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Digital divides

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Introduction

Digital divides refer to differences in access to and purposeful use of information systems and technologies by people, or by social or political units such as cities, states, and nations. As computing became more widespread in the late 20th century, government and academic awareness of a variety of digital divides commenced, as illustrated by the early studies of the US National Telecommunications and Information Administration (NTIA 1995–1999), international agencies (ITU 1997–2016; World Bank 1982–2016; WEF 2004–2016), by early researchers (Hargittai 1999; Robison and Crenshaw 2002–2003), and by the recognition of the global information society (Castells 1996–1998).

In the 1990s, some national governments recognized the need to support digital access for their citizens. For example, Estonia, which established its independence from the Soviet Union in 1991, set attainment of widespread information technology as a national goal. With investment and support from its high-tech neighbor, Finland, Estonia steadily built up societal information and communication technologies (ICTs) knowledge and skills over several years through education, training, and government initiatives during successive administrations (WEF 2007, 81–90). The nation’s first prime minister, Mart Laar, placed information technology as a unifying theme to advance the small nation and went as far as making the declaration that the Internet is a basic human right (WEF 2007). By continually reaching for very high goals over the next 15 years and through successive administrations, the nation moved up to achieve a high world ranking in its national use of ICTs, including the Internet. Another example of a nation that set high ICT-based goals early on throughout its society was Singapore (WEF 2015). The leaders of the nation have sought since the 1990s to advance Singapore by infusing information technology throughout its society to become an “intelligent island” (Warschauer 2001).

This chapter introduces the concepts of the digital divide, considers the evolution of its concepts and definitions, describes the different units of analysis, specifies their measurement and sources of data, describes several digital divide theories, indicates major determinants of digital divides, and discusses the evolution of concerns from access, to utilization, to productive outcomes of use. Digital divides worldwide will be illustrated by emphasizing major
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continental regions. At the national level, a more detailed comparison will be made of changes in digital divides within the United States and within the Russian Federation. The chapter will conclude by considering the goal of an inclusive and fair digital society (United Nations 2001; DiMaggio et al. 2004), how this relates to basic human rights, and the journey from digital access to usage and positive outcomes. The question of whether trends in digital divides are narrowing or widening, a newly emerging digital divide in big data, digital natives, and the question of how digital inclusion supports education (Warschauer and Matuchniak 2010) will also be discussed.

Digital divides are regarded by many observers, and by us in this chapter, as complex and evolving phenomena, which have multiple dimensions, measurements, units of analysis, and relationships with society and the economy (Barzilai-Nahon 2006; James 2008; van Dijk and Hacker 2003). An observer who has particularly pointed to the complexity of the digital divide concept (van Dijk 2005) posits a complex model that is permeated by inequalities. Personal characteristics such as age, intelligence, and personality lead to unequal availability of mental, social, and cultural resources, which in turn results in differential access. ICT access impacts the society, economy, culture, and politics, which leads to unequal positions in education, the workforce, and national leadership, which complete a feedback loop by influencing resource availability. Another loop impacting this access loop involves the capacities of ICTs and the associated skills to use them (van Dijk 2013). This model has the complexity that we feel is appropriate in viewing digital divides, yet, the model is so large that it can be difficult to operationalize and validate.

The complexity of these phenomena is also reflected in the wide variety of tools to analyze digital divides. Metrics that can be used range from those of infrastructure access, to affordability, utilization, social and government support or constraints, and socio-demographic factors, which amount to over 30 basic types of metrics (Barzilai-Nahon 2006). A comprehensive index of all such metrics is probably not achievable or useful, but rather a more specific set of metrics can be applied given a unit of analysis, cultural context, and specific purpose of a study.

Finally, the digital divide phenomenon is rendered complex because divides are evolving over time from access divides, to usage divides, and to inequalities in outcomes (DiMaggio et al. 2004; van Dijk 2013; Warschauer and Matuchniak 2010). In the 1990s and early 2000s, there were very large gaps among socio-economic groups in access to ICTs (NTIA 1998, 1999), but in the 2000s as access gaps narrowed, at least in developed nations, studies shifted to emphasizing usage of technologies (WEF 2011, 3–32; van Dijk 2012). Recently, as usage gaps have narrowed, studies have started to have a principal focus on outcomes of use. The outcomes include improved learning, economic productivity, social connectedness, professional skills, political engagement, and access to information. We can expect that this thrust will continue, and we give it attention in the chapter.

In digital divide studies, often the challenge of social inclusiveness in digital access and use appears. In the United States, although many divides are closing (NTIA 2014), parts of US society do not have basic digital access and use. Thus, social and political inclusion becomes a policy issue, that is, how to bring the fruits of using contemporary digital technologies to the underserved, who include the elderly, certain racial and ethnic minorities, and the impoverished. Because digital divides are very complex, solutions to expand inclusiveness are also complicated.

This chapter will proceed to examine many of these concepts and issues by next turning to analyze global digital divides.
Global digital divides

An important determinant of digital divides is the affordability of the hardware, software, and services that make up ICTs. Many people in developed countries therefore take for granted access to and use of telecommunications and Internet services. Such individuals live and work in a well-connected information society with universal availability of ICTs. A global analysis of contemporary digital divides, however, paints a much more variegated picture (Chinn and Fairlie 2007; Hilbert 2011; Pick and Sarkar 2015; UN 2015b).

Measuring global digital divides

Many measures of digital divides assess the extent to which ICTs have been adopted by individuals, households, schools, and other organizations in different countries. The diffusion, adoption, and affordability of ICTs is measured and tracked by several organizations.

The International Telecommunication Union (ITU) maintains and extends international cooperation “for the improvement and rational use of telecommunications of all kinds” and publishes current and historical data for many measures of digital divides, some of which are listed in Table 27.1.

