget that voice communication is still the most significant function and the primary source of revenue for mobile operators.

Voice usage varies considerably both across and within countries. For example, the average Chinese user talks on a mobile phone more than seven times longer per month than

the average Moroccan (figure 1.2a). Price is a major factor in calling patterns, with a clear relation between monthly minutes of use and the price per minute. Interconnection fees between operators are a main determinant of price. In some countries these wholesale rates do not reflect underlying costs that drive up the price of mobile calls. A second factor relates to whether the subscriptions are paid in advance (prepaid) or paid on the basis of a contract (postpaid). Prepaid subscriptions are much more popular in developing economies, where incomes may be less stable, but postpaid contracts tend to generate higher usage per subscriber (figure 1.2b).

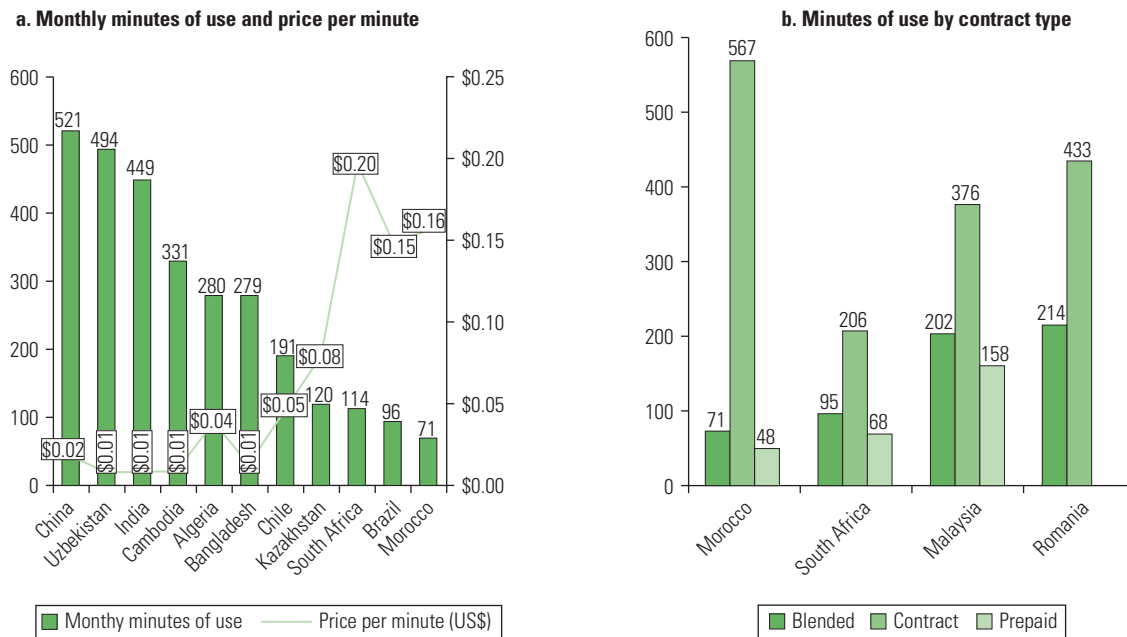
As with fixed networks, a growing proportion of traffic from mobile devices is moving to Voice over Internet Protocol (VoIP), often routed over Wi-Fi rather than the cellular network, thereby avoiding per-minute usage charges. According to CISCO, a major supplier of IP networking equipment, mobile VoIP traffic is forecast to grow 42 percent between 2010 and 2015.² Although mobile VoIP accounts for a tiny share of total mobile data traffic, its value impact on mobile operators is much greater. Skype, a leading VoIP provider, has reported over 19 million downloads of its iPhone application since its launch in 2009. In addition to voice and video, Skype processed 84 million SMS text messages during the first half of 2010.³ One study forecasts 288 million mobile VoIP users by 2013 (van Buskirk 2010).

Not just for voice anymore

Although voice is still the main revenue generator, its growth has slowed (TeleGeography 2012) as data and text-based applications have grown in popularity, their use made possible by advances in cell phone technology (box 1.1). Mobile applications are the main theme of this book. For many people, a mobile phone is one of the most used and useful appliances they own. Built-in features are indispensable to many for checking the time, setting an alarm, taking photos, performing calculations, and a variety of other daily tasks. Downloadable applications can extend functionalities.

A number of nonvoice applications use wireless networks on a one-off basis (to download, for example); other applications (such as incoming email notifications) are always on. Stand-alone features mean that users do not necessarily need to use a mobile network. For example, downloading of content or applications can be carried out from a PC and then transferred to a mobile phone, or such tasks can be

Figure 1.2 Talking and paying: mobile voice use and price for selected countries, 2010



Source: Mobile operator reports.

Note: Data refer to largest mobile operator (by subscriptions). Price per minute is calculated by dividing minutes of use by average revenue per user.

Box 1.1 Mobile phones and applications

The use of mobile phones has evolved dramatically over time and will continue to do so at an ever faster pace, so it is important to define some terms that are used throughout this report, while noting that these definitions are not necessarily stable. Many mobile handsets, particularly in the developing world are so-called **basic phones**, based on the second-generation (2G) GSM (Global System for Mobile communications) standard, first introduced in 1991. GSM offers a number of different services embedded in the standard and therefore available on all GSM-compatible devices, however basic. These include short message service (SMS) text messages of up to 160 characters, and instant messaging using the USSD (Unstructured Supplementary Service Data) protocol. Many of the older “mobile applications,” particularly in the developing world, are based on SMS or USSD, because they do not require additional data services or user downloads and are available on virtually any device. Strictly speaking, however, these should be considered **network services** rather than applications (box table 1.1.1). Internet-enabled handsets, or **feature phones**, were introduced with the launching of data services over mobile networks in the early 2000s. These phones supported transmission of picture messages and the downloading of music and often included a built-in camera. **Smartphones** appeared in the late 2000s. They typically feature graphical interfaces and touchscreen capability, built-in Wi-Fi, and GPS (global positioning system) capability.

Smartphones with memories and internet access are also able to download applications, or “**apps**,” pieces of software that sit on the phone’s memory and carry out specific functions,

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Box 1.1 (continued)

Box Table 1.1.1 Mobile devices and their capabilities

Device	Capabilities	Device	Capabilities
Basic mobile phone	<i>Network services, including:</i>	Smartphone	<i>As Featurephone plus:</i>
	Voice telephony and voice mail		Video camera
	SMS (short message service)		Web browser
	USSD (unstructured supplementary service data)		GPS (global positioning system)
	SMS-based services, such as mobile money		3G+ internet access
USSD services, such as instant messaging		Mobile operating “platform” (such as iOS, Android, Blackberry)	
		Ability to download and manage applications	
		VoIP (Voice over Internet Protocol)	
		Mobile TV (if available)	
		Removable memory card	
Featurephone	<i>As basic mobile phone plus:</i>	Tablet	<i>As smartphone plus:</i>
	Multimedia Messaging Service (MMS)		Front and rear-facing video cameras (for video calls)
	Still picture camera		Larger screen and memory capability
	MP3 music player		Faster processor, enabling video playback
	2.5G data access		Touchscreen with virtual keyboard
			USB (universal serial bus) port

Note: The list of capabilities is not exhaustive, and not all devices have all features.

like accessing websites or reporting the phone’s location and status. In this report, the term “apps” is used to denote such applications that may be downloaded and used on the device, either with or without a fee, in a stand-alone mode. The most popular apps are games. More than 30 billion apps had been downloaded as of early 2012 (Gartner 2012; Paul 2012). Using mobile applications for development usually requires more than simply downloading an app to a user device, however. Specifically, the most useful mobile applications, such as those discussed in this report, typically require an ecosystem of content providers (for instance, reporting price data for agricultural produce, discussed in chapter 2) or agents (such as those providing cash upload facilities for mobile financial services, discussed in chapter 4). These kinds of “**ecosystem-based mobile applications**” are the main topic of this report.

