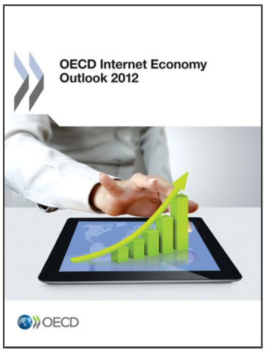



**From:**
## OECD Internet Economy Outlook 2012

**Access the complete publication at:**
http://dx.doi.org/10.1787/9789264086463-en

# Internet trends and development

**Please cite this chapter as:**

OECD (2012), “Internet trends and development”, in *OECD Internet Economy Outlook 2012*, OECD Publishing.
http://dx.doi.org/10.1787/9789264086463-5-en

*Chapter 2*

# Internet trends and development

*This chapter provides a forward-looking perspective on recent trends in ICT technologies, applications and services, and offers predictions for development over the next few years, highlighting particular trends that could have a substantial impact on future policy. It examines these trends in terms of networks, devices and services. It concludes with an analysis of Internet developments in various sectors of the economy. The chapter also highlights three key overarching trends: the growth of broadband, the importance of mobility, and the shift to cloud computing.*

## Emerging technologies

The pace of technological change on the Internet and in the ICT sector in general is extremely rapid, compared to other sectors of the economy. In just a period of two years or less, the entire sector can shift as a result of new technologies, applications and services. New companies can rapidly gain market share while former market leaders quickly falter.

Markets move so quickly that policy makers and other market participants constantly need to keep an eye on developments and evolving market trends as a way to respond quickly to new policy challenges. This chapter focuses on some of the most promising and important Internet trends that are emerging and will continue to evolve over the next two years, providing an early glimpse of potential policy implications. The chapter begins by examining emerging technologies related to networks, devices and services. It continues with broader trends of how the Internet is transforming different sectors across the economy.

### *Networks*

Networks are the underlying physical infrastructure of the Internet, which support evolving applications and services. High-speed networks are increasingly viewed as fundamental for economic and social development. They serve as a communication and transaction platform for the entire economy and can be used to improve productivity across all sectors.

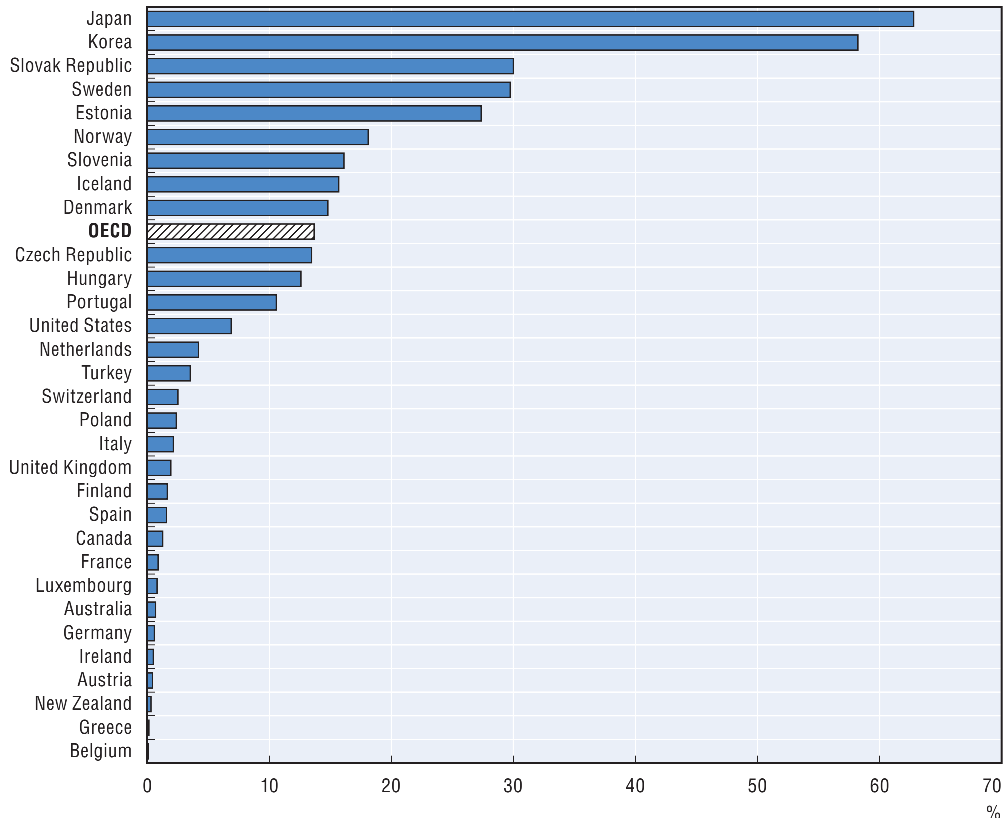
Broadband has thus become a key focus of government policy makers. Many governments seeking to increase private sector investment in high-speed broadband networks have reviewed existing legal and regulatory frameworks so as to ensure the levels of investment necessary to achieve policy goals. Most governments have set targets as part of their plans, such as requiring certain levels of geographic coverage and minimum or average transmission speeds (*e.g.* 100 Mbps). Short-term targets include detailed explanations of the necessary requirements for their achievement, while longer-term targets are less specific to allow further refinement and development (OECD, 2011d).

Two key trends are emerging that will shape the near future of connectivity: *very-high-speed fibre connections* are being deployed closer to population areas and new *high-speed wireless connections* are spreading connectivity to an increasingly mobile population.

The upgrading of broadband subscriptions to fibre, so as to support much higher speeds, has begun in OECD countries (Figure 2.1). However, a recent assessment suggests that, with some notable exceptions, fibre-to-the-home/broadband (FTTH/B) deployment remains tentative or at an early stage. The exceptions are Korea and Japan, both of which have prioritised fibre deployment. Estonia, Japan, Korea, the Slovak Republic and Sweden lead the OECD in number of fibre subscriptions as a percentage of total wired broadband subscriptions (over 25%). Meanwhile, the Global FTTH Council reports that no more than 26 economies worldwide have at least 1% of their households connected to FTTH or fibre-to-the-building (FTTB), and of these only eight are G20 members (Global FTTH Council, 2011).

Figure 2.1. **Fibre broadband penetration, December 2011**

Percentage of fibre connections in total broadband subscriptions




*Note:* Includes fibre-to-the-home (FTTH) and fibre-to-the-building (FTTB or apartment LAN) connections. Some countries may have fibre, but have not reported figures so they are not included in the chart. See the OECD broadband portal for information on data sources and notes.

*Source:* OECD Broadband Portal, July 2012. StatLink http://dx.doi.org/10.1787/888932692942

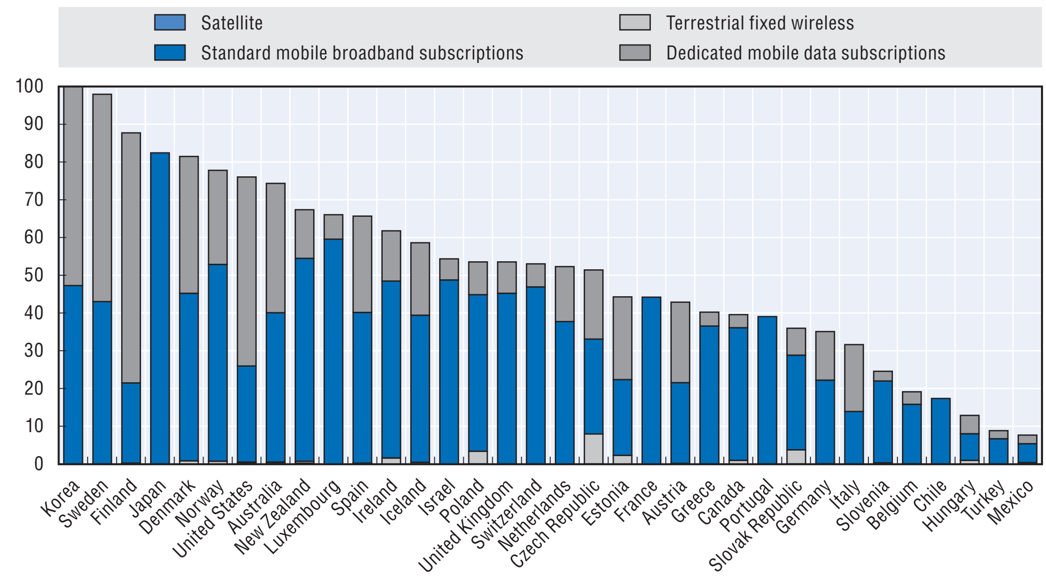
Fibre-based broadband connections offer the fastest data transfers, but it is the mobile segment of the Internet access market that has seen the most impressive growth over the last two years. Wireless broadband has quickly become the dominant broadband access channel in OECD countries. In December 2011, there were 315 million wired and 667 million wireless broadband subscriptions throughout the OECD. Standard mobile subscriptions with wireless broadband access outnumbered DSL subscriptions by two-to-one across the OECD. Finland, Japan, Korea and Sweden lead the OECD in terms of wireless broadband subscriptions per 100 inhabitants (Figure 2.2).