The World Bank compiles national data on financial aspects of ICTs. For example, it tracks telecommunications revenue and investment and also ICT imports and exports. It also tracks the aggregate size of the Web using the number of secure Internet servers online as the indicator (World Bank 2015a, 2016). Whereas the ITU, UNESCO, and World Bank measure digital divides in very broad contexts, the World Economic Forum (WEF) does so in the context of an economic, social, and political framework. The WEF (2016) organizes measures of digital divides into four areas, namely environment (business and government), readiness (infrastructure, affordability, and skills), usage, and impact (economic and social), each with multiple indicators. Additionally, Internet World Stats (www.internetworldstats.com) is a non-governmental website that publishes social media (Facebook and Twitter) usage data.

Because most measures of digital divides revolve around individual choice, capability, and usage, it is helpful to consider a theory that integrates these factors. In the language of van

Table 27.1 Measures of digital divides tracked by the United Nations (UN) sources

| In UN Millennium Development Goals (MDGs) | Fixed-telephone subscriptions per 100 inhabitants |
| In UN Sustainable Development Goals (SDGs) | Mobile-cellular telephone subscriptions per 100 inhabitants |
| | Internet use as the percentage of individuals using the Internet (also in UN SDGs) |
| Tracked by ITU and WEF | Computer access as proportion of households with a computer |
| | Proportion of households with Internet access |
| | Percentage of population covered by a mobile network, by technology |
| | Proportion of individuals who own a mobile telephone, by gender |
| | Fixed-broadband subscriptions per 100 inhabitants, by access speed |
| | Proportion of schools with access to (1) computers and (2) the Internet for teaching |
| | Proportion of individuals with ICT skills, by type of skill |

Source: ITU (2015a, 2016a); UN (2015a, 2015b).
Dijk’s (2013) resources and appropriation theory (pp. 32–35), purchasing a subscription, for example, to a broadband service, is an appropriation of a digital technology. Van Dijk considers each appropriation of an ICT to be based on four distinct but related kinds of access: motivational, physical and material, digital skills, and usage, as shown in Figure 27.1.

To appropriate a new technology one should first be motivated to use it. When sufficient motivation is developed one should be able to acquire physical access to a computer, the Internet or another digital medium. Additionally, one needs the material resources to keep using the technology that consist of peripheral equipment, software, ink, paper, subscriptions, and so on. Having physical and material access does not automatically lead to appropriation of the technology as one first has to develop several skills to use the medium concerned. The more these skills are developed the more appropriate use can be made of the technology in several applications. The concept of usage can be measured, among others by the observation of the frequency of usage and the number and diversity of applications.

(van Dijk, 2013, 34)

This chapter measures the access divide of ICTs – globally, nationally, and regionally – in terms of the number of subscriptions as well as the proportion of individuals or households. Later in the chapter, we discuss a shift in the digital divide discourse away from access and use and toward social, economic, and environmental outcomes such as those articulated in the UN Sustainable Development Goals (UN 2015b).

Figure 27.1 Four successive types of access in the appropriation of an ICT

Source: Adapted from van Dijk (2012, 2013).
Evolution of global digital divides

The term “digital divide” is used both in the singular and plural. Within the broad array of current definitions, the term was first used in the singular by Lloyd Morrisett to describe a divide between the information “haves” and “have-nots” (Compaine 2001). As the term came into common use, it became both a motivator for and a target of policy agendas (Selwyn 2004). Before the turn of the century, attention on digital divides focused mostly on access to ICTs and their relationship to economic development and education (UN 2001; Warschauer 2004). Subsequently, scholars began to grasp the complexity of understanding digital divides in the large (Norris 2001) and also their dynamic nature (van Dijk and Hacker 2003). It is therefore not surprising that in their latest report, the ITU (2015a) uses 61 “core” variables to measure global digital divides and their many interrelated dimensions. Furthermore, as the United Nations prepares to track global progress toward its Sustainable Development Goals, several targets highlight the important role that access to ICTs, the skills to use them, and their productive use play in leveraging the full potential of ICTs for sustainable development.

Figure 27.2 shows to what extent specific global digital divides are narrowing over time. Since 2000, the adoption of mobile-cellular services has followed the well-known S-shaped curve predicted by the diffusion of innovations theory (Rogers 2003). The quality and per capita distribution of mobile-cellular subscriptions, however, vary greatly. Between countries and regions, the voice quality and the reliability of message delivery are uneven. Furthermore, aggregated statistics like those shown in Figure 27.2 mask the fact that affluence and cultural factors can yield subscription ratios that vary greatly in different countries (UN 2015a). While not shown in this figure, the number of fixed-telephone subscriptions peaked at about 19.4 (per 100 inhabitants/households) in 2001.
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100 inhabitants) in 2005 (ITU 2014b) and has been declining since then due to fixed-mobile substitution and to the higher cost of maintaining fixed-line infrastructure.

The global adoption of mobile-cellular subscriptions is perhaps the most significant bridge across the many digital divides since the advent of computing in the 1940s. In contrast, the sluggish adoption of fixed-broadband services highlights a significant and continuing global digital divide, which like most such divides is greatest between developed and developing countries (Norris 2001; van Dijk 2005). This divide is mostly due to the high capital costs of building broadband infrastructure and high labor costs to deploy fixed-broadband services.

What makes digital divides in aggregate a more challenging problem than any single divide is that these divides often travel together. Moreover, in early stages of development new ICTs may reinforce or even widen existing economic, political, and social inequalities between the have and have-nots (Guillén and Suárez 2005; NTIA 1999). As the Internet emerged as a new technology in the 1990s, residents of the wealthiest nations were appropriating second-generation cellular phones at the same time (Gruber and Verboven 2001). Recent longitudinal analysis (Hilbert 2016) suggests that this pattern is repeating as optical fiber-based fixed-broadband is being adopted concurrently with fourth- and fifth-generation mobile services that include mobile-broadband, but almost exclusively in high-income countries as of this writing. It is therefore important to think of van Dijk’s four types of access, illustrated in Figure 27.1, as repeating for each new or next generation technology and also sometimes at work in parallel, for example, for distinct types of access such as fixed- and mobile-broadband today (Lee, Marcu, and Lee 2011).