However, technological change continues apace. Newer generations of mobile application may be “**cloud based**,” in the sense that data is stored by servers on the internet rather than locally on the device. Applications that use HTML5 (the current generation of hypertext mark-up language), for instance, may not require any software to be downloaded. Such applications may have the advantage that they can be used independently of the network or mobile device that the user is currently using. For instance, a music track stored on the “cloud” might be accessed from a user’s tablet, smartphone, or PC, and even when the user is roaming abroad. But such a shift depends on much lower prices, without monthly caps, for mobile data transmission.

carried out over Wi-Fi. Indeed, the “mobile” in “mobile applications” refers as much to the type of device as the manner of usage.

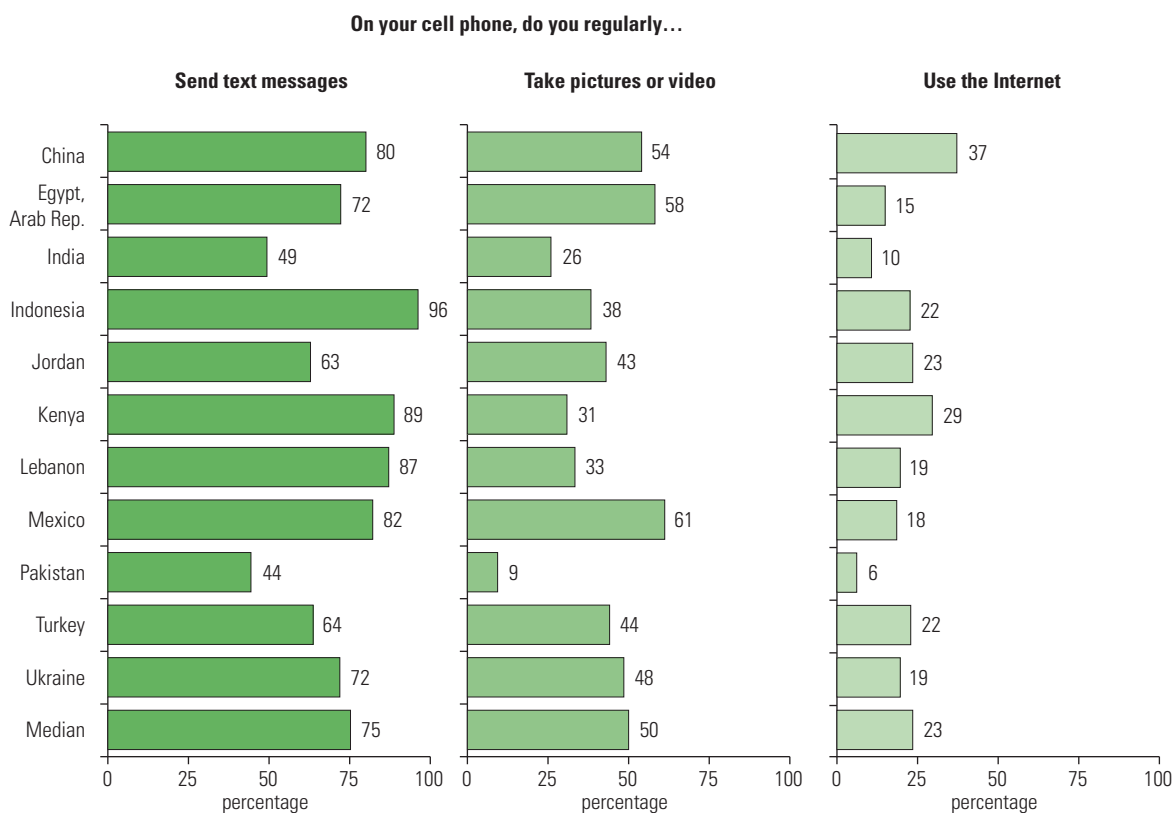
A survey (Pew Research Center 2011) carried out across a range of countries at varying economic levels and in different regions illustrates the varied uses of mobile phones (figure 1.3). After voice usage, text messaging is the most widely used: in more than half the countries surveyed, three-quarters of mobile phone owners sent text messages; in Indonesia virtually all mobile users sent text. Although usage rates vary, mobile devices were used to access the internet in all surveyed countries, with almost a quarter of cell phone owners using this feature on average.

Messaging

Despite the attention focused on more glamorous mobile applications, text messaging (or SMS) is a popular and profitable nonvoice application in many countries. Close to 5 trillion text messages were sent worldwide in 2010

(figure 1.4a) accounting for 80 percent of operator revenue from value-added-services, or \$106 billion (Informa 2011). This is an attractive revenue source for operators because the cost of transmitting text messages is so low. Although its use in some countries is now starting to decline in favor of instant messaging and phone-based email, SMS remains an alternative for costly voice calls in some countries or suffices for users who do not have access to the internet on their mobiles (or do not know how to use it). Messaging has become popular as a feedback mechanism for voting on TV reality shows and a way of providing value-added services such as banking or pricing information. As a form of asynchronous (that is, non-real-time) communication, it is particularly useful for coordinating meetings or reaching correspondents who are not available to talk (Ling and Donner 2009). Text messaging is also important for applications in the mobile-for-development arena. Many agricultural pricing and health programs for rural dwellers revolve around

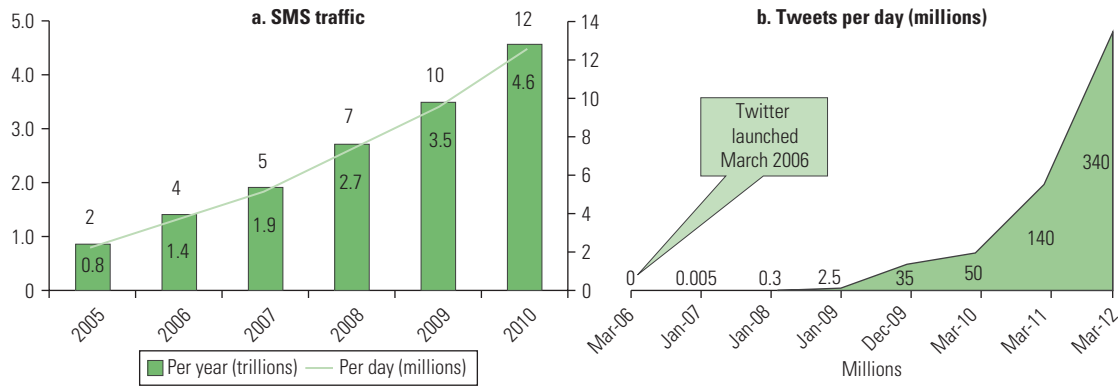
Figure 1.3 Mobile phone usage around the world, 2011



Source: Pew Research Center 2011.

Note: Survey carried out in March–May 2011.