High-speed networks have become increasingly important for new services and applications. Indeed, the fusion of cloud computing, mobile devices and broadband are changing the way companies deal with computing resources and the way people perceive and use computer technology. Tablet PCs and smartphones are making computers ubiquitous, while cloud services and mobile Internet enable "everything/everywhere" data access.

The demand for high-speed bandwidth continues to climb and the breakdown of traffic is evolving. Traditional media broadcasting is transitioning to on-demand programmes, such as Internet TV and mobile audio and video streaming. According to Cisco, in 2010 global Internet video traffic surpassed global peer-to-peer (P2P) traffic, which has dominated networks over the past ten years. Cisco's Visual Networking Index (Cisco,

Figure 2.2. **OECD wireless broadband subscriptions per 100 inhabitants, December 2011**

By technology




*Note:* Standard mobile broadband subscriptions may include dedicated mobile data subscriptions when breakdowns are not available. See the OECD broadband portal for information on specific country notes.

Information on data for Israel: *http://dx.doi.org/10.1787/888932315602*.

*Source:* OECD Broadband Portal, July 2012.

StatLink *http://dx.doi.org/10.1787/888932692961*

2011) also predicts that by 2012 Internet video will account for over 50% of consumer Internet traffic. In 2010, video traffic accounted for 40% of total traffic and Cisco predicts that this will rise to 50% by the end of 2012 and 62% by 2015.

Wireless networks are also seeing large growth in traffic volumes. The use of unlimited data tariff plans, popular with many users, has stimulated traffic growth and raised questions over pricing structures on some mobile networks. In the United States, AT&T (and its affiliates), which had an exclusive handset arrangement with Apple for the iPhone, announced that it would move to tiered pricing for new customers, and would no longer offer a plan for unlimited data use. In response, some competitors stepped up their advertising for unlimited plans with rival smartphones. They also offered customers various choices to tether smartphones and portable devices, such as tablet computers, to their mobile handsets, with unlimited tariff plans.

Unlimited data plans undoubtedly encourage increased data usage and most likely the development of applications for smartphones. At the same time, increased use may challenge network capacity, requiring higher investment by operators to avoid network congestion. The extent to which data caps will curtail usage and network enhancements will match increasing data usage remains to be seen.

Next-generation mobile networks are currently being upgraded to support these new data demands. In the first quarter of 2011, the 3rd Generation Partnership Project (3GPP) announced the first implemented technology to meet the requirements of full-featured 4G technology: Long Term Evolution (LTE) Advanced (Parkvall *et al.*, 2008). Agilent demonstrated LTE at the Mobile World Congress 2011 (Agilent, 2011). The above requirements are known as International Mobile Telecommunications (IMT)-Advanced criteria and include: peak data rates of 100 Mbit/s for high mobility (train or car), up to 1 Gbit/s for low mobility (pedestrians and fixed-access points), and an all-IP packet switched network. LTE Advanced is competing with WiMAX-Advanced, currently under development at the Institute of Electrical and Electronics Engineers (IEEE, 2008).

Even though such systems are far from ready for large-scale market deployment, mobile telecommunication providers are selling many existing products under the 4G label that claim to offer high-speed Internet connectivity.

Another key trend affecting the Internet is the transition from IPv4 to IPv6. The ability of the Internet to scale to connect billions of people and devices relies upon the Internet Protocol (IP) system. This addressing protocol specifies how communications take place between one device and another. Each device must have an IP address in order to communicate. However, the current version, IPv4, is expected to run out of previously unallocated addresses in 2012.

Once this has happened, operators and service providers will need to migrate to the newer version of the Internet Protocol, IPv6, in order to add additional customers or devices to their networks. The only alternative is to employ complex and expensive layers of network address translation (NAT) to share scarce IPv4 addresses among multiple users and devices. For this reason, the timely deployment of IPv6 by network operators and content/application providers is an increasing priority for all Internet stakeholders. In terms of public policy, IPv6 plays an important role in enabling Internet growth to support further innovation. In addition, the depletion of IPv4 implies security, interoperability and competition issues (Perset, 2010).

The supply of available unallocated IPv4 addresses began to run out in February 2011, when the Internet Assigned Numbers Authority (IANA) allocated its remaining address blocks to regional registries. This has made the need to migrate to IPv6 more pressing.

There are numerous metrics for measuring IPv6 deployment, although meaningful data are hard to identify. All sources point to rising numbers of hosts and networks with native IPv6 support, but report the monitored IPv6 traffic share at less than 1%. This indicates that most ISPs and mobile operators do not yet offer IPv6 service to their customers.

### *Devices and operating systems*

Interaction with the Internet is based on a combination of hardware and software. Devices such as PCs, tablets and mobile phones provide the hardware for users to connect to the Internet, and serve as a platform for the software interface that guides interaction with information and content. This section examines some key developments in both hardware devices and the software platforms and operating systems that support the Internet economy.

### *Device trends*

Several seemingly contrary trends for emerging and upcoming computing devices in fact support a single paradigm shift. Hardware advancements are producing very powerful super-computers with extraordinary computing power. At the same, there is a current trend to transfer some computational requirements of mobile devices back into the cloud to reduce cost and improve battery performance (see the section on cloud computing later in the chapter for more details).

In the first case, manufacturers, such as Hewlett Packard or Fujitsu, are developing very high-performance servers for massive parallel computation, for example, computers featuring 8 central processing units (CPUs) with 10 cores each (80 cores) and main memory of up to 4 terabytes (128 banks for 32GB memory). Some current products on the market make use of terabyte-scale main memory capacities, and many more applications are under development to take advantages of gains in computing power.

One of the most important developments in improving computational speed is the focus on in-memory database technology. This eliminates time-consuming access to disk access by storing and manipulating data in memory. This is a key component for the implementation of next-generation business analytics operating on real-time data. Analysts at Gartner expect 30% of analytic applications to use in-memory functions for add scale and computational speed by 2014. Gartner also estimate that by 2014, 30% of analytic applications will use proactive, predictive and forecasting capabilities based on real-time computation.

Examples of the second case include personal computing devices such as mobile phones and tablets, as well as a number of highly specialised embedded computers for applications, such as smart grids, and even smaller devices that enable sensor networks for various monitoring applications, for example, in environmental sensing, perimeter surveillance or agricultural monitoring.

Together these two trends describe a shift in computational capabilities from the desktop to central instances (on-premise servers or the cloud), while personal devices transform presentation tools and human-computer interfaces.

A state-of-the-art example of this paradigm shift and the influence of changes in device technology on application design is the triumvirate of Amazon's Kindle Fire tablet, Amazon Cloud Services and the Amazon Silk browser (Amazon, 2011b) (Box 2.1).

### Box 2.1. **Amazon's Kindle Fire browser: Using cloud computing to display web pages faster**

Traditional browser software employs HTTP communication to obtain resources (HTML code, images, CSS layout styles and JavaScript) to render a website as presented to users. New technologies for website layout mean that rendering has become a computing-intensive task. The increasing dissemination of HTML 5 and CSS 3 will place even higher demands on browser rendering engines, in particular, the use of substantial visual effects and animation on webpages, which are then rendered natively in the browsers. Amazon's Silk browser project for the Android operating system presents a solution for higher computing demands to mobile devices: the Silk browser need not perform all the rendering tasks locally on the mobile device, but can make use of the Amazon cloud to execute expensive computation tasks. In this case, the browser is used just for the presentation of the output results rendered in the cloud.

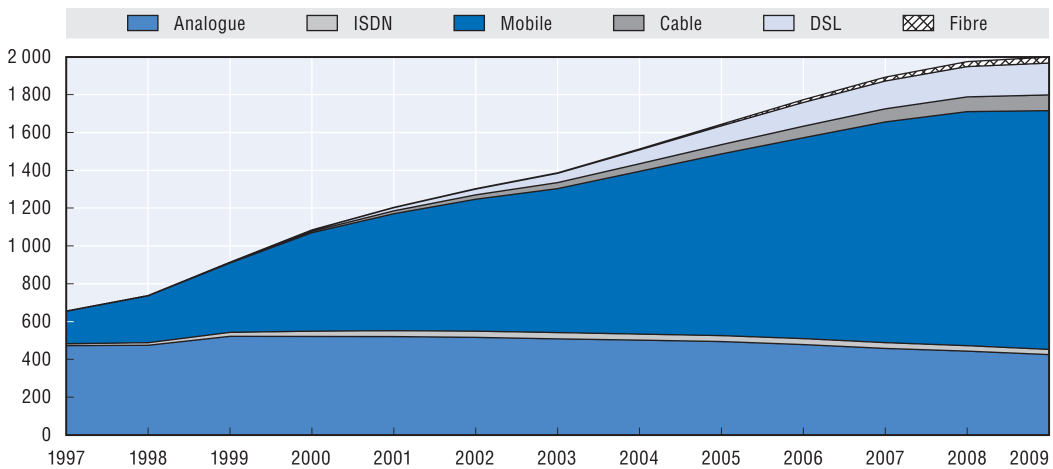
Another key trend is the increasing use of mobile devices connected to the Internet. Initially, mobile Internet connections were largely linked to mobile phones, and later, to dongles for personal computers. However, the rapid growth of tablet computers has changed the landscape.