**Current and future global divides**

It is important to understand and visualize global digital divides and how they change over time (Pick and Sarkar 2015; Skaletsky, Soremekun, and Galliers 2014), even if it is difficult to understand the divides themselves, their causes, their effects, and their interrelationship at every level of detail (Hilbert 2011). Figure 27.3 shows that in 2014, Internet use was very...
high in North America, Europe, and Australia, but quite low in African nations in which less than 10% of the population regularly uses the Internet. Africa also exhibits lower levels of adoption of mobile-cellular technology on average (see Figure 27.4), however, some countries (e.g., Libya, Mali, Gabon, Botswana, and South Africa) have demonstrated “leapfrogging,” in which mobile-cellular services have been adopted at levels that exceed those in more developed and affluent countries. South America, Europe, and Australia appear to have high numbers of mobile subscriptions, however more interesting comparisons occur across continental boundaries. Specifically, Figure 27.4 highlights there are some countries that have a very high number of mobile subscriptions, some of which are expected (e.g., Uruguay, Italy, Austria, Kuwait, UAE, and Australia) and some of which are unexpected (e.g., Suriname, Argentina, Jordan, Saudi Arabia, Oman, Kazakhstan, and the Russian Federation) (ITU 2015a, ITU 2016c).

Mobile-broadband services combine the benefits of mobility, voice, and messaging, as well as access to many web-based and mobile applications (ITU 2014b).

Figure 27.4  Mobile-cellular subscriptions per 100 inhabitants in 2014

Figure 27.5  Mobile-broadband subscriptions per 100 inhabitants in 2015
Source: ITU (2016b).
Africa again exhibits lower levels of adoption of this mobile technology on average (see Figure 27.5). Only some African countries (Tunisia, Ghana, Namibia, Botswana, and South Africa) have adoption levels that approach the worldwide average. Again, more interesting comparisons occur across continental boundaries. Specifically, this figure highlights there are only some countries that have very high per capita levels of mobile-broadband subscriptions; namely, the Nordic countries, Estonia, the United States, Kuwait, Saudi Arabia, Bahrain, Singapore, South Korea, Japan, Australia, and New Zealand.

Overall progress toward bridging global digital divides has been mixed. Figure 27.4 shows that of the over seven billion people that have mobile-cellular subscriptions in 2015, many are living in affluent countries in which the number of subscriptions per person is greater than two. This good news is offset by the bad news that a greater number are living in poorer countries where there is less than a subscription per person, even though 95% of the world’s population is covered by a mobile-cellular signal (UN 2015a). The adoption of this mobile technology has happened quickly in historical terms, as shown in Figure 27.2; however, less than three-quarters of a billion people subscribed to mobile services in 2000. A similar uneven per capita distribution of Internet use is illustrated in Figure 27.3. In aggregate, however, Internet use by the world’s population has grown from just over 6% in 2000 to 43% in 2015. As a result, 3.2 billion people were linked to a global network of content and applications at this time (UN 2015a). One reason that Internet use has progressed more slowly than mobile phone use is that using the Internet requires greater literacy and superior digital skills (van Dijk 2005).

As old digital divides are bridged, new digital divides emerge. For example, as mobile- and fixed-broadband are being adopted more widely, bandwidth digital divides and their importance are emerging (Hilbert 2016). Although Barzilai-Nahon (2006) and others argue against over-emphasizing bandwidth as an important digital divide, recent studies remind us that greater bandwidth promotes more productive use of ICTs by increasing access to the number and diversity of applications and often providing a richer user experience.

**Regional digital divides**

Since the start of the new millennium, ICTs have catalyzed the fourth industrial revolution (WEF 2016). During the period 2000–2015, adoption and use of ICTs worldwide increased across the board, with the exception of fixed-telephone subscriptions. For example, the global growth in mobile-cellular adoption reflects rapid deployment of mobile infrastructure and concomitant improvements in network coverage. Multiple subscriptions per person in wealthier countries, however, in part explains the quintupling of such subscriptions since 2000 (see Figure 27.2). Leveraging similar but more advanced technologies, growth in mobile-broadband is more recent. This is due to increasing availability and declining pricing of mobile-broadband networks, especially in developing nations (Rouvinen 2006), and to rapid adoption of smart devices, mostly in developed nations (ITU 2016a). While mobile-broadband is projected to bridge affordability and connectivity divides, it is being used as a complementary technology (to fixed-broadband) in more affluent countries while being adopted more gradually in poorer countries as an affordable substitute (ITU 2016b).

The growth in household personal computer adoption since 2005 has been outpaced by the near tripling of both proportions of individuals using the Internet and of households with Internet access at home. Available data from the ITU indicate that nearly half of the global population is expected to have cyber-connectivity in 2016. ICT data also point to the fact that increasing cyber-connectivity is being spurred by the explosion of mobile-cellular
Closer examination of subscriptions to ICT services and ICT usage patterns, however, demonstrate significant digital divides between world regions. The gaps between the developed and developing world in terms of leading ICT indicators such as Internet, mobile-cellular, broadband (both fixed and mobile) remain stark, as shown in Figure 27.6. In 2015, mobile-cellular subscriptions in the developing world lagged those in the developed world by almost 32 per 100 inhabitants. Moreover, this gap has persisted at over 30 subscriptions per 100 inhabitants between the developed and developing nations since 2012. Broadband subscriptions also paint a similar picture, with fixed- and mobile-broadband subscriptions per capita in developing nations lagging behind those in developed nations by a factor of approximately 4.0 and 2.5, respectively, in 2015. Encouragingly, the gap in percentage of individuals using the Internet has shrunk somewhat between developing and developed countries since 2010. In 2016, per capita Internet access in the developing world is projected to be approximately half of the developed world (81% individuals using the Internet in developed nations compared to 40% in the developing world) (ITU 2015a).