Figure 1.4 Worldwide SMS and Twitter traffic



Sources: World Bank estimates (panel a); Twitter 2010, 2011 (panel b).

SMS, and text messaging is used by several governments for citizen alerts.

Twitter, a social networking “microblog” launched in 2006, is also based on short messages, or “tweets,” which are intentionally similar to the length of a text message and therefore a good fit for mobile phone use.⁴ Around 40 million people (some 37 percent of all Twitter users) were “tweeting” from their mobile devices in April 2010; a year later that number exceeded 100 million (Watters 2010).⁵ By March 2012 Twitter users were sending 340 million tweets a day (figure 1.4b).⁶ Twitter is integrated with SMS, so tweets can be sent and received as text messages. Twitter short codes have been implemented for several countries so that most SMS tweets are charged at domestic rates. Twitter is working with mobile operators to lower the cost of sending tweets through SMS or USSD or even to make them free. Twitter has rapidly emerged as a tool for social activism and citizen engagement ranging from the Delhi police tweeting traffic updates⁷ to tweeting the revolution in the Arab Republic of Egypt.⁸

Web browsing

Access to the internet via a web browser on a mobile device varies across countries depending on costs, education, speeds, and content. Overall, usage is growing, however, with an estimated 10 percent of global internet access coming from mobile phones in 2010, up from 4 percent in 2005. Most popular websites have special versions adapted to mobile devices, although customized mobile browsers,

such as Opera, are suited to featurephones.⁹ On most smartphones, users are encouraged to download applications from special app stores, sometimes belonging to the operator but increasingly owned by the device platform (such as Apple, Android, Windows, and Blackberry). That arrangement has the convenience of ensuring that the application is suitable for the smaller screen size of mobile devices, although the full range of internet content is still available through a web browser.

Social networking is popular, ranking in the top 10 among mobile internet use in practically every country. Facebook is predominant except in countries such as China and the Russian Federation, where local social networking sites are used. More than 425 million people accessed Facebook through their mobile devices in December 2011.¹⁰

East Asia in particular is bucking the trend toward use of global applications. The main reason is large domestic markets (such as China, Japan, Republic of Korea), which use non-western alphabets and create huge demand for local content and applications. China Mobile, the world’s largest mobile operator, has developed its own applications that mimic global trends in areas such as mobile money, ebooks, video, music, and gaming. But these application are basically closed systems, unfathomable to users that do not speak Chinese and not easily exportable to other countries.

The most downloaded applications for smartphone portals include utilities for tools such as mapping, social networking, chatting, and messaging (table 1.1).

One genre in every list of top downloads across all application portals and all regions is games. The popularity of

Table 1.1 Top mobile applications, June 2011

	Android		Apple		Blackberry	
	Paid	Free	Paid	Free	Paid	Free
1	Beautiful Widgets (\$2.85)	Google Maps	Sonic/Sega All-Star Racing (\$4.99)	Turtle Fly	One Touch Flashlight (\$0.99)	BlackBerry Messenger
2	ROM Manager (\$5.86)	Facebook	Angry Birds (\$0.99)	Line Jumper	Super Color LED (\$1.99)	UberSocial
3	Fruit Ninja (\$1.25)	Pandora	Fruit Ninja (\$0.99)	Tiny Tower	MegaHorn (\$0.99)	Copter
4	Robo Defense (\$2.99)	Angry Birds	Tiny Wings (\$0.99)	Cars 2 Lite	Tetris (\$0.99)	Facebook
5	Root Explorer (\$3.83)	YouTube	Angry Birds Rio (\$0.99)	Hanging with Friends	Photo Editor Ultimate (\$1.99)	WhatsApp Messenger
6	PowerAMP (\$5.17)	Words With Friends	Cars 2 (\$0.99)	Racing Penguin	Angry Farm (\$0.99)	foursquare
7	WeatherBug (\$1.99)	Advanced Task Killer	Cut the Rope (\$0.99)	Sea Battles Lite	Chat for Facebook (\$0.99)	Twitter
8	Better Keyboard (\$2.99)	Angry Birds Rio	Hanging with Friends (\$1.99)	Dream Bride	BeAlert (\$0.99)	Pixelated
9	DocumentsToGo (\$14.99)	music download	Camera+ (\$1.99)	Super World Adventure	A+ Chat (\$0.99)	Free Chat for Facebook
10	Titanium Backup (\$6.05)	Yahoo! Mail	Angry Birds Seasons (\$0.99)	Facebook	Next Dual Pack (\$0.99)	Windows Live Messenger

Source: Respective application stores, June 30, 2011.

games has made millionaires of some application developers (box 1.2) and attests to the significant financial impact the gaming sector is having on the mobile industry.

Games are particularly big in East Asia, accounting for almost half of the estimated global mobile gaming revenue of \$5.5 billion in 2008 (Portio Research 2009). In Korea the mobile games sector was worth 424.2 billion won (\$390 million) in 2010 even though games downloaded from smartphone application stores operated by Apple and Android were considered illegal because of the government ratings system.¹¹ That ratings system is set to be loosened, which will likely lead to further market growth. In Japan the mobile games market was estimated to be worth 88.4 billion yen (\$1 billion) in 2009 (Toto 2011). China Mobile reported that it had 4.6 million paying users of its online library of 3,000 games in 2010.¹²

The popularity of mobile games and the size of the sector holds opportunities in the areas of software development, virtual cash, and local customization (Lehdonvirta 2011). The traits of game playing, such as acquiring points, leveling, and solving challenges are also entering other fields where applications are used, such as education or social media, in a process called “gamification.” The thinking is that users who have become accustomed to using games on their mobile devices would then be

more comfortable using similar thought processes in areas that are not entertainment-oriented, including health or business.

Data traffic

Growing mobile data usage is triggering explosive growth in traffic. Social networking entails considerable photo and video exchange and is the leading generator of traffic in many countries (Opera Software 2011). YouTube, the video portal, ranks among the top 10 web applications in most countries. According to CISCO (2012), video is expected to account for more than two-thirds of all mobile traffic in 2016, and mobile data traffic will increase 18-fold between 2011 and 2016.

Mobile operators are struggling to handle all this data and control the traffic. They are adding as much capacity as they can to their networks within investment and spectrum constraints. They are also off-loading traffic to Wi-Fi wherever possible. The most common method for controlling, or “shaping,” traffic is through data caps on mobile data plans. Few operators offer truly unlimited mobile data plans, and the cost of exceeding caps can be steep, with users facing a loss or severe disruption of service and dramatically reduced speeds. The case of Hong Kong SAR, China, illustrates well

Box 1.2 How to make a million from Angry Birds

Angry Birds has been a worldwide game sensation. It was the number one Apple iPhone download in countries ranging from Pakistan to Peru and the Philippines to Portugal. Rovio Mobile, a Finnish firm founded in 2003, developed Angry Birds.^a

In 2009 Rovio released Angry Birds for the iPhone. The company's development of Angry Birds outlines the relationships between game developers, publishers, and giant gaming companies. Rovio initially worked with publisher Chillingo to develop the iPhone version of Angry Birds, keeping the rights for versions on other platforms. Following the sale of Chillingo to gaming company Electronic Arts in October 2010, Rovio developed its own Angry Birds versions for other mobile systems such as Android and Nokia. It is also leveraging its Angry Birds success by expanding into merchandizing with T-shirts and other products.