Mobiles phones still constitute the most prevalent communication path, both in OECD countries and worldwide (Figure 2.3). As such, the mobile phone remains the communication path with the largest potential to extend Internet connectivity, as users upgrade previous "feature phones" to new smartphones with applications that rely on Internet connectivity.

The upgrade of mobile phones to smartphones has been brisk with analysts projecting that smartphones will cross the 50% penetration line in the United States for the first time in late 2012 (Kellogg, 2011; Waterfall Mobile, 2011). Figure 2.4 shows that the uptake of smartphone users started to be more significant by the end of 2009 with a smartphone

Figure 2.3. **Total fixed line, mobile and broadband access paths**

Subscriber access (millions)

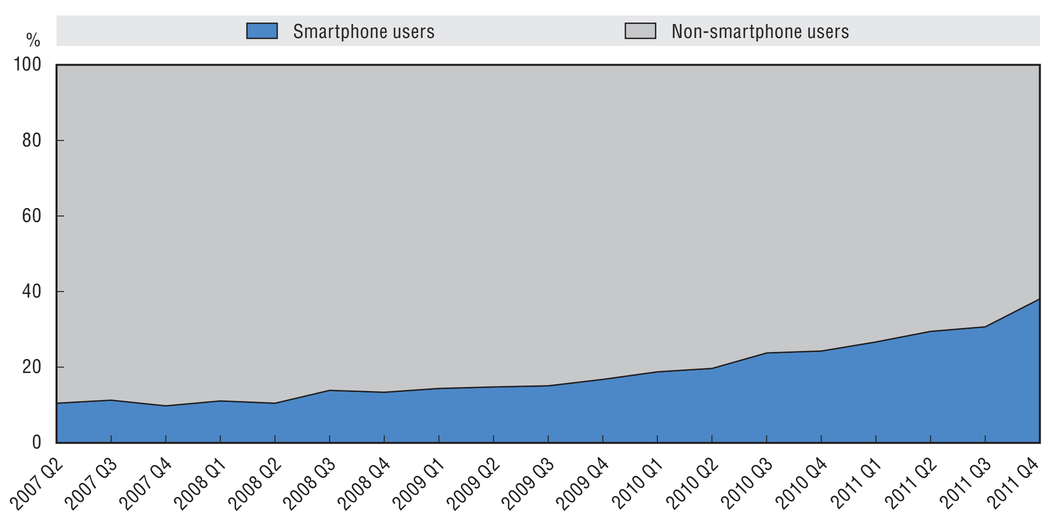



*Source:* *OECD Communications Outlook 2011*, OECD, Paris

StatLink http://dx.doi.org/10.1787/888932692980

Figure 2.4. **US smartphone penetration, Q2 2007-Q4 2011**

Percentage of total mobile phones




*Source:* Based on Dediu, H. (2012), "The US Smartphone Landscape", Asymco, June 2012.

StatLink http://dx.doi.org/10.1787/888932692999

penetration of 17%. By the end of 2011, this rate had doubled, reaching 38% (Dediu, 2012). Smartphone penetration has also been faster in certain segments of the population. For example, smartphone penetration is as high as 62% among users in the United States between the ages of 25 to 34 (Waterfall Mobile, 2011).

The rapid adoption of smartphones throughout OECD countries will continue as their prices decline. Inexpensive Android-based smartphones from providers such as Huawei are available in some markets for as low as USD 75 (SIM unlocked and without a contract). Even popular smartphones such as Apple's iPhone 3GS are now available for free (with a handset subsidy) from various operators with a two-year contract. The same applies for a number of 2010 and 2011 Android-driven smartphones.

While smartphones will remain the dominant access path for mobile connectivity for some time, the growth of tablets has been rapid and new devices are increasing market competition, which will likely usher in lower prices for consumers and increased penetration. Tablets do not seem to be displacing mobile phones, but rather laptop computers. For example, Gartner predicts that "by 2015, media tablet shipments will account for roughly 50% of laptop shipments" (Cooney, 2011). Already in 2011, analysts noted a significant drop in PC (laptop + desktop) sales. Gartner has found a global PC shipment drop rate of 1.1% in Q1 of 2011, compared to the same period in 2010, while IDC calculates a 3.2% decline. Laptops comprise a major share of the decrease in sales, while desktop PC shipments remains relatively stable. Both analysts identify tablets as the cause of weak sales figures: "With the launch of the iPad2 in February, more consumers switched to buying an alternative device, or simply held back from buying PCs" (Gartner, 2011a; IDC, 2011a).

Consumers are increasingly carrying one or more devices that offer Internet connectivity, and it is becoming more common for these to be used both in the home and work environments. In the past, people typically used different devices in different settings. But devices today tend to be more personalised and tied to important services that people use throughout the day. This is one reason behind the growth of the "bring your own device" (BYOD) culture in businesses and schools.

Companies are currently evaluating the benefits of BYOD environments (higher productivity, employer satisfaction, lower training costs) against the downsides, which include a more heterogeneous IT infrastructure posing new challenges for IT departments. The introduction of private laptops in the workplace also raises security concerns, but the use of virtual machines is helping to support the use of different devices in various settings. A virtual machine is a piece of software that emulates a physical computing environment. The benefit is that multiple virtual machines can run simultaneously on the same hardware.

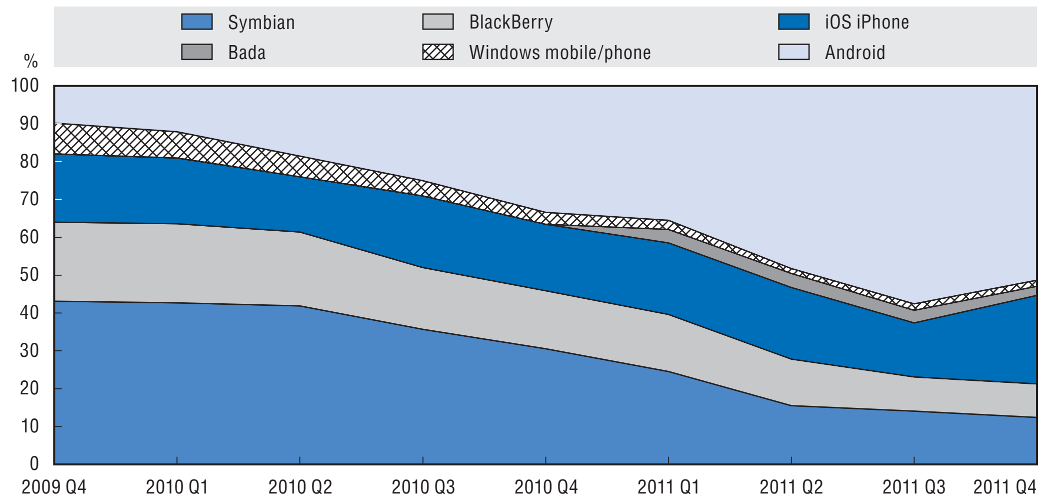
One key technological enhancement for laptops in this regard is the integration of bare-metal (type 1) client hypervisors. These act as the "go-between" for virtual machines and the hardware platforms that support them. These hypervisors allow companies to deliver a workplace desktop as a virtual machine image that can be run directly on a user's personal laptop or tablet computer. Malware infecting operating systems used for private use, which are kept on the same device, cannot harm the centrally maintained company desktop. Software solutions already exist from Citrix (*XenDesktop* and *XenClient*).

### *Platforms/operating systems*

There have also been significant shifts in operating systems for Internet-connected devices, in particular, in the mobile sector. The last two years have witnessed a significant transformation in mobile platforms. Android, an open-source software stack for mobile devices from Google, has emerged as the new dominant platform, quickly capturing 50% of the overall smartphone market share. Apple's iOS operating system has grown its market share, while other operating systems, such as Blackberry, Symbian and Windows Mobile have seen significant declines in market share since the last quarter of 2009 (Figure 2.5).

Desktop platforms are also evolving and there will likely be convergence between desktop and mobile platforms in the future. One example of this trend is Apple's release of Mac OS X 10.7 (Lion) for desktop computers. The changes since the previous release (Snow Leopard) imply that Apple may be moving towards a converged product with an operating system based around the ways users interact with hardware. Apple has now aligned gestures in both Mac OS X and iOS (see Box 2.2). It also introduced an App store for desktop computers following the successful App store for mobile devices that run iOS.

Figure 2.5. **Platform shares for installed base of US smartphones**




*Source:* Based on Dediu, H. (2012), "The US Smartphone Landscape", Asymco, June 2012.