Digital divides between developed and developing countries are often echoed in disparities in the adoption and diffusion of ICTs among the major continental regions of the world. While Internet users and mobile-cellular subscribers in the Asia-Pacific region far outnumber their peers in Europe and the Americas due to a large population base of such users in China and India, per capita penetration of the Internet is half of that in Europe, as shown in Figure 27.7. However, the world region most afflicted by poor ICT connectivity is Africa, which lags significantly behind Europe, the Americas, and also the Asia-Pacific in all forms of ICT adoption.

Digital divides are often symptoms of economic, social, and technological divides. For example, in 2015 only 22.5% of African individuals had Internet connectivity compared to 62.2% in

![Figure 27.6](image_url)  
*Figure 27.6  Digital divides in developed vs. developing countries, 2015*  
*Source: ITU (2016c).*
the Americas. Encouragingly however, giant strides have been made in Africa recently; since 2010, mobile-cellular subscriptions have grown from 45 per 100 inhabitants (2010) to nearly 81 projected subscriptions in 2016. Similarly Internet penetration has more than doubled from almost 10% to 22.5% of total population in 2015. Fixed-broadband subscriptions continue to lag in African nations compared with the Asia-Pacific and with developed and industrialized Western economies, suggesting an infrastructural malaise (Fuchs and Horak 2008).

Over the years, demographic and socio-economic factors such as age, gender, race and ethnicity, income, and educational attainment, as well as geographic location (urban versus rural) have been associated with disparities in adoption and diffusion of ICTs in many parts of the world (Pick and Sarkar 2015). Gaps in Internet adoption and use stemming from disparities in income and education are as geography-invariant in modern, industrialized Western economies as in poverty-stricken, socio-economically challenged nations in the African continent (Warf 2013).

European nations for the most part are considered as leaders, with high GDP per capita and the availability of a skilled workforce due to high per capita human resources in science and technology acting as catalysts in their adoption and use of ICTs, especially the Internet (European Union 2015; Vicente and López 2011). Regional unemployment, however, imposes challenges in bridging ICT disparities in Europe, and so do non-English speaking populations in eastern and southern parts of Europe compared to northern and western Europe (Vicente and López 2011; Warf 2013). Much of Europe is aging; in fact, nine out of the 10 most aged nations worldwide in 2012 are European (UN Statistics Division 2016); therefore many of Europe’s ICT challenges stem from an aging population.
Infrastructural deficiencies also continue to engender challenges in bridging digital divides in many parts of Asia, including India. However, in both China and India, nationally and internationally reputed centers of higher education have contributed to the ready availability of a highly educated professional, scientific, and technical workforce, contributing to rapid growth and development in the nations’ hardware, software, and knowledge-services sectors, respectively (Gregory, Nollen, and Tenev 2009). This helps bridge digital divides in the two most populous nations of the world (Pick and Sarkar 2015, chaps. 5, 6). Additionally, consistent with findings in recent literature (Agarwal, Animesh, and Prasad 2005; Chen 2013), social capital—often manifesting itself in tight, socially knit communities such as cooperative societies founded and operated on the basis of agrarian cooperation (Prakash and De’ 2007; Veeraraghavan, Yasodhar, and Toyama 2009) in rural areas—has been found to be associated with adoption and diffusion of ICTs in India (Pick, Nishida, and Sarkar 2014).

In the broader context of digital divides, the role of Internet censorship has received considerable attention in the literature. Apart from China, Central Asian nations such as Kazakhstan, Arab countries such as Saudi Arabia, and minuscule Internet penetration in sub-Saharan Africa has often been associated with various levels of censorship that enfeeble civil society and discourage open and free dissemination of information (Warf 2013). Unsurprisingly, one recent study (Pick and Sarkar 2015, chap. 9) has documented the strong association of societal openness along with urbanization and industrial activity in the manufacturing sector with higher levels of ICT adoption in African nations. Another finding that has gained prominence with regard to digital divides in Africa counters the argument that neoliberal policies encouraging market liberalization, deregulation, and privatization are part of the solution to bridge digital divides in less prosperous, developing parts of the world including sub-Saharan Africa. Older studies (e.g., Fuchs and Horak 2008; Heeks 2002) have provided exemplary cases of Internet use founded on the principles of bridging economic disparities and social inequities in which technology is conceptualized and used to solve human problems with clearly articulated development goals in traditionally impoverished settings.

An example of the pluses of societal openness is the success in Bangladesh of Dnet, a not-for-profit social enterprise that works with rural, impoverished communities to provide access to information, healthcare, education, and employment using ICTs to provide pathways for social and economic empowerment. Like many less developed and highly populous nations, the voice and messaging digital divides in Bangladesh are marked by a patriarchal society resulting in deep-rooted gender-based discrepancies in access to education, employment, and technology, infrastructural challenges in the telecommunications sector, and consequent “leapfrogging” stemming from availability of cheap mobile devices and calling plans, which contrast with a sparser, less reliable fixed-phone network. Over the past decade, Dnet has hired and equipped rural Bangladeshi women with mobile phones and trained them as “mobile info-ladies” who are employed at Dnet’s helpdesk. The info-ladies would assist their untrained rural peers in connecting and communicating with experts such as doctors, lawyers, and specialists in healthcare, education, agriculture, and other fields. Dnet also conducted research that ultimately led to the creation of a knowledge repository database and search engine in the local Bengali language, thus providing access to valuable information that would otherwise prove illusive to the socially disconnected, often uneducated rural poor. This and other social empowerment initiatives facilitated by ICTs are highlighted by the Broadband Commission for Sustainable Development (Broadband Commission 2016).