According to one source, Angry Birds had over 5 million downloads from the Apple app store during the first six months of 2010 alone (Parker 2010). At \$0.99 a download, the game generated at least \$5 million in revenue during that period.

a. <http://www.rovio.com>.

the impending wave of data usage that will soon be hitting other countries (figure 1.5a). During 2011 average monthly mobile data usage increased by more than 70 percent to over 500 megabytes (MB) per 2.5G or 3G user. Although Hong Kong is an advanced economy, and therefore well ahead of most developing nations, the same trends can be expected elsewhere at a later date. CISCO (2012) forecasts monthly usage to reach more than 10 exabytes (that is, 1 billion gigabytes) in 2016, with smartphones, laptops, tablets, and mobile broadband networks leading the charge (figure 1.5b). This subject is developed further in chapter 7.

The changing mobile ecosystem

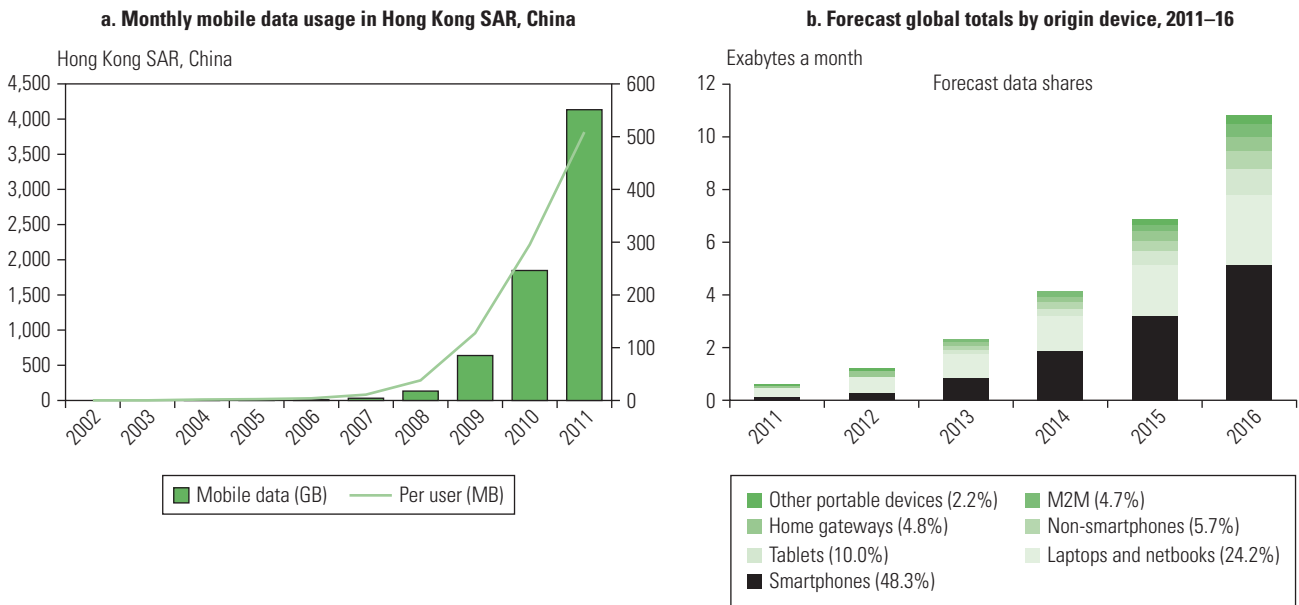
Before the emergence of smartphones, network operators had historically controlled the mobile ecosystem. They were the main point of interface for users regarding devices and applications. Although users were free to purchase their own handsets, operators typically subsidized them where regulation allowed them to do so, at least for the postpaid segment. Users who wanted to talk, send a message, or access the internet did so over the mobile operator's network. Access was often through an operator's "walled garden"—a portal where content providers paid operators to feature their applications. If users went outside the walled garden, they typically had to pay extra. Developments such as value-added text messages and

mobile payments widened this ecosystem, but operators essentially remained the gatekeepers.

The app revolution

Operator control started to break down with the emergence of smartphones and other devices that run specific mobile operating systems, incorporate built-in Wi-Fi, and allow users to purchase content and applications through special online stores. The first kink in the direct relationship between operators and users was the BlackBerry, introduced by Canadian company Research in Motion (RIM) in January 1999. Marketed as "wearable wireless email,"¹³ the BlackBerry could arguably be called the world's first smartphone. Revolutionary at the time, it allowed subscribers to receive email using RIM's proprietary Enterprise Server. The BlackBerry was a big hit within the corporate world because it ensured that key personnel could receive emails anytime, anywhere. RIM later expanded BlackBerry distribution to reach mass markets, earning \$20 billion in revenue in its 2010 fiscal year. RIM has moved into emerging markets and into social networking through its BlackBerry Messenger. The company shipped 52 million devices in its 2010 fiscal year and had some 55 million subscribers in November 2010 (figure 1.6a).¹⁴ BlackBerry App World launched in 2009, but having been an early trendsetter, it is now struggling to keep up with developments elsewhere.

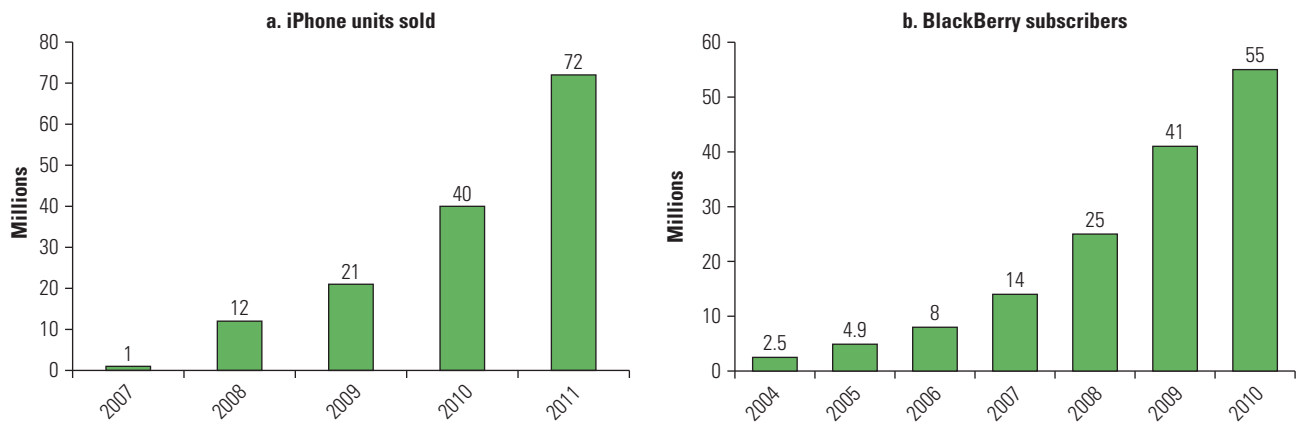
Figure 1.5 Data, data everywhere



Sources: OFTA 2012 (panel a); CISCO 2012 (panel b).

Note: The compounded annual growth rate for mobile data usage is projected to be 78 percent between 2011 and 2016.

Figure 1.6 Apples and Berries: iPhone sales and Blackberry subscriptions



Sources: Apple and RIM operating reports.

Note: Data for Apple refer to fiscal years ending September 25. Data for Blackberry refer to fiscal years ending March.