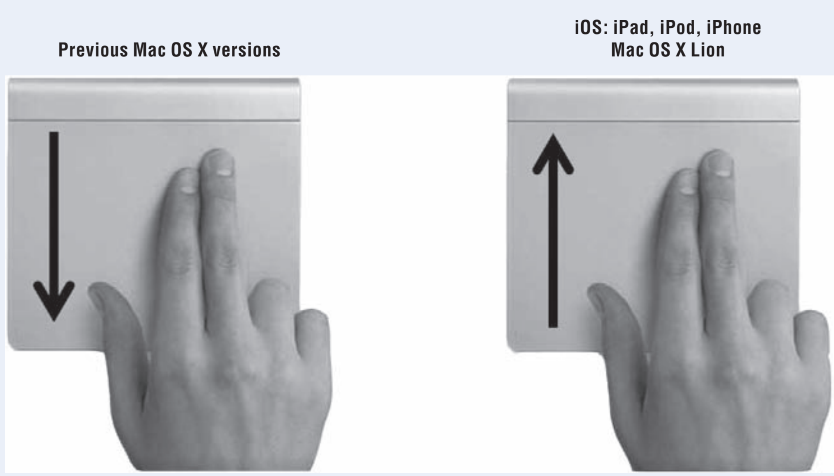
StatLink http://dx.doi.org/10.1787/888932693018

Box 2.2. **Mouse gestures: the effect of tablet use on personal computers**

Apple recently changed the touchpad mouse gestures of its Mac OS X operating system. Previously, pulling two fingers toward the user would scroll down a page. However, Apple's iOS platform for mobiles employed a different gesture: users would push up with two fingers to move down in a document.

The introduction of Mac OS X Lion finally aligned the gestures in the two operating systems by choosing the gesture familiar to iOS users. The change highlights the convergence between desktop and mobile devices, which is likely to continue over the next few years.

Figure 2.6. **Gesture for scrolling down on a page**




*Source:* Modified by OECD. Original graphic from Apple.com.

Microsoft's roadmap for Windows also follows this trend. Windows 8, due for release in 2012, will include a default user interface that constitutes a progression of the current Windows Phone desktop. It is being designed not only for traditional desktops and notebook PCs, but also for tablets. Some analysts are predicting that Windows Phone apps will directly run on Windows 8 (Schonfeld, 2011).

Google is also focusing heavily on convergence, its CEO stating that: "convergence lies in the heart of Google's mobile OS road map" (Lomas, 2011). Chrome OS and Android will eventually merge into a single operating system.

One of the key supporting elements of this convergence is the emergence of application distribution platforms, or "app stores". The launch of Apple's iOS and Google's Android introduced large numbers of users to these markets. Popular app markets now include the App Store for iOS, the Android Market, Amazon's Appstore for Android, the Blackberry App World and Windows Phone Marketplace. Google's Android Market reached 10 billion downloads in December 2011 and adds approximately an additional billion downloads each month (TechCrunch, 2011).

App stores have proved very popular with mobile phone users and the experience is now moving to desktop computing. Apple's App Store for Mac (personal computers) reached 100 million downloads in less than a year of operation, making it the "largest and fastest growing PC software store in the world" according to Apple (Apple, 2011b). Google offers the Chrome Web Store with applications for Chrome OS and the Chrome Browser platform, while Microsoft announced the upcoming Windows 8 App Store (NIST, 2010). One way to gauge the growth of this phenomenon is to consider terminology: in a few years the phrase used to describe application software has changed from "program" or "application" to "app".

The new shape of distribution platforms changes the way in which software is bought and sold. Software delivered on a data carrier with license keys printed on paper is now an exception to the rule. App stores actually bring a number of benefits for consumer: app licenses are stored in the respective app store account and are easy to locate; and apps themselves can be installed, removed and reinstalled on demand and on any device. In many cases, app store customers are less concerned about malware or spyware, because the apps provided in the online stores are reviewed by the company operating the platform before being offered.

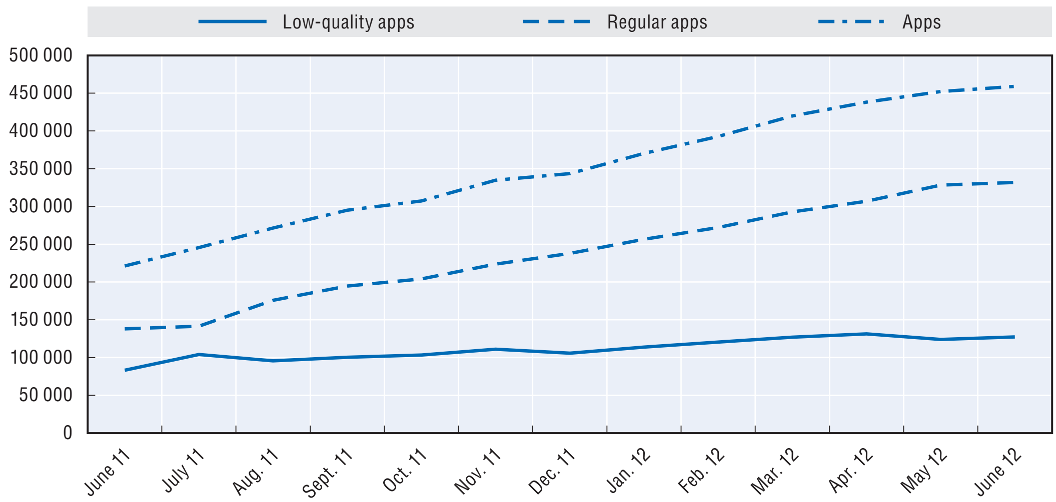
The app store paradigm also provides an important market opportunity for small software vendors without their own distribution channel. The image editing application *Pixelmator* originated in Lithuania and grossed USD 1 million on the App Store for Mac within just 20 days. A potential downside of software distribution via these digital platforms is the control that the operating companies retain over acceptance or rejection of apps submitted for distribution in their store. Some vendors report that their products are rejected for elusive reasons.

### *Services*

The emergence of fast Internet networks, paired with new platforms and operating systems, has helped form a dynamic ecosystem for new and innovative services. In June 2012, the Android Market reached more than 450 000 apps available for download, from which 27% were classified as low-quality apps (Figure 2.7). This has spurred the development of service applications.

Figure 2.7. **Android apps available on the Android Market, June 2012**

Total number of apps




*Note:* Google occasionally removes apps from the Android Market, which causes the total number of available apps to sometimes decrease. AppBrain subdivides apps into regular and low-quality ones.

*Source:* Based on AppBrain (2012) "Number of available Android applications", March 2012.

StatLink http://dx.doi.org/10.1787/888932693037

These new services are available in a large number of different areas. Moreover, new and specialised apps are constantly appearing. The Apple App Store lists 21 categories of apps on its iOS platform, while Google's Android Market has 25 categories with a separate breakdown within the games segment (Table 2.1).

Table 2.1. **Application categories in Apple's App Store and Google's Android Market**

| Apple App Store | Android Market Applications | Android Market Games |
|---|---|---|
| Books | Books & Reference | Arcade & Action |
| Business | Business | Brain & Puzzle |
| Education | Comics | Cards & Casino |
| Entertainment | Communication | Casual |
| Finance | Education | Live Wallpaper |
| Games | Entertainment | Racing |
| Health & Fitness | Finance | Sports Games |
| Lifestyle | Health & Fitness | Widgets |
| Medical | Libraries & Demo | |
| Music | Lifestyle | |
| Navigation | Live Wallpaper | |
| News | Media & Video | |
| Newsstand | Medical | |
| Photo & Video | Music & Audio | |
| Productivity | News & Magazines | |
| Reference | Personalisation | |
| Social Networking | Photography | |
| Sports | Productivity | |
| Travel | Shopping | |
| Utilities | Social | |
| Weather | Sports Games | |
| | Tools | |
| | Transportation | |
| | Travel & Local | |
| | Weather | |

StatLink http://dx.doi.org/10.1787/888932694899

The breadth of applications, as seen by the sheer number of categories in each of the app stores, highlights the difficulty in selecting specific service trends within the sector. This section focuses on three key types of services that are evolving, and which have the potential to significantly change user-device interaction and influence the economy at large. They include: new location-based services, augmented reality and relationship management tools.

### *Location-based services*

Location-based services rely on technologies such as GPS, Wi-Fi databases or mobile cell tower details to determine the location of users and tailor services accordingly. The development of location-based services is strongly connected to the rapid growth of smartphones and tablets, as GPS chips and technology have become a common feature in mobile devices. The latest Pew Research Center survey (Zickuhr and Smith, 2011) shows that 23% of American adults (55% of smartphone users) use mobile and social location-based services. Nearly all of them use services to obtain location-based directions and recommendations, while 12% of smartphone owners also use geosocial services (*e.g.* Foursquare, Facebook Places) and location-based tagging (*e.g.* for Twitter).

At present, mature location-based services such as traffic navigation (driving direction and public transport) or location-based recommendations (Yelp, Qype, etc.) are the most used. In some cases, location-based services have the potential to significantly alter existing markets, making them more efficient by combining location information with specific communication services (Box 2.3).

Location information is finding its way into many applications beyond transportation or navigation. One example is location-based reminders, such as those introduced by Apple with the release of iOS 5 (Weigert, 2011). iPhone owners can now define reminders that are triggered by leaving or reaching a specified location. For example, the application can initiate a reminder to stop and buy bread when the person leaves work. Several location-aware reminder apps are available on the Android Market, including *RemindThat*, *Location Alert* and *ByTheWay GPS Reminders*.