Whereas this chapter focuses mostly on the relationship between economic and social factors and digital divides (e.g., van Dijk 2005; Warschauer and Matuchniak 2010), technological divides cannot be ignored (e.g., Gulati and Yates 2012). In other words, while...
the focus on education, digital skills and usage is important, technological divides are also critical in defining the questions of who (e.g. divide between individuals, countries, etc.), with which kinds of characteristics (e.g. income, geography, age, etc.), connects how (mere access or effective adoption), to what (e.g. phones, Internet, digital TV, etc.). Different constellations in these four variables lead to a combinatorial array of choices to define the digital divide.

(Hilbert 2011, 715)

Hilbert (2016) further argues that traditional approaches of measuring digital divides are inadequate, and need to be expanded to recognize the extent and quality of an individual’s foray into cyberspace. Accordingly, computer storage capacity and network bandwidth represent additional dimensions of digital inequality. Such developments reflect an expanded research opportunity to focus on newly emerging computing and network capabilities that underlie ICT usage and outcomes.

Digital divides in the United States

The United States, as one of the most populous, geographically vast, and diverse nations worldwide is also a world leader in the access to and use of ICTs. In 2014, the United States was ranked 15th worldwide in terms of the International Telecommunication Union’s ICT Development Index, a gain of one position since 2010 (ITU 2015a). In fact, since the turn of the millennium, US household adoption of computers, Internet, and broadband have all increased consistently as documented in a series of reports of the National Telecommunications and Information Administration (NTIA 2011–2013). These reports paint a picture of diminishing digital divides, with computer, Internet, and broadband adoption all exceeding 70% household adoption by 2013, as shown in Figure 27.8 (NTIA 2014).

From Figure 27.8, it is evident that the growth in broadband adoption since 2000 steadily increased and caught up with computer and Internet adoption in the household by 2012–2013.

Figure 27.8 Household adoption of computer, internet, and broadband (% of households), 1997–2012
Part of this impressive growth can be attributed to the development of the National Broadband Plan in 2008–2010 in the aftermath of the housing market crash and economic recession in the United States. The development of such a plan was based on the contention that improved access to broadband provides the foundation for economic growth, employment opportunities, global competitiveness, and a better quality of life. Since 2007, home broadband use has increased, with the most dramatic increase (from 32% in 2007 to 47% in 2012) in the 65 and older age group. This is encouraging because age is one of several factors that continues to impede a uniformly networked society in the United States.

Among other ICTs, computer and Internet adoption in the household continue to increase, with adoption levels approaching 80% of US households in 2016. Despite steady gains in Internet connectivity, disparities continue to persist, with low user interest in cyber-connectivity, concerns stemming from affordability, and lack of a computer—in that order—being the primary deterrents (NTIA 2014).

The NTIA in its recent reports has begun to focus on the mobile Internet. In 2000, mobile Internet subscriptions numbered fewer than 40 per 100 inhabitants in the United States, much lower compared to developed peers such as the United Kingdom, where the corresponding number exceeded 70. Since then, however, mobile subscriptions have steadily increased in the United States to almost 118 mobile-cellular subscriptions per 100 inhabitants in 2014 (ITU 2015a). As broadband availability has improved and smartphones have become ubiquitous, mobile devices and tablets rather than personal computers have provided alternative pathways to Internet connectivity to the US consumer (NTIA 2014). While mobile phone use has become widespread even among traditionally disadvantaged groups such as low-income families and people with disabilities, use of applications on mobile phones has varied significantly based upon educational attainment, income, population density, and other factors. In fact, US digital divides (NTIA 2014), irrespective of the type of ICT, are associated with demographic, socio-economic, and social connectivity factors.

**Individual digital divides in the United States**

Prior studies found socio-economic differences in the rates of use of ICTs (Fairlie 2004; Martin 2003), with those who are less educated, have lower income, minorities, and women having lower rates of use.

The difference in Internet use in the United States by gender was quite low in 2000, with 54% of men and 50% of women using the Internet. This difference shrunk to about 2% beginning in 2005 and closed in 2014 (see Figure 27.9). While more extensive research is required to assess whether there is a larger difference between genders when controlling for income, education, and other demographic characteristics, these numbers reassure us that there is no significant gender divide in Internet use in the United States.

The patterns of Internet use for people in different age, education and income groups are very similar. Those who are younger, more educated, and have higher income use the Internet at higher rates. Even though differences in Internet use by people in different age groups has decreased over time, it remains present and quite large (see Figure 27.10). While the difference between Internet users ages 18–29 and 30–49 has almost closed (96% and 93% in 2015), older age groups still lag behind, especially those 65 and older. However, the 65 and older group had the highest rate of increase in Internet users from 2000 to 2015, with the number of users increasing from 14% to 58%.

A similar pattern is seen in Internet use by people with different educational and income levels. Those with the highest levels of income and education have the highest rates of Internet
use (see Figure 27.11). However, the rate of Internet use among those with the lowest level of education and income has risen at the highest rate from 2000 to 2015.

We conclude that digital divides in the United States among individuals in different socio-economic groups still exist, with those who are younger and those having a higher educational
and income level achieving higher rates of Internet use. However, gaps have consistently decreased over the past 15 years, with those in the oldest, least educated, and lowest income groups making the most progress.

**Regional divides in the United States**

Regional digital divides are expected to be present in large and diverse countries such as the United States, China, India, and Russia. In 2003, US states with the highest percentages of households with a computer and Internet were concentrated in the Northeast, West Coast, and Rocky Mountain states. States in the Midwest and the Rust Belt reported moderate levels of computer ownership and Internet access. States with the lowest rates of household adoption of computers and Internet access were in the rural South, an area acknowledged as a laggard in adoption and diffusion of ICTs (NTIA 2014; Pick, Sarkar, and Johnson 2015).