The industry changed dramatically with the introduction of Apple's touchscreen iPhone in June 2007, followed by the launch of its App Store in July 2008.¹⁵ The exclusive agreements that Apple initially made with mobile operators have now largely ended. In January 2010 the company crossed another milestone, introducing the iPad, its tablet computer. All Apple mobile devices (such as iPhone, iPad, and the iPod music player) are powered by the iOS mobile operating system. The iPhone is distributed through Apple's retail and online stores and also by mobile carriers. In addition to the

App Store, iPhone users can download music and video from the iTunes store and ebooks from the iBookstore.

By simplifying and taking ownership of the application platform, handset vendors were able to exert control over the quality of applications on offer and also to create a market for purchasing them. Although the majority of downloaded applications are still free, users are urged to upgrade to paid content or subscriptions, if only to get rid of advertising. By February 2011 Apple had downloaded more than 25 billion applications from the App Store. Sales of the iPhone grew

from 1.4 million in 2007 to 72 million in 2011 (figure 1.6b). Revenues from the iPhone and related products and services grew to \$47 billion in 2011, accounting for 44 percent of Apple’s total sales.¹⁶ An equipment-selling business is rapidly becoming a software-and-services industry, with operators scrambling to provide the spectrum bandwidth to carry the heavy volumes of data traffic while plotting their own applications portals.

Android, Inc., was founded in 2003 to develop mobile phone operating systems and then purchased by search giant Google in 2005. Google made the Android software open source to encourage programmers and handset manufacturers to develop applications and products. The first Android handset, the HTC Dream, was launched in October 2008. Google itself has self-branded several Android phones and developed Android Market (now called Google Play), a portal for obtaining Android applications. By the fourth quarter of 2011 Android had captured just over half the market for smartphone operating systems (Gartner 2012). Google Play offers more than 400,000 applications with over 10 billion downloaded by January 2012 (Paul 2012).

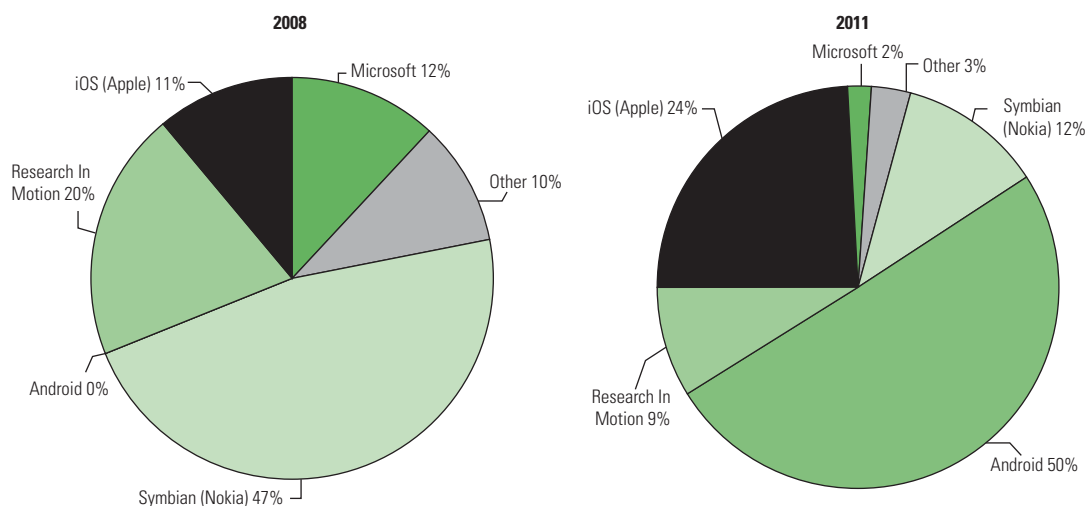
Another significant player is mobile equipment manufacturer Nokia. It has traditionally had a large market share of the handset market, especially in the developing world (figure 1.7). Nokia’s mobile operating system, Symbian, is installed on most of these handsets. Thus far, however, Nokia has failed to capture a large share of the smartphone market. In 2011 it forged an agreement with Microsoft to begin

offering the Windows operating system on its smartphones.¹⁷

The rise of smartphones thus sparked tremendous shifts in the mobile ecosystem. A user can now bypass mobile networks completely by downloading content and programs through application stores using Wi-Fi. One survey reported that half the respondents used Wi-Fi to download applications to their mobile phones (In-Stat 2011). Second, users can use VoIP or other applications to communicate instead of the operator’s mobile voice service. Third, most handset manufacturers are essentially constrained to using the Android or Windows mobile operating systems for their handsets because RIM and Apple brand their own devices.

As a result of the rise of the smartphone, operators have much less control over the mobile ecosystem. They risk being “genericized,” where users do not care about the mobile network brand but instead whether it has the fastest speed, best coverage, cheapest prices, highest quality, or biggest subsidy for popular handsets. Prepaid users, in particular, have little brand loyalty, with high rates of churn in markets where mobile number portability is a regulatory obligation. In some ways, this process is a repeat of the one that occurred in the early 2000s when the rise of the internet threatened to commoditize the “dumb pipes” of telecom operators, only now it is the mobile operators that are under pressure. At the same time, the emergence of HTML5 could cause another disruption in the industry. With the HTML5 standard, apps can be run directly from web browsers, freeing users from

Figure 1.7 Changing market share of mobile handset sales by operating system



Sources: Adapted from Gartner 2012.

being locked in to a proprietary operating system and creating a new distribution channel for application developers (A.T. Kearney 2011).

Mobile content

The evolution of handsets has driven content providers and aggregators to the mobile industry. In the early days, content largely consisted of ringtones and screen pictures downloaded to customize simple mobile phones. As handsets become more sophisticated and included internet access, more and more of the “big” internet can be reformatted to mobile content, making the “third” screen (after television and PCs) a desirable outlet for the content industry. Content providers have also been aided by the rise of application stores, which allow users to navigate easily to online supermarkets to satisfy their content cravings.

While big technology and media companies dominate content distribution and to some extent content creation, there are opportunities for small software developers and local information aggregators. Examples of these aggregators include:

- Seven out of ten Brazilian internet users visit Brazil’s UOL internet portal, formerly Universo Online. It created a mobile version, UOL Celular, with more than 1,000 daily news, weather, and traffic reports. It ranks as the 10th most visited site by Brazilian Opera mobile browser users and the second-leading local site.
- Detikcom is the third most visited site by Indonesian Opera users. It was launched in 1998 and introduced a mobile version in 2002, significantly contributing to growth. It envisions itself as a new media company with partnerships for content and relationships with the country’s mobile operators to ensure distribution across the country’s mobile networks.
- In South Africa, News24 is a leading portal with updated breaking news. It has a dedicated WAP (wireless access protocol) version for mobile phones. It had more than 500,000 unique visitors to its mobile site in December 2010, up 200 percent over the previous year.¹⁸

The emergence of cloud computing and multiple types of devices (PCs, tablets, mobile handsets) is creating different distribution markets. On the one hand, companies like Apple produce content only for their own brand. Apple’s iBooks, for example, can be read only on Apple devices.

This approach ties users to the brand because they cannot use the content they have purchased if they switch brands. On the other hand, companies like Amazon, which makes the Kindle ebook reader, sell software applications that allow Kindle ebooks to be read on multiple platforms. Similarly, Netflix movie streaming is available across a number of platforms. As cloud computing invades the mobile space, it will be possible to run applications remotely instead of having to purchase and download them to the device. This development will create more subscription-like services rather than single downloads. This is good news for developing nations because it lowers the cost of applications and content. But to take advantage of the cloud, users will need good mobile broadband connectivity.