Location-based services will likely grow in importance and new applications will emerge to better tailor a wide range of services to individuals and businesses. Telecommunication operators are particularly interested in the potential of location-based services as a way to leverage their relationships with subscribers and develop new, higher-level revenue streams.

### *Augmented reality (AR)*

Another emerging technology related to location-based services and enabled through the rising computational power of modern smartphones is mobile augmented reality (AR) applications. While the first mobile AR applications in the field of gaming and product marketing were primarily technology showcases, modern applications clearly show useful functionality, especially in the area of travel guidance and direction. Examples include mobile applications that allow users to find the nearest public transport stops (*e.g. Next Subway* or *Fahrinfo-Berlin* for the iPhone), or apps where users can store and memorise the position of their parked car.

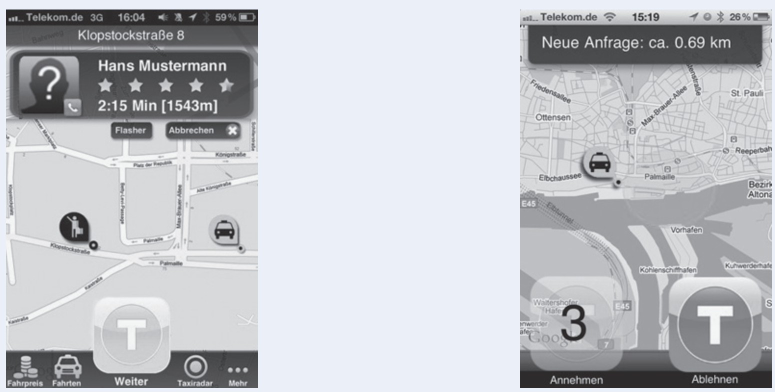
Another very promising use case is the *Layar* AR browser. Like most mobile AR applications, the browser uses the mobile phone's sensor data (*e.g.* the camera, GPS and digital compass) to identify the user's location and field of view. By using the geographical position, various layers of data are inserted over the camera view. The data used to augment the browser view is third-party content, provided via a public Application

### Box 2.3. **Revolution of the taxi business**

Taxi passenger applications, such as *MyTaxi* (available for iOS and Android), are an example of successful businesses enabled by mobile Internet in combination with location-based services (Treiss, 2011). The mobile application allows passengers to locate their position (via GPS), select options for a taxi (*e.g.* credit card payment, taxi-van, minimum rating or specific driver/taxi company), and order the closest matching taxi. The user can track the taxi's progress and receive information on the driver, arrival time and remaining distance. Users can also rate taxis and drivers after a trip (or an unfulfilled request).

Figure 2.8. ***MyTaxi* passenger app (left) and *Driver App* (right)**

***MyTaxi* passenger app** | ***Driver App***




*Source: http://myTaxi.net.*

The taxi drivers use a smartphone to run the driver's variant of the application, which informs them of trip requests within their current radius of service. The driver has 3 seconds to read the request and an additional 3 seconds to accept the request. If confirmation is not given within this period, the request is passed to the next driver in range. Taxi drivers pay a fee of approximately EUR 0.80 to Intelligent Apps for each trip.

This method of booking taxis dispenses with the need for traditional taxi offices. Passengers and taxi drivers deal directly with one other via an intelligent platform. There are clear benefits for both parties: passengers can profit from and provide feedback on their trip, and drivers can significantly reduce the monthly fee payable to taxi offices for radio dispatch, in addition to the fee for each tour. These services are already forcing changes in the taxi dispatch market and have put pressure on drivers to offer a higher level of service (DiePresse, 2011; Weigert, 2011). Both reactions are strong indicators of the impact that ICTs are having in just one specific market.

*MyTaxi* shows how an emerging service enabled by mature technology with large-scale dissemination (mobile Internet on smartphones) can massively influence a very traditional business.

Programming Interface (API). As of September 2011, *Layar* had roughly 3 000 layers, which shows a growth of 200% in one year. Layers can be created for many different purposes, including: tourist information at points of interest, augmented camera views of buildings with price estimations for apartments for rent or sale (Figure 2.9), or enhancing data artefacts with geotags from social media applications such as photos from *Flickr* or *Panoramio*, tweets and social recommendations. In 2010, the World Economic Forum named the Dutch company Layar a 2011 Technology Pioneer (Grose, 2011).

Figure 2.9. ***Layar* AR browser displaying estimated apartment prices**


*Source: www.meilleursagents.com.*

The enhancement of mobile AR with social media data highlights an important trend for the future development of social networks. Augmented reality applications such as the TAT app *Augmented ID* combine facial recognition capabilities with links to relevant information from social networking and other data-sharing sites. Users are able to choose which of their social networking profiles are displayed when anyone else uses the software to identify them using their phone's camera (Figure 2.10). For example, a user may select different profiles to be shown during working hours and another on weekends. In academia, these new developments have been called "the context of reality" (Buckland and Langley, 2011).

Figure 2.10. **Future of social networking with augmented reality**


### *Relationship management tools*

The growth of social media has been one of the most important Internet developments over the past two years. Online social networking and media services will continue to evolve over time, but one emerging trend is the advancement of social media monitoring as a way to develop better relationships with customers.

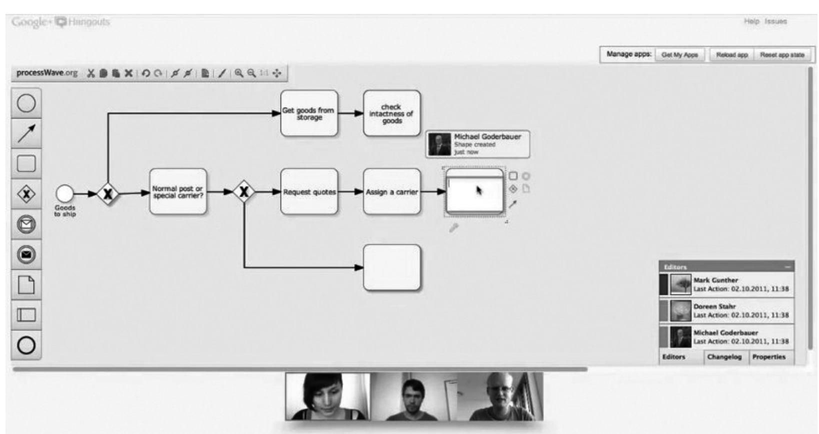
Social customer relationship management (CRM) is the use of social media services, techniques and technology by organisations to actively engage with customers. The variety of CRM applications cover marketing, customer services and sales, including peer-to-peer customer service, market research and brand reputation management.

The growth of social CRM is recent and relatively few data points are available to analyse its growth to date. Analysts at Gartner predict that the market for social CRM will surpass USD 1 billion in revenue by the end of 2012 (Gartner, 2011b). What is clear is that traditional CRM products will increasingly merge with social media as a way to improve client relationships. Dedicated analysis for monitored social network activity (such as return-on-investment analysis) will also be a future focus of social CRM.

Another important change in the social networking sector is the launch of new social network platforms, such as Google+ in 2011. Until recently, social networks focused on the individual, however, one of the key new trends is the use of social networking by groups, companies and organisations. Major platforms such as Google+ and Facebook include features that allow users to target updates to specific groups as a way to tailor information delivery. In the early days of online social networks, status updates were only shared with predefined friends. Now, social networks are making it much easier to share information with the public.

Social networks such as Google+ can play a useful role in project workflows. Collaborative features that use Google+ APIs can enhance productivity tools, as demonstrated by the Diagram Editor for Google Plus Hangouts (Goderbauer, 2011). Hangouts are multi-user video chats in Google+ (Figure 2.11).

Figure 2.11. **Diagram editor for Google+ Hangouts**




*Source:* Diagram Editor for Google+ Hangouts, *http://code.google.com/p/diagram-editor-for-google-plus/*.

The editor enables Google+ users to collaboratively create diagrams with their contacts while they videochat with them in a Google+ Hangout. Everyone can contribute to the diagram and all updates are displayed in real time. This is essentially a digital adaption of a classic collaborative working mode with local presence in a conference room where users edit the diagram on a whiteboard. The editor includes a number of diagram types. The editor tool example clearly shows that social networking can be used in application scenarios beyond marketing and customer relations, but also for company workflows.

Customer relationship management has always been a key element of business operations and intelligence. A promising trend cited by many analysts for the near future is mobile business apps on tablets and smartphones for CRM or business resource planning.

Executives from SAP (Systems, Applications and Products in Data Processing) stated at the 2011 Sapphire exhibition that: "the enterprise terminal of the future is a tablet or smartphone". SAP co-CEO Bill McDermott even noted that he could "run the company from an iPad" (Dignan, 2011). SAP's Sybase Mobile Sales for SAP CRM product for the iPad and Blackberry was released in 2010. Competitors such as Oracle (Oracle Mobile Sales Assistant, iPhone only) or salesforce.com (Salesforce Mobile CRM, iOS and Blackberry) also offer mobile CRM solutions.

## Internet developments across the economy

The following section looks at how networks, devices and services are being used in various sectors of the economy and society, including E-energy, the smart home, the future of work and learning environments, e-government, e-commerce and digital payment services.