Figures 27.12 and 27.13 depict the states in 2013 by percentage of population living in households with a computer and households with a high-speed Internet connection, respectively. Interestingly, the geographic distribution of percent of people living in a household with a computer in 2013 is almost identical to the percent of households with a computer in 2003, as shown in Figure 27.12. The states with the highest and the lowest rates mostly remained the same. Overall progress was achieved between 2003 and 2013, however; the gap between states with the highest and lowest levels of computer ownership in the household decreased from 25.3% in 2003 to 14.9% in 2013, indicating a narrowing of the Internet digital divide. A narrowing of the high-speed Internet digital divide can also be observed by comparing Figures 27.11 and 27.13.

Broadband adoption patterns in US states (see Figure 27.16) largely mirror the geographic distributions of high-speed Internet adoption and computer use. Computer ownership, high-speed Internet, and broadband digital divides in US states follow an urban–rural divide,
indicating that where people live often dictates the availability of and access to ICTs. Traditionally rural states and regions of the country have experienced slower and less extensive buildout of network infrastructure (NTIA 2014) indicating that infrastructural issues persist as impediments to bridging digital divides in the United States.
An exception to this rule is the narrowing of the gap in mobile-cellular adoption in US states. As evident from Figure 27.17, at least half of the households in states in the rural South are wireless-only households, indicating possible infrastructural deficiencies with respect to
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fixed-line technologies. Nonetheless, a recent NTIA (2014) report provides evidence that mobile phones are becoming more common among historically disadvantaged groups and adoption gaps are diminishing across demographic and socio-economic groups, indicating a narrowing of the mobile digital divide in the United States.

We conclude this section by observing that recent research indicates that social interactions and connectedness of individuals and communities, which is often measured by social capital, is positively associated with adoption and diffusion of ICTs in the United States at the individual (Chen 2013), and also the state level (Pick, Sarkar, and Johnson 2015). Social capital in this context represents the extent of an individual’s social and intellectual interactions in their communities. This reiterates the fact that a digital divide is not simply the difference between digital haves and have-nots, but rather it is multidimensional and multilayered.

Digital divides in Russia

Given the great progress achieved in access to and use of information and communication technologies in recent years, Russia can be considered a success story. Access to ICTs in Russia expanded significantly over the past several years. The proportion of households with Internet access increased from 48% in 2010 to almost 74% in 2014, while the proportion of households with personal computers increased from 55% to 75% during the same period (see Figure 27.18). The number of fixed-broadband subscriptions per 100 people increased from 1.1 in 2005 to 17.45 in 2014, while the number of mobile phone subscriptions per 100 people increased from 2.2 in 2000 to 155.1 in 2014 (World Bank 2015a). These significant improvements in access to ICTs improved Russia’s position relative to those of other countries. Despite the current recession and economic difficulties, Russia’s Networked Readiness Index global rank improved to 41 in 2015, up from 77 in 2010 (WEF 2011, 2016).

Figure 27.17 Wireless-only households in US states in 2012
Source: NTIA (2014); the data for MT, SD, and WY are missing.
A variety of data on ICT access and use, both at the individual and regional levels in Russia, is collected and made available. The Russian Federal Agency of National Statistics (ROSSTAT)\(^1\) has been conducting annual living standards surveys of Russian households since 2005. Another source of data is the Russian Longitudinal Monitoring Survey (RLMS),\(^2\) a comprehensive living standards survey covering every year from 1992 to 2015. Both sources include data on access to ICTs, such as personal computers and the Internet, and also on the purpose of Internet use.

Despite the progress made in access to ICTs overall, there are significant inequalities among some demographic groups based upon age, ethnicity, gender, and extent of urbanization, as well as among regions.

**Individual digital divides in Russia**

As in the United States, there is a significant difference in the use of Internet by people in different age groups. Figure 27.19 shows that while 60.7% of the Russian population used the Internet in 2014, only 28.5% of those older than 55 used the Internet compared to 81.2% of those 18 to 35 years old. This is consistent with Internet usage patterns in many other nations where cyber-connectivity of older populations lags significantly behind that of their younger counterparts.

Another significant divide in Internet use is between urban and rural areas, as shown in Figure 27.20. While the extent of Internet use for those in urban areas was 65.6%, usage in rural areas was only 46%. The main reason for this difference is the very high cost of providing fixed Internet access to remote rural areas (Deviatko 2013). The most dramatic difference between Internet use in rural and urban areas was in the older group – 48% fewer of the older population in rural areas used the Internet compared to the same age group in urban areas.

While there is no significant gender difference in use of the Internet overall and in rural areas, Skaletsky (2013) found a significant gender-based difference in urban areas. While further investigation is needed to draw conclusions about the reasons for this difference, it might be attributed to the fact that fewer technical employment positions are held by women. It is therefore possible that the inequality in use of ICTs between men and women in urban areas is a symptom of a larger problem of employment inequality. Skaletsky (2013) also found a
significant difference in levels of technology use among people of different ethnicities, with those of Russian ethnicity having higher levels of Internet use, compared to the minorities. Thus, an ethnic divide is also reflected within the regional digital divides in Russia.