Mobile-enabled social and economic trends

Research shows that mobile networks are having a growing impact on the economy. One of the earliest and frequently cited studies on the subject was carried out by three consultants from the Law and Economics Consulting Group. Using data from 92 countries between 1980 and 2003, they found that an increase of 10 mobile subscriptions per 100 people raised GDP growth by 0.6 percent (Waverman, Meschi, and Fuss 2005). A similar study using data through 2006 found that a 10 percent increase in mobile penetration in developing countries was correlated to a 0.8 percent increase in economic growth (Qiang and Rossotto 2009). Several studies also find that growth in mobile networks is positively correlated to foreign direct investment (Lane et al. 2006; Williams 2005).

Mounting evidence also shows the microeconomic impact of mobile in specific countries and industries. The benefits typically accrue from better access to information brought about through mobile and are typically related to lower transactions costs, savings in travel costs and time spent traveling, better market information, and opportunities to improve one’s livelihood (Jensen 2007; Salahuddin et al. 2003; Aker 2008; see also tables 1.2 and 2.1 and box 1.3).

Mobile for development

As noted by the United Nations Development Programme “Mobile phones can enhance pro-poor development . . .

Table 1.2 Mobile and the Millennium Development Goals

MDG	Example
Poverty and hunger 	A study on grain traders in Niger found that cell phones improved consumer welfare (Aker 2008). Access to cell phones allowed traders to obtain better information about grain prices across the country without incurring the high cost of having to travel to different markets. On average grain traders with cell phones had 29 percent higher profits than those without cell phones. In the Niger example, demand sprang up organically rather than through a specific program.
Universal education 	According to a survey of teachers in villages in four African countries, one-quarter reported that the use of mobile phones helped increase student attendance. A main factor was that teachers could contact parents to enquire about their child's whereabouts (Puri et al, n.d.). Mobile phones have also been used in Uganda to track school attendance so that school administrators can see patterns in attendance, for instance by village, by day of the week, and by season. Tracking attendance for pupils indirectly also tracks absenteeism among teachers (Twaweza 2010)
Gender equality 	A study looking at gender differences in the availability and use of mobile phones in developing countries reported that 93 percent of the women who had mobiles felt safer because of the phone, 85 percent felt more independent, and 41 percent had increased income or professional opportunities (GSM Association 2011). The report found that closing the mobile gender gap would increase revenues for mobile operators by \$13 billion.
Child health 	A program using text messaging to identify malnutrition among rural children in Malawi is notable for its impact on the speed and quality of the data flows. ^a Using a system called RapidSMS, health workers in rural areas were able to transmit weight and height information in two minutes instead of the two months needed under the previous system. The data entry error rate was significantly improved to just 2.8 percent from 14.2 percent in the old system. The improved information flow enabled experts to analyze data more quickly and accurately, identify children at risk, and provide treatment information to the health staff in the field.
Maternal health 	One of the earliest uses of mobile technology to improve maternal health took place in rural districts of Uganda in the late 1990s. Traditional birth attendants were provided walkie-talkies, allowing them to stay in contact with health centers and obtain advice. An assessment of the program found that it led to roughly a 50 percent reduction in the maternal mortality rate (Musoke 2002).
HIV/AIDS 	In Kenya weekly text messages were sent to AIDS patients to remind them to take their antiretroviral drugs (Lester et al. 2010). Those who received the text messages had significantly higher rates of taking the drugs than those who did not receive them. The study noted that SMS intervention was less expensive than in-person community adherence interventions on the basis of travel costs alone and could theoretically translate into huge health and economic benefits if scaled up.
Environment 	According to one forecast, mobile technology could lower greenhouse gas emissions 2 percent by the year 2020 (GSM Association 2009). This reduction can be met through, among other things, widespread adoption of various mobile-enabled technologies such as smart transportation and logistics, smart grids and meters, smart buildings, and "dematerialization" (replacing the physical movement of goods and services with online transmission). Mobile phones can also be used as tools for environmental monitoring. In Ghana, for example, cab drivers in Accra were outfitted with mobile phones with GPS and a tube containing a carbon monoxide sensor to test pollution levels. ^b
Partnership? 	MDG target 8F states: "In cooperation with the private sector, make available benefits of new technologies, especially information and communications." Mobile phone penetration in low-income economies has grown from less than one per 100 people in 2000 to almost one per every three by 2010—largely as a result of private sector investment. Of some 800 telecom projects in developing countries with private sector participation between 1990 and 2009, almost three-quarters involved greenfield operations primarily in mobile telephony. ^c

a. "Malawi – Nutritional Surveillance" on the RapidSMS web site: <http://www.rapidsms.org/case-studies/malawi-nutritional-surveillance/>.

b. http://www.globalproblems-globalsolutions-files.org/unf_website/PDF/vodafone/tech_social_change/Environmental_Conservation_case3.pdf

c. World Bank and PPIAF, PPI Project Database. <http://ppi.worldbank.org>.

in sectors such as health, education, agriculture, employment, crisis prevention and the environment . . . that are helping to improve human development efforts around the world" (UNDP 2012). The Millennium Development Goals (MDGs) provide a useful framework

for assessing the development impact of mobile phones. The MDGs highlight eight priority areas. Examples of the ways mobile phones are being used to address each of the MDGs are given in table 1.2 and throughout this report.

Box 1.3 Smartphones and tablets for development

The introduction of smartphones and light-weight tablet computers has revolutionized the way people access the internet from mobile devices. These powerful touchscreen devices have popularized downloadable apps that can do anything from recognize a song to turn the device into a flashlight. Scaled-down versions of popular office applications for word processing, spreadsheets, and presentations are available for

smartphones and tablets as well as ebook software. These devices support internet access over cellular broadband networks and Wi-Fi and often include built-in GPS and still and video cameras.

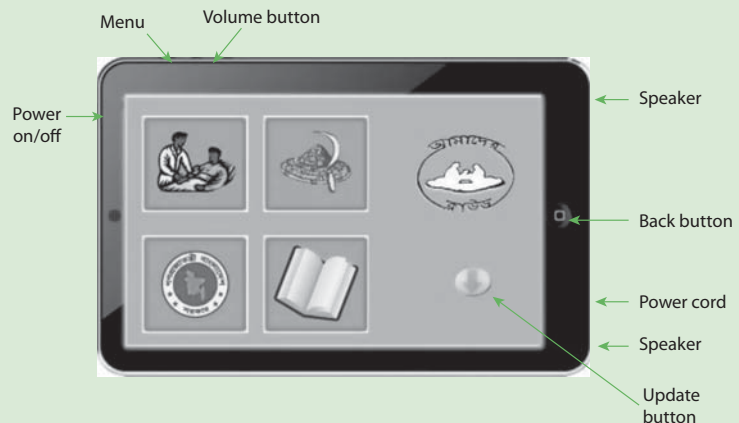
The graphical user interfaces and touchscreens make them ideal for many developing nations particularly those with non-western alphabets and sizable illiterate populations. Smartphone and tablet penetration is rising rapidly in urban areas of developing countries.