### *Cloud computing*

The last two years have seen cloud computing emerge as one of the most important platforms for innovative new services. It is changing the way computing is done. Users no longer have to make significant, up-front investments in IT infrastructure and software, but can now pay for computing resources via a pay-as-you go model. Cloud computing providers have much lower operating costs than companies that run their own IT infrastructure. This is because of the global scale of cloud computing providers and the possibility to aggregate the demands of multiple users, especially in public clouds. Providers are able to provision computing resources in a rapid and elastic way allowing adaptation to changing requirements (OECD, forthcoming).

Currently, multiple definitions of cloud computing exist. For the purpose of OECD's work on cloud computing, cloud computing is defined as "as a service model for computing services based on a set of computing resources that can be accessed in a flexible, elastic, on-demand way with low management effort" (OECD, forthcoming). Cloud computing covers a whole range of services that can be further structured into three service models, and four deployment models (private, community, public and hybrid cloud) (Mell and Grance, 2011).

The service model defines the different layers of the traditional IT resource stack: infrastructure, platform and software. Infrastructure as a Service (IaaS) replaces the purchase of hardware like servers or storage. Platform as a Service (PaaS) provides a standardised middleware stack. Software-as-a-Service (SaaS) offerings in the cloud replace the traditional purchase and installation of software packages with subscription access to a managed environment.

The deployment model defines with whom IT resources are shared. Levels of sharing start with a single user via a private cloud service, then proceed to a limited number of defined and trusted users, and finally move to up-to-unlimited and general use. A hybrid cloud is a composition of several clouds (*e.g.* public or community). The latter approach benefits from multiple deployment models.

Cloud computing has grown in importance over the last few years (Box 2.4) and is not confined to storage or web-based services; computing-intensive desktop applications are also moving to the cloud. The shape of personal computing devices is changing from desktop workstations with extensive computational power to thin, mobile devices such as netbooks, tablets and slates, and of course mobile phones (Baudisch, 2010). One of the most advanced implementations of this paradigm is Google's Chromebook (Google, 2011). These Chrome OS-driven netbooks only run applications on the web (Software as a Service), which therefore results in very limited capabilities when offline. Smartphones and slate devices such as the iPad will behave similarly, as the newly introduced iCloud services imply (Apple, 2011a).

### Box 2.4. **DropBox: Relying on the cloud for a business model**

Dropbox is an example of a business model that relies on cloud computing to provide a data/storage intensive service without the need for its own data centre. Dropbox is a digital storage service provided by only 70 employees, but which serves an estimated 50 million users, with another user joining every second. The number of users has increased threefold from one year ago. The service has successfully employed a "freemium" business model (where basic services are provided for free and users can choose to pay for additional or expanded services) and is projected to reach USD 240 million in revenue in 2011, despite the fact that 96% of users have free accounts (Barret, 2011).

Dropbox was devised by an MIT student looking for a way to enable anywhere-access for files without a USB drive. Users have access to 2GB of free storage, while paying customers can obtain as much as 100 GB of space.

Dropbox has been able to accommodate its own rapid growth by relying on Amazon's Simple Storage Service (S3) in addition to the user's own computer. Amazon operates multiple data centres across the United States, and Dropbox's resources are spread out among them (NetHosting, 2011).

By relying on cloud computing infrastructure, Dropbox has created a backup, file-sharing and syncing service without needing to build its own data centre.

However, Dropbox also exemplifies the security challenges facing cloud computing. In June 2011, a problem in the service's authentication software made passwords optional for about four hours. This meant that anyone could access a user's account by simply entering the user name.

An additional driver of growth in cloud computing is the ever-increasing amount of data, which is predicted to outpace growth in storage capacity. Currently, it is very difficult to estimate future volume of data, but different estimates are being published. According to IDC Iview, the amount of digital information created and replicated is estimated to surpass 1.8 zettabytes[1] by the end of 2011, and this amount is supposed to more than double over the next two years. In addition, IDC estimate that nine times more information is available today than five years ago (IDC, 2011b).

The number of containers representing information (files) is growing faster than the information itself. According to the same study, the number of files will grow by a factor of eight over the next five years. In the next decade, the number of files will grow by a factor of 75, while the amount of information will grow by a factor of 50. At the same time, the number of servers needed to manage all the information will grow by a factor of 10 worldwide. This behaviour will result in a need for effective management of IT resources, and flexible and scalable IT infrastructure. Cloud technology may provide an opportunity for new tools for search and discovery, information classification and management, information security and even information disposal.

From an economic perspective, cloud computing significantly lowers the entry barriers for new firms entering the market in various sectors. It has the potential to become a veritable platform for innovation spurring the development of new products and services. In the context of innovation, cloud computing also facilitates online collaboration on a global basis. In addition, it is particularly interesting for SMEs, which are an important source of growth and innovation in many OECD member countries. Cloud computing enables them to save on investment costs, while benefiting from access to cutting-edge technology and services, including software updates. Large companies, institutions and governments are examining cloud computing as an important cost-saving option that reduces expenditure on IT infrastructure and services and ongoing maintenance costs (OECD, forthcoming).

There are a number of challenges and open issues concerning cloud computing that need to be addressed, however. Among these is privacy, including cross-border issues related to privacy protection (see below). Security is another key concern. It is essential that firms undertake a thorough and holistic risk management exercise, since cloud computing is the acme of networked computing. This is feasible for multinationals, but not necessarily for SMEs or consumers. Furthermore, the current terms and conditions of standard cloud computing contracts raise liability issues. An additional major open issue is the current lack of standards, especially in the area of platform as a service. Finally, cloud computing may also have structural implications for the IT sector, and it is likely that business models will have to change or risk becoming obsolete.

### *The role of governments and government policy*

In addition to businesses, governments also see cloud computing as an opportunity to save costs. The twin pressures of reduced budgets and the need for greater efficiency have led the US federal government to strongly promote cloud computing as a solution whenever possible. The US Office of Management and Budget in December 2010 declared that the government now operates under a cloud-first policy, meaning that agencies must first try to incorporate some type of cloud computing into projects. If they choose not to use a cloud scenario, they must justify their decision. Various vendors provide private clouds to the US government, including IBM, Hewlett-Packard, Lockheed Martin and Oracle. Examples of cloud computing use by government-related agencies include the following:

- NATO's Allied Command Transformation, in concert with IBM, is developing a private, on-premise cloud for testing and developing network solutions for command, control, intelligence, surveillance and reconnaissance projects.
- Last year, the US Customs and Border Patrol agency started moving its collaboration software and e-mail services to a private cloud inside of one of the Homeland Security Department's data centres.
- The US Los Alamos National Laboratory has implemented a private cloud with HP technology that allows researchers to use servers on demand.
- The US Department of Energy (DOE) is exploring the cloud concept with its federal partners to identify opportunities to provide better service at lower cost through cloud services.

Other examples of cloud computing deployment by governments and non-profit organisations in Europe include OPTIMIS, launched by the European Commission, EuroCloud and the trusted cloud initiative in Germany.

In 2010, the European Commission launched the OPTIMIS project to enable an open and dependable Cloud Service Ecosystem that delivers IT services that are adaptable, reliable, auditable and sustainable (ecological and economical) (OPTIMIS, 2011). The funding of the initiative amounted to EUR 10.4 million (USD 13.83 million). The key goal is to allow organisations to automatically and seamlessly externalise services and applications to trustworthy and auditable cloud providers.

EuroCloud is another European initiative. This independent non-profit organisation comprises a two-tier setup whereby European countries may participate as long as they respect the EuroCloud statutes. In less than two years, 27 countries have acquired a EuroCloud presence and 17 European countries have a formally established local EuroCloud (EuroCloud, 2012). The initiative aims to create transparency for the various cloud service offerings and support for providers and users with regard to the numerous questions relating to security, law and compliance.

### Box 2.5. **Germany's TrustedCloud programme**

One example of the future relevance of cloud computing to individual governments is Germany's "TrustedCloud" programme. The German Federal Ministry of Economics and Technology (BMWi) uses the programme to promote 14 technology projects, each addressing IT security and data protection issues at different levels of the IT resource stack. Over the next 3.5 years around EUR 100 million (USD 133 million) will be available to support the development and testing of innovative, secure and legal cloud solutions. BMWi will contribute approximately EUR 50 million (USD 66.5 million) and project partners will contributed the remainder. One of the projects is the "Sealed Cloud", which aims to provide a "sealed" or extremely secure infrastructure for cloud solutions to eliminate the risk of unauthorised access to hosted resources. The system design prevents even the cloud provider from accessing customer data.

*Source: www.bmwi.de/BMWi/Navigation/Service/Projekte-und-Wettbewerbe/Archiv/trusted-cloud.html.*

Given the positive impacts of cloud computing, but also the inherent challenges, policy makers have an important role to play in a multitude of areas (OECD 2012):

- **Spurring the use of cloud computing.** Governments have a key role to play in this regard, by acting as lead users, fostering skills and education, supporting R&D projects, and establishing public-private partnerships.
- **Standardisation.** A major challenge is the lack of standards and the fear of vendor lock-in. Governments could encourage the development of cloud computing interoperation standards as well as open source clouds.
- **Measurement of cloud computing.** At present, there is a lack of data on the field of cloud computing. Policy makers could help develop a framework for the measurement of cloud computing.
- **Cloud computing for development.** Cloud computing constitutes an important tool for organisations and consumers in developing countries. However, certain challenges must be addressed, such as the availability of network infrastructure. Policy makers have a role to play in spurring the development of cloud computing and the adaptation of cloud services in developing countries.
- **Broadband infrastructure.** With the growth of cloud computing, demand for bandwidth is expected to increase significantly. Policy makers should promote flexible network technologies and topologies, and spur competition to develop future solutions that promote increased bandwidth.