**Regional divides in Russia**

Regional digital divides present significant problems in large countries, such as China, India, and Russia. Russia presents an interesting case because not only is it the largest country in the world in terms of land area, spanning 6.6 million square miles and 11 time zones, but it is also ethnically diverse. Russia’s population includes over 185 ethnic groups, 26 of which are concentrated in national republics. Overall, there are 85 different regions within Russia. The 2013–2014 report of the composite Index of Readiness for the information society shows that while the difference in the readiness index, as well as all of the sub-indices, among Russian regions has decreased over time, it still remains extremely high (Institute of Development of Information Society 2015). The highest value of the index in 2013–2014 was 0.693 in Moscow, which is 2.3 times higher than the lowest value of 0.302 for the Republic of Dagestan, located in the North Caucasus region. This region has a very ethnically diverse population, with more than 30 languages spoken.
While densely populated metropolitan regions such as Moscow and St. Petersburg enjoy some of the highest levels of digital development in the country, small population centers, especially those in rural areas, lag far behind. For example, the Moscow and St. Petersburg regions lead the nation in mobile phone subscriptions per capita in 2000, as shown in Figure 27.21 (per 100 inhabitants). Unsurprisingly, Moscow and St. Petersburg have experienced the highest levels of development throughout the history of the Soviet Union and Russian Federation as centers that attract high numbers of tourists and serve as showcases of the country.

As evident from Figures 27.21 and 27.22, the number of mobile phone subscriptions increased dramatically throughout Russia by 2014. However, the Moscow and St. Petersburg regions still had the highest number of subscriptions. Figure 27.22 shows that some regions, particularly in the eastern and northern part of the country such as the Yamalo-Nenetskiy Autonomous Region and Magadanskaya Oblast, among others, made significant progress, while many regions remained far behind.

The difference between the regions with the highest and the lowest levels of digital development is very high. The number of mobile phone subscriptions per 100 people in the city with the highest number of subscriptions (St. Petersburg) was three times higher than that in the region with the lowest number (Republic of Ingushetiya) in 2014. Differences between the numbers with mobile access to the Internet are even more dramatic between regions (see Figure 27.23). Interestingly, the highest numbers for mobile Internet use, besides Moscow

![Figure 27.21](image1.png)

*Figure 27.21* Number of mobile subscriptions per 100 people in 2000

*Source: ROSSTAT (2012).*

![Figure 27.22](image2.png)

*Figure 27.22* Number of mobile subscriptions per 100 people in 2014 (excluding St. Petersburg)

*Source: ROSSTAT (2015b).*
and a few other regional centers in the western part of the country, appear to be in the eastern regions.

Regions that are homes to various ethnic minority groups are among those with the lowest levels of both mobile phone and Internet use. Many of those regions, especially those in the Caucasus region, in the far southwest of the nation, had not only some of the lowest levels of digital development, but also the lowest levels of change between 2010 and 2014. Of the 20 regions with the lowest levels of mobile phone use in 2014, 15 were regions with a higher ethnic minority population per capita. Some of these regions also had the lowest increase in mobile phone use between 2010 and 2014. Thirteen of the minority republics were also among the 20 regions with the lowest levels of households with Internet access through personal computers in 2014.

While Russia has made significant progress in digital development overall in recent years, and improved its global standing, digital divides remain a problem within the country. Gender, age, and especially ethnic differences remain present in the levels of use of ICTs by different demographic groups. Furthermore, regional differences present a problem, with most less developed regions lagging far behind urban population centers like Moscow and other highly developed parts of the country. In sum, regional digital divides in Russia also reflect an ethnic divide, with regions that are home to a higher concentration of ethnic minorities having lower levels of digital development.

**Summary and ways forward**

**Narrowing divides, international aspirations**

Since the emergence of the Internet more than 25 years ago, the role of ICTs in the global information society has vastly expanded. This motivates the need to work harder to bridge current digital divides. Such effort is reflected at the international level as the United Nations has transitioned its focus from the Millennium Development Goals (UN 2015a) to the Sustainable Development Goals (SDGs), which specify goals and targets through 2030 (UN 2015b). Based on needs for economic development, there is also a strong shift in countries toward making broadband policy universal and promoting the adoption of more advanced technologies. For example, of the 196 nations for which the ITU gathers data on ICTs, 151 have a national broadband plan or strategy (ITU 2016b).
Looking to the future, the ITU and UNESCO are jointly tracking an expanded set of social, economic, and ICT-specific goals and targets. For example, the Connect 2020 goals are:

1. **Growth** – Enable and foster access to and increased use of telecommunications/ICTs;
2. **Inclusiveness** – Bridge the digital divide and provide broadband for all;
3. **Sustainability** – Manage challenges resulting from telecommunication/ICT development;

Many of the SDGs are motivated by economic, educational, and other inequalities that remain a significant challenge. Thus, the SDGs argue for social justice and for environmental sustainability. With respect to social inequalities, for example, the Broadband Commission recently stated that conventional approaches to bridging digital divides “will not produce the results needed to connect the remaining offline populations, who are now found in more remote, rural areas, and consisting disproportionately of poorer, minority, less educated, and often female, members of society” (ITU 2016b, 6).

**Convergence or divergence in digital divides**

As access and use of technologies grows worldwide, it might be assumed that the digital divides will narrow, leading to convergence in measures of the technology intensity between the technology leaders and trailers. It is perhaps a surprise that very detailed studies of convergence versus divergence have mixed results (Hilbert 2016; Kyriakidou, Michalakelis, and Sphicopoulos 2011; Park, Choi, and Hong 2015; Pick and Sarkar 2015; Rath 2016). One explanation is that as older technologies converge or die away, the new technologies introduced refresh or even increase the relative size of the divides. Another explanation might be that the 21st-century aging of the world’s population is tending to perpetuate the age-related digital divide (Niehaves and Plattfaut 2014). A study of convergence/divergence in 47 developing and developed nations based on annual data for the first 12 years of this century indicated that the initial divergence in IT development will reach a steady state that is even more diverged (Rath 2016). The drivers of the intensifying divergences were per capita income growth and the urban-to-rural population ratio. It is therefore likely that the shift in emphasis to differences in outcomes due to underlying digital inequalities means that global digital divides (Pick and Sarkar 2015) will persist for years to come.