Several initiatives are under way that feature low-cost tablets and investigate the feasibility of devices for rural areas:

- **In Bangladesh**, the Digits to All (DTA) project distributed custom developed tablets (see screenshot) to over 100 households in a rural village to test their feasibility. The \$100 Amadeyr tablet uses the Android operating system with software specifically designed and customized for use by semiliterate, illiterate, and bottom-of-the-pyramid users. The tablet uses a touchscreen operated by seeing pictures and hearing instructions given in Bengali, making it user-friendly for illiterate villagers. The project found that villagers who had never used PCs, let alone the internet, were able to use the tablets within a few days and noted: "It is not the rural population who needs to be trained to have access to information but it is the next generation communication technologies that can be tailored to meet the local needs and be made easily accessible by rural communities" (Quadri et al. 2011).
- **India** launched its locally manufactured Aakash tablet in October 2011 (Tuli 2011). Priced at around \$35 the tablet is aimed for widespread distribution in schools. Apart from its low cost, the Aakash tablet has other features suitable for the Indian environment including data compression techniques that lower consumption and hence reduce Internet access charges. One of the organizations involved in the project forecasts that some 5 million of the tablets will be shipped in 2012, around half of the equivalent PC figure.

(continued next page)

Box figure 1.3.1 Annotated screenshot of Bangladesh's Amadeyr Tablet



Source: <http://amadeyr.org/en/content/amadeyr-tablets>.

Box 1.3 (continued)

- A project in **Tanzania** has been familiarizing farmers with smartphones to introduce them to the features and potential uses (Banks 2011). Although most farmers already had cell phones, they had never used the internet. The smartphones have been used for geotagging climate information and to make videos of farmers offering advice on techniques. The information is uploaded to the internet to share with other farmers. The visually oriented information helped one maize grower to learn from planting mistakes and a few months later he had his first successful harvest.

Governments, the private sector, academia, and the development community all have a role to play in promoting smartphones and tablets for development. Governments in particular can be encouraged by the potential of these devices to take ICT for development to another level through easy-to-use graphical interfaces with Internet connectivity over wireless networks. Just as the One Laptop per Child program helped trigger a reduction in low-end computers, a “One Smartphone/Tablet per Citizen” initiative could help generate mass availability.

Social networking and democracy

Electronic communication has increasingly become two-way: examples include participation through feedback in comments, discussions in forums, and active contribution to applications such as Wikipedia or Mozilla. In addition, the tools for users to generate content have been simplified—not only can most people master text messaging and tweeting but a growing number can also create social networking pages and blogs. Often driven by youth, participation is reaching up the age ladder as these tools and their impact become publicized and popularized.

The increasing availability of these tools and applications on mobile phones is enhancing their popularity. Operators in developing countries are working around the limitations of low-end handsets that do not have internet capabilities by providing ways of interacting with social networking applications through instant messaging, such as MXit in South Africa.¹⁹ Safaricom in Kenya offers special SMS functions allowing users to send and receive Twitter tweets and to update their status and send messages to Facebook.²⁰

The diffusion of mobile phones coupled with social networking creates a new space for citizens around the globe to engage in political action concerning democracy, freedom, and human rights. There is disagreement about the extent to which these tools affect appeals for freedom and democracy. Some observers argue that social network-

ing tools empower people to defend freedom and that Twitter should be nominated for a Nobel Peace Prize (Gladwell 2010). Others argue that, while these applications make it easier for people to express themselves, it is “harder for that expression to have any impact.” In other words, applications like Facebook and Twitter make it possible for large numbers of people to voice their opinion, but they do so virtually, and these tools are not substitutes for physical participation.

Regardless, recent history has demonstrated that social media along with messages, videos, and pictures sent from mobile phones are useful tools for organizing protests and monitoring democracy and freedom. Examples include:

- One of the first uses of text messaging for social change took place in the Philippines in January 2001. Political activists sent SMS text messages urging Filipinos to assemble at Epifanio de los Santos Avenue (EDSA) in Manila to demonstrate for the impeachment of then-president Joseph Estrada. The message, typically reforwarded by recipients, read: “Go 2 EDSA. Wear blk.” During the next few days more than a million people showed up and some 7 million SMS were sent. It is argued that this giant outburst concerned legislators, who allowed evidence in the impeachment trial to be presented. By January 20 Estrada had resigned,

blaming his exit on the “the text-messaging generation” (Shirky 2011).

- Thousands of Moldovans demonstrated against the government in the spring of 2009. It was dubbed the “Twitter Revolution,” because that application was a main method used to organize the demonstrators. One of Twitter’s “Trending Topics” at the time was the tag “#pman” an abbreviation for Piata Marii Adunari Nationale, the main square in downtown Chisinau, the nation’s capital and location of the demonstrations. Protestors used the local mobile data network to post tweets from their mobile phones (Morozov 2009).
- In Côte d’Ivoire a so-called “web mash-up” site called Wonzomai (“sentential” in the Ivorian Bété dialect) was created to monitor the 2010 presidential election. Users were provided with telephone number short codes to which they could send free SMS and tweets to report abnormalities that they had witnessed during and immediately after the election. The reports were visualized on a website, which showed the locations where incidents had taken place as well as trends plotted over the duration of the election.²¹

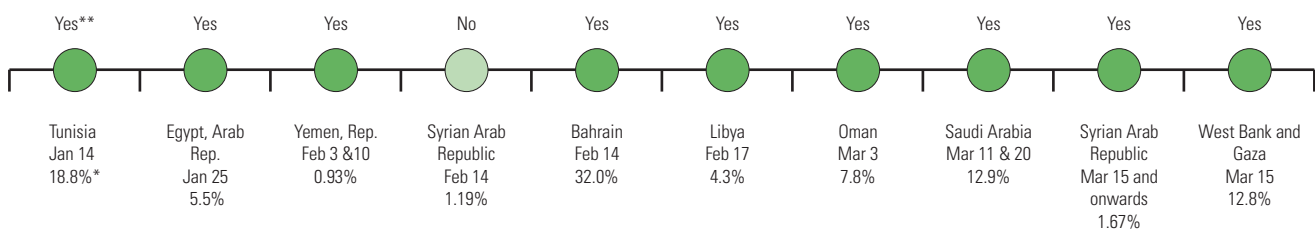
In the Middle East, mobile has unsettled the region’s social and political traditions since the mid-2000s (Ibahrine 2009). Its greatest impact to date may have come between 2010 and 2012 when social media played a role in the “Arab Spring” uprisings in Bahrain, Egypt, Libya, the Syrian Arab Republic, Tunisia, the Republic of Yemen, and other countries in the region. As one Egyptian protestor put it: “We use Facebook to schedule the protests, Twitter to coordinate, and

YouTube to tell the world.”²² Surges in social networking and demonstrations in these countries appear to be connected. All but one demonstration reportedly took place following the initial call to protest on a Facebook page (figure 1.8). The number of Facebook users in these countries also grew significantly during the demonstrations.

Similarly, Twitter use increased during the Arab Spring. The #jan25 tag, created to organize the first big protest in Egypt falling on that day, remained in active use for several weeks afterward and tag accounted for a majority of Twitter traffic in Egypt through the resignation of President Hosni Mubarak on February 11, 2011. Although there were only around 130,000 active tweeters in Egypt at the time, the #jan25 tag had over 1.2 million mentions, illustrating the viral effect of social networking where a tweet can be retweeted by many other users. The day Mubarak left office, the number of tweets in Egypt reached its zenith at 35,000. During a five-day internet blackout, tweets were sent using proxy servers or through contacts in other countries (Zirulnick 2011).