- **Trade and competition implications.** It is probably too early to evaluate the trade and competition implications of cloud computing. However, policy makers should keep potential trade and competition issues in the area of cloud computing in mind, such as the possible implications of a future cloud computing market dominated by few companies.
- **Tax implications.** Policy makers have a direct role to play in dealing with the tax implications of cloud computing, mainly seen as related to record-keeping requirements and possible tax evasion.
- **Contractual issues.** Certain challenges remain regarding standard cloud computing contracts. For example, policy makers could urge cloud-computing providers to do more in the area of privacy and security. In addition, service-level agreements should address service outages and propose concrete remedies.
- **Security and risk management.** The starting point for cloud-computing security assessments is that cloud computing is not a completely new technology. Consequently, a new security approach is not necessarily required. The OECD Guidelines for the Security of Information Systems and Networks towards a Culture of Security (2002) provide a valuable approach to dealing with cloud computing security challenges. They highlight four fundamental principles: *i)* risk assessment; *ii)* risk management; *iii)* security design and implementation; and *iv)* risk reassessment.
- **Privacy.** A global approach to privacy that is harmonised among governments would facilitate the deployment of cloud computing. In particular, policy makers should address questions of which legal authorities have access to data in the cloud, whose laws apply to the data stored in the cloud, and under which circumstances data processing in the cloud amounts to a cross-border transfer, implicating data protection laws in some countries. In addition, individuals that conduct substantial online activities through cloud-based services will face identity management challenges.

#### *Smart energy*

Global energy challenges are immense. Over the past three decades, global energy production and consumption have accelerated to unprecedented levels. Between 1973 and 2008, total energy production has basically doubled (OECD calculations based on IEA World Energy Statistics and OECD, 2012a). This is problematic because close to 70% of global energy demand is satisfied using energy generated from sources that emit relatively large amounts of greenhouse gases (*e.g.* carbon dioxide). The energy supply sector, which is responsible for one quarter of global greenhouse gas (GHG) emissions, has therefore become a major target of climate change mitigation action (IPCC, 2007).

Electricity is a pivotal element in understanding global energy challenges. Electricity by itself and its consumption does not emit greenhouse gas emissions. It is an energy carrier, an intermediary between the supply of primary energy sources (*e.g.* coal) and the demand for energy-using services (*e.g.* transport, heating and lighting). In fact, electricity is one of the main energy carriers used around the world for residential, commercial and industrial processes.

The smart grid has great potential to drive innovation in the ways electricity is produced, managed and consumed, as it relies on communication channels largely provided over Internet data networks (OECD, 2012a). The application of ICTs and opportunities provided by the Internet can help sustain electricity supply while limiting environmental impacts. ICTs are seen as promoting a wider integration of renewable energy sources, promoting low-carbon transport options including electric vehicles, and inducting structural shifts in electricity consumption.

Political interest and media coverage regarding the smart grid is increasing, comparable to cloud computing. However, both topics are difficult to define and the potential impact on future markets and society is not yet fully recognised.

Smart grids are typically described as electricity systems complemented by communications networks, monitoring and control systems, "smart" devices and end-user interfaces (OECD, 2009, 2010, 2012a). The International Energy Agency (IEA) proposes a definition that blends both functions and components:

A smart grid is an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end-users. Smart grids co-ordinate the needs and capabilities of all generators, grid operators, end-users and electricity market stakeholders to operate all parts of the system as efficiently as possible, minimising costs and environmental impacts while maximising system reliability, resilience and stability (IEA, 2011).

The United States' National Institute of Standards and Technology (NIST) defines the smart grid as a modernised, better protected, optimised and self-healing infrastructure with bidirectional communication between all components involved in the system. In the smart grid, existing electrical networks and communications technologies are linked to a distributed infrastructure to form a new intelligent system, in which a large number of producers, consumers and storage facilities act on the extremely complex energy market. NIST also call the smart grid "the world's largest and most complex machine" (NIST, 2010).

The smart grid is expected to significantly lower electricity-related greenhouse gas emissions in the future. Direct reductions are typically attributed to more efficient processes in electricity generation, transmission and distribution, as well as to energy conservation at customer sites. Indirect reductions are expected in the sense that the smart grid will facilitate wider diffusion of renewable energy sources as well as their integration with the wider uptake of electric vehicles.

However, national roadmaps that concern the smart grid make clear that this technology will not be fully developed by the end of the decade. It will take time to address the many challenges (and opportunities) related to international standardisation, regulation and implementation, to enable the world's largest machine to work. Experts expect the first national smart grids to be established in the 2020s (*e.g.* in Germany (Niemand, 2011)). While the IEA general roadmap for interconnected smart grids on the global energy market is projected through to 2050 (IEA, 2011).

Furthermore, many of the discussions surrounding smart grid deployment in 2011 concerned Advanced Metering Infrastructures (AMI). These projects mainly cover the installation of smart metering devices in test region households, and gather metre data using the prototypical metre data management systems of energy providers, who run the test deployments. Efforts in smart metre deployment can be observed in many OECD countries. Sweden is one of the leading countries in the OECD, achieving a 100% smart metre rollout in July 2010.

Yet smart metre deployment is just one component of a smart grid. Smart metre deployment provides the information leverage needed to support advanced smart grid applications. One of the first applications to reach mature development will be energy information display (EID) technology for home energy management. EIDs are designed to raise awareness of energy use among customers. Companies such as General Electric provide comprehensive software, while the Google PowerMeter and Microsoft Hohm have been discontinued due to slow market adoption. Nevertheless, the Google and Microsoft experiences highlight the importance of visualising energy information for customers. Studies show that informed customers were able to reduce energy use by up to 15% (Darby, 2006). Sophisticated solutions for home energy management visualisation will be an important part of the future smart home.

Other trends for smart grid applications focus on energy providers and cover distribution automation, data analytics, demand response and carbon management (Wheelock *et al.*, 2011). Distribution automation concerns technologies that sense, monitor, report, control and automate the operation of the energy distribution network, and thereby integrate advanced metering infrastructure into the electricity grid. The driving forces for such projects include expected reliability improvements due to the ability to remotely control field devices, and the possibility to optimise electricity distribution.

Smart grids will also create substantial real-time data that will need analysing to allow informed decisions on realising potential efficiency gains. Technologies such as in-memory technology and massive parallel computation will likely provide support for smart grids in this regard.

Large data collections directly from the smart grid will form a key part of business data intelligence for energy firms. Currently, each subsystem of the utility system, such as metre data management (MDM) systems and distribution management systems (DMS), has its own analytics technologies. This will likely change over time as IT firms with analytics expertise enter the market and provide comprehensive analytics tools for the whole set of smart grid data. Analysed data can help operators gain insight into infrastructure operation, as well as forecast load, improve reliability, and determine business risks for energy providers and make available advanced energy advice for consumers.

In terms of a timetable, currently available smart grid applications such as ICT solutions can help provide information on household electricity use and the digital energy marketplace. Other fields of research and development that rely on electrical and mechanical engineering to support efficient smart grids are still in the early stages, and are not expected to reach maturity in the near future.

Furthermore, the growing cost of fuel and the negative effects on the environment caused by conventional energy production are convincing more people to produce electricity at home. The desire to save money and provide environmentally sustainable energy is resulting in increasing number of private households becoming producers of renewable energy.

A significant technical and financial outlay is required to store and/or transport such generated energy over greater distances. From an economic perspective it is more beneficial to utilise this energy both locally and promptly. However, this requires a system that can cope with excess production at short notice. While no widespread solution to this problem is currently available, this is an area of significant research and could see developments in the next few years.

In Germany, for example, an ongoing technology project called the "Peer Energy Cloud" aims to provide a virtual market place for local power trading. The project also aims to develop new recordings and forecast methods within a so-called "micro grid". The integration of local sensors and actuators at end-user locations, via fiber-optic cable, would enable new services to access usage data in real-time, which can then be used, for example, to generate forecasts.

The use of household-related context information can result in additional added value. Examples include adjusting refuse collection dates and frequency in line with actual requirements, or providing dynamic price models that support energy utilisation geared towards the actual situation. A specific case is currently under review relating to a micro grid in the city of Saarlouis. The grid consists of approximately 500 housing units and numerous photovoltaic facilities. The German Federal Ministry of Economics and Technology (BMWi) is promoting the initiative in the context of the TrustedCloud programme (Der neue Personalausweis, 2010).