Divides are not only converging/diverging for nations but also for smaller geographic units such as states, counties, and urban areas, which have been little studied. This opens up challenging areas of research that have large practical implications for regional planning, healthcare, marketing, educational planning, and equity and inclusiveness.

**Journey from access to usage to outcomes**

The digital divides of the 1990s concerned people and households gaining access to what were then relatively new technologies (personal computers, mobile phones, email). By 2015, although the simple use gap has narrowed considerably, another gap of what the users are doing is receiving more attention. For example, if a college-educated person mainly uses the Internet for gaming, but a high school graduate uses it for lifelong learning of career skills, there is a new type of digital gap emerging. Beyond use, an even more contemporary and
forward-looking view is to evaluate what the differences are in the outcomes of use, that is, on the economy, society, behavior, communication, and politics.

In the 21st century, as the developed world has achieved high penetration rates for personal computers, mobile devices, and Internet access, the prominent digital divide phenomenon is becoming outcomes. This advance in the concept is exemplified by the shift in 2012 in the World Economic Forum’s Networked Readiness Index (NRI), a prominent measure of the digital level of nations. The NRI definition remained largely unchanged from 2002–2011 with a focus on usage of traditional technologies, such as mobile phones, personal computers, and the Internet. The definitional change was provoked by the world overflowing with connected technologies, which is termed hyperconnectivity (WEF 2012, 3–34). The WEF responded by reworking the NRI to include four drivers: regulatory and innovation environment; technology readiness; technology usage by people, business, and government; and impacts on the economy and society (WEF 2012). The new NRI is much more complex than its predecessor, with 53 underlying variables. This example reflects the challenge of digital divide outcomes; phenomena that are much more complex and difficult to measure.

Another example of the newly perceived digital divide of outcomes was evident in a review of studies involving digital divides for K–12 schooling in the United States (Warschauer and Matuchniak 2010). The study identified that the older measure of access was outmoded for the American 21st-century youth, because nearly all youth had access. Accordingly, scholars shifted to examine use of technologies, but although numbers of users could be counted, it was very difficult to understand what school children were doing online, what their IT support and training systems were, and how their in-school versus out-of-school uses varied. Interest has now moved to understanding and measuring technology outcomes, but that has become exceedingly difficult “in part because the goals of teaching with technology are so diverse” and because metrics are not available to measure these outcomes (Warschauer and Matuchniak 2010, 201).

What can we draw from this evolution in digital divide concepts? Outcomes due to underlying digital inequalities will be much more complex to study, yet their practical implications are far greater. There is not the wealth of systematic government data to ground research on outcomes in a common base, but rather multiple smaller research studies will be needed of particular technologies, cultures, applications, and skills. More complex theoretical models will be required, going beyond even the most comprehensive ones in the literature (e.g., van Dijk 2005, 2013). Furthermore, the outcome differences are so great between privileged and deprived communities worldwide that outcomes due to digital divides might persist for many years and call for even more investigation than for earlier digital divides, as well as governmental efforts toward inclusion of the digitally deprived.

**Digital natives, big data and emerging digital divides**

One of the relatively new phenomena related to the use of ICTs is the notion of “digital natives,” the population of young people who have been using ICTs in their daily lives since an early age. Many different definitions of digital natives exist, all of which refer to young people who do not know life without ICTs. Not only do digital natives adopt technologies more easily than older generations, but research suggests that the use of ICTs also has changed the way they think and learn (Prensky 2001). More research is needed to assess the long-term effects of these cognitive changes and ways in which education should adjust to be able to accommodate them. While most research on digital natives concentrates on developed countries, this
phenomenon will have the most effect in developing countries (ITU 2013a). The development and adoption of new technologies lead to the emergence of new opportunities and consequently to the new divides. Crowdsourcing is one example of an emerging use of ICTs leading to a new form of digital divide. Crowdsourcing, or crowdsourcing, is a virtual marketplace where individuals perform small-scale tasks requested by organizations or other individuals. Some of the examples of crowdsourcing platforms are Amazon Mechanical Turk, Fiverr, and Microworker. These marketplaces are growing and include workers and job providers from different parts of the world. Workers’ compensation varies from a few cents per minute to hundreds of dollars per task. While crowdsourcing offers job opportunities and flexibility to workers, Deng, Galliers and Joshi (2016) discuss the differences in motivation, perceived value, and use of crowdsourcing platforms by different demographic groups. They find that those who are unemployed and those with lower educational levels are impacted the most by the power imbalance between the crowdworkers and job providers, and thus are marginalized in terms of digital divides.

Another example of a new digital divide is the divide related to the capability to collect, store, and analyze big data. The volume of data available from various sources has increased dramatically in recent years. Big data mining has a variety of business, technological, healthcare, government, and other applications. Knowledge extracted from big data allows predicting customers’ behavior, exploring the human genome, creating smart cities with focus on sustainable development, and so forth. The ability to process large volumes of data in real time requires both cutting-edge technological capabilities and analytical skills. Therefore, new divides emerge between organizations that have the ability to extract knowledge from big data and those that do not. The importance of narrowing the looming digital divide in utilization of big data is recognized by the UN Global Pulse initiative (http://unglobalpulse.org) and offers new research avenues. The mission of this initiative is “to accelerate discovery, development and scaled adoption of big data innovation for sustainable development and humanitarian action.” The Global Pulse projects include analysis of social media to gain understanding of immunization awareness in India, Pakistan, Kenya, and Nigeria, measuring poverty in Uganda by using satellite images to determine roofs of different materials, used as a proxy for poverty, and using mobile phone data to track population mobility in Senegal, among many other projects.

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Notes

1 www.gks.ru/.
3 A more comprehensive set of references can be found at http://atc4.bentley.edu/media/Digital_Divide_Chapter_Extended_References.pdf.

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Digital divides: past, present, and future


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