It is difficult to pinpoint the exact role mobile played in the uprisings because social networking applications can also be used on PCs. In most of the non-Gulf Arab nations, however, mobile ownership far outnumbers computer possession (figure 1.9a). Further the portability and ease of concealment of mobiles are ideally suited to street protests. In addition, camera phones are well integrated with mobile social networking applications, making it relatively simple to record and dispatch images and videos over the high-speed wireless networks available in most Arab nations. In Egypt, almost 60 percent of mobile owners use their phone to take photos or video (figure 1.9b). About 1,000 videos were sent

Figure 1.8 Mapping calls for protest on Facebook to actual “Arab Spring” demonstrations, 2011



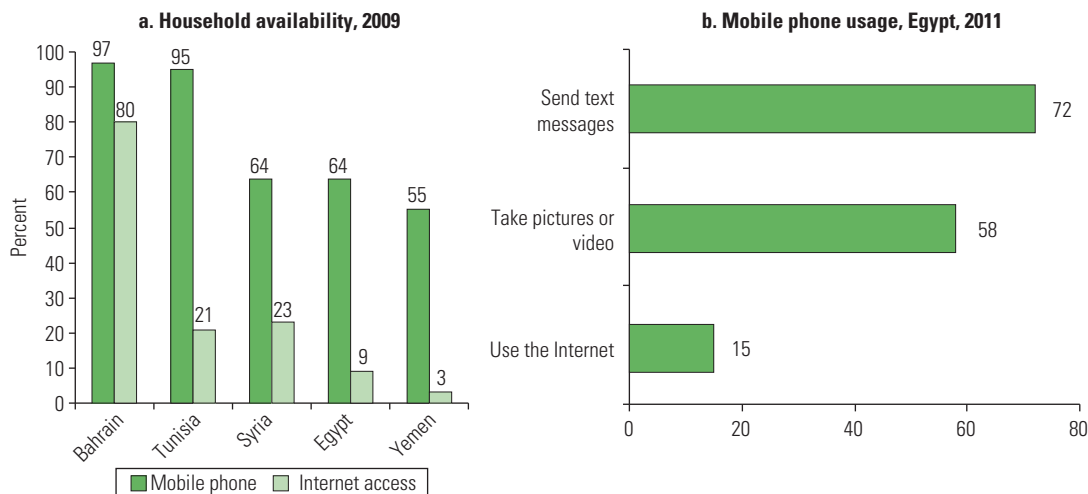
Source: Dubai School of Government, Arab Social Media Report, May 2011.

Note: The percentages underneath each country show Facebook penetration rates at the start of protests.

* Facebook penetration rates at the start of protests in each country.

** Initial protest was not organized on Facebook, although further protests were.

Figure 1.9 Mobile phone versus internet access household availability



Sources: Gallup 2009; Pew Research Center 2011.

from cell phones to the Al-Jazeera news organization during the Egyptian protests.²³

Although governments can try to restrict access to the internet and mobile networks, they may pay a heavy price. The Organisation for Economic Co-operation and Development (OECD 2011) estimated that the direct costs to the Egyptian government of shutting down the internet and mobile phone networks during demonstrations was \$18 million a day, with a much wider economic impact when factoring in industries such as eCommerce, tourism, and business process outsourcing. Restricting access also tends to have a reverse effect: according to a survey of Egyptian and Tunisian citizens, blocking networks causes “people to be more active, [and] decisive and to find ways to be more creative about communicating and organizing even more” (Dubai School of Government 2011). Short of a complete shutdown, users can find workarounds to blocked applications by using proxies; if close enough, they can also pick up cellular signals from neighboring countries. Intriguingly, some of the countries identified as having the heaviest internet restrictions were also those where social-media-driven demonstrations have taken place (Reporters Without Borders 2009).

Structure of the report

The rest of this report explores these themes in more detail. The report distills work carried out by the World Bank Group and its development partners since the last edition of

this report, in 2009, with a particular focus on mobile applications for development. Chapters 2, 3, and 4 have a sectoral focus on the use of mobile applications in agriculture and rural development, health, and financial services respectively. Chapters 5 and 6 are cross-cutting, looking at how mobile communications are contributing to entrepreneurship and employment and how they are being used to bring citizens and government closer together. Finally, chapter 7 looks at the shift from narrowband to broadband mobile networks and the policy implications involved. The Statistical Appendix provides an overview of recent trends in the mobile sector and introduces a new analytical tool. The Country Tables at the end of the report provide an at-a-glance view of the status of mobile communications in World Bank member countries.

Notes

1. “[Y]oung people around the world are more immersed in mobile technology than any previous generation.” See Nielsen 2010.
2. http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html.
3. <http://www.sec.gov/Archives/edgar/data/1498209/000119312510182561/ds1.htm>.
4. A “tweet” is 140 characters (compared to 160 characters for an SMS).
5. For mobile users of Twitter growth in 2010, see <http://blog.twitter.com/2011/03/numbers.html>.

6. <http://blog.twitter.com/2012/03/twitter-turns-six.html>.
7. <http://trak.in/tags/business/2010/05/24/facebook-twitter-delhi-police/>.
8. <http://globalvoicesonline.org/2011/01/25/egypt-tweeting-the-day-of-revolution/>.
9. <http://www.opera.com>.
10. “Statistics,” <http://newsroom.fb.com/content/default.aspx?NewsAreaId=22>.
11. In Korea, games must be reviewed and rated by the Games Ratings Board before they can come on the market. See “‘Big Bang’ of Mobile Games.” *JoongAng Daily*, May 17, 2011. <http://koreajoongangdaily.joinsmsn.com/news/article/article.aspx?aid=2936279>
12. <http://www.chinamobileltd.com>.
13. RIM (Research in Motion). 1999. Annual Report. p. 2.
14. “Research in Motion Reports Third Quarter Results.” Press release. December 16, 2010. <http://press.rim.com/financial/>.
15. Information on the iPhone is adapted from Apple annual operating reports at <http://investor.apple.com/sec.cfm#filings>.
16. Apple Inc, 2011 10-K Annual Report, filed Oct. 26, 2011, at: <http://files.shareholder.com/downloads/AAPL/1664072048x0xS1193125-11-282113/320193/filing.pdf>.
17. “Nokia and Microsoft Announce Plans for a Broad Strategic Partnership to Build a New Global Ecosystem.” *Nokia Stock Exchange Release*, February 11, 2011.
18. “News24’s Mobile Site Hits the Half-a-Million Unique Users Mark.” Press release, January 20, 2011. <http://www.news24.com/xArchive/PressReleases/News24-mobile-hits-500-000-users-20110120>.
19. <http://www.mxit.com>.
20. <http://www.safaricom.co.ke/index.php?id=1265>.
21. “Wonzomai: plateforme d’alertes citoyennes pour les élections présidentielles en Côte d’Ivoire.” *Internet Sans Frontières*, October 29, 2010. http://www.internetsansfrontieres.com/Wonzomai-plateforme-d-alertes-citoyennes-pour-les-elections-presidentielles-en-Cote-d-Ivoire_a243.html.
22. <http://www.miller-mccune.com/politics/the-cascading-effects-of-the-arab-spring-28575/>.
23. <http://www.guardian.co.uk/world/2011/dec/29/arab-spring-captured-on-cameraphones>.
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