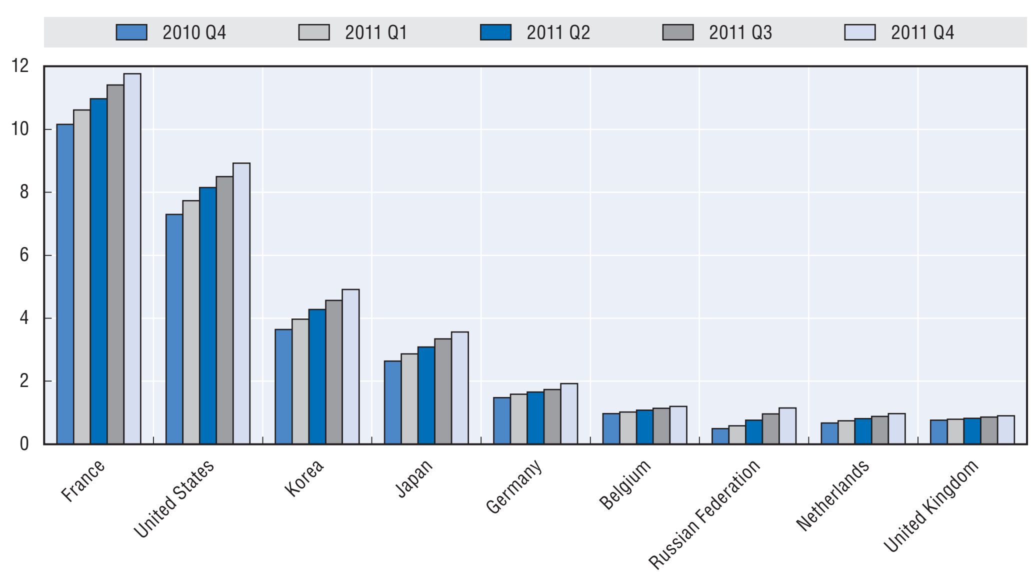
### *Smart home*

The smart homes of the (near) future will integrate a large variety of home automation technology. Since electric device control uses the same communication bus systems or wireless technologies as smart metres both the smart grid and advanced metering technologies will play a role. In addition, home displays for energy monitoring will likely converge with multi-purpose home control devices and become apps for mobile devices (CEDIA, 2011). General Electric is one of the leading providers in home energy management systems and already offers a smartphone app for energy monitoring and thermostat controls based on their Nucleus system.

In addition to monitoring electricity consumption, another important element of smart homes will be home entertainment. Television and video delivery are largely moving onto the Internet and this creates significant opportunities for converged displays for the entire home via a mobile phone, laptop, tablet or television. This convergence is already taking place. The French market leads the OECD area with nearly 12 million IPTV subscribers who receive traditional television signals over a broadband line, allowing for a much richer and interactive viewing experience (Figure 2.12). France's strong performance relative to other European countries is largely down to the energy of new entrant

Figure 2.12. **Leading IPTV countries, Q4 2010-Q4 2011**

Million subscribers




*Source:* Based on Point Topic Ltd. (2012), IPTV: Short Report – Q4 2011. April 2012, Point Topic, London.

StatLink http://dx.doi.org/10.1787/888932693056

broadband operators that included IPTV in all inexpensive broadband bundles. However, China managed to overtake France for the first time in Q1 2011 and continued to grow ever since, reaching 13 million subscribers by the end of 2011 (Point Topic, 2012).

While the current economic crisis may dampen adoption rates of some new technologies, the shift from classic radio and TV devices to network-bound variants will likely continue for the next few years, led by IPTV dissemination. A new generation of devices will be integrated into home automation networks via the Internet-connected household. This applies to stationary devices as well as mobile ones.

Mobile devices and cloud computing will be two of the pillars supporting home automation. Industry experts predict a number of important future trends for the next few years, including the development of "integrated audio" or the ability to control the audio of individual rooms through a mobile device, often accessing content via the cloud (CEDIA, 2011). Consumers will be able to use wireless control via a mobile or tablet to manipulate home devices, such as the audio produced by installed speakers and amplifiers. Options in this category will grow significantly in the years ahead, while installation costs are expected to simultaneously decrease thanks to improvements in wireless technologies and cloud-based content. These developments in audio flexibility will also apply to video.

The year 2011 witnessed the introduction of a number of commercial audio services that use the cloud. Apple introduced a cloud-based service for music delivery that integrated iTunes and the iCloud through iTunes Match (Apple, 2011c). The application matches a local music library with Apple's iTunes Store and allows streaming playback of all matching titles from the cloud services to any device connected to the same iTunes user account. Amazon (with the Cloud Drive), mSpot and Google Music also offer cloud-based services for music streaming. All these services follow a similar approach: users upload their media files to a cloud storage service and then use a proprietary player application on their computers or mobile devices. In most cases, these services also allow users to stream video files in the same fashion.

These cloud-based services in combination with integrated audio hardware enable access to a centralised music library throughout the home (or anywhere with an Internet connection). Some existing products allow users with a portable device to play music played through other compatible devices in the home such as televisions and computers and stereo equipment. Examples include Sonos (Sonos, 2011) and Apple's AirPlay (in cooperation with major consumer audio companies like Denon, Marantz and JBL). These products use wireless networks to stream music to receivers (integrated speaker docks with streaming clients or stand-alone clients connected to existing hi-fi equipment). Consumers can configure and control the whole interconnected audio system from a central location. Users can playback different songs in different rooms, change the volume for each streaming client or synchronise music playback in every room by means of their personal mobile device. Manufacturers are also introducing their own apps for home audio control, for example, iTunes for Airplay-based installations and a legacy app for Sonos hardware. These integrate access to local music libraries, such as iTunes, and a number of streaming services (*e.g.* some Internet radio stations, social music services such as last.fm, and commercial streaming services such as Pandora, Spotify and Napster/Rhapsody).

Ten years ago, predictions for the entertainment system of the future envisioned a central home server that would host all content and share it among devices throughout the home. Some devices using this model have emerged, but the growth of cloud computing infrastructure has called into question the future dominance of the home-based server model. As broadband connections become more widespread, it is likely that digital content will shift largely to the cloud to be accessed via a streaming model. Legacy systems for home control may also be superseded by apps for mobile devices. Home owners will not only control their entertainment system, but also any other aspect of home automation, such as thermostats, security systems or energy management, from their smartphones or tablets.

An additional driving force for R&D in home automation is healthcare applications and services for older people and those with disabilities (see Chapter 6). Home automation is becoming a viable option for those who would prefer to stay in the comfort of their homes rather than move to a healthcare facility. This field uses much of the same technology and equipment as home automation for security, entertainment and energy conservation, but tailors it for this new market. Home automation for healthcare systems includes lighting and motion sensors, environmental controls, video cameras, automated timers, emergency assistance systems and alerts.

The next generation of technology in the home will be built to support health and wellness, not just assist in times of crisis. These systems can track long-term issues such as glucose levels and weight, monitor stress levels, and help individuals to identify which habits or daily practices to change to help lead a healthier lifestyle. Tools of this nature that are currently or will soon be available include automated pill dispensers that provide scheduled alerts for medication, wireless motion sensors that detect when one is up and moving, or networked diagnostic devices, such as heart rate and blood pressure sensors.

Novel human-computer interfaces such as touch-sensitive floors enable new approaches for healthcare applications in the smart home. These interfaces have capacitive proximity sensors and can detect shapes on or above the ground. For example, a ground sensor can detect if a person is standing or lying on the floor, and track movement (Figure 2.13). Other applications include fall detection alerts, activating orientation lights, and dispatching care workers if an unattended, unstable patient leaves the bed (Future Shape, 2005).

Figure 2.13. **The Multitoe project: touch-sensitive floors**


*Source:* T. Augsten *et al.*, Multitoe: high-precision interaction with back-projected floors based on high-resolution multi-touch input, Proceedings of the 23nd annual ACM symposium on User interface software and technology, ACM Press, New York, 2010.

Touch-sensitive floors can also acts as sensors for a wide range of commercial applications, such as security (counting passers-by, access control, door control), and the design of interactive rooms. Research projects demonstrate the ability of high-resolution sensor technology to even detect and distinguish different users once a shoe or foot profile has been assigned to an identity (Augsten, 2010). Home automation can use this technique for a wide range of personalised ambient applications.

### *E-Work and e-Learning*

Advances in technology are influencing the way we work, communicate and learn. The main drivers are digital mobility (*i.e.* sophisticated mobile personal devices, high-bandwidth connections everywhere and social networks) and limitations to traditional mobility (travelling or being on-site).

Companies have focused on travel as an area to potentially reduce costs. In particular, the eruption of Iceland's Eyjafjallajokull volcano in 2010 caused the cancellation of thousands of business meetings due to cancelled flights and highlighted the need for e-work solutions. E-work has the potential to reduce travel expenses, and time costs caused by employees in transit and administrative overheads. Reducing unnecessary travel is also a way for companies to promote green thinking and limit their carbon footprint. There have been sustained calls for new ways of collaborating over long distances and for improvements in the work-life balance of employees, especially valuable, highly qualified personnel.

New forms of working practice include flexible work (working from home or from the nearest local office, client site or co-working facility) and home-based telework, as well as modern tools for computer supported collaborative work (CSCW).

One of the most important aspects of CSCW remains video conferencing. Existing solutions that demonstrate business value have a consistent balance of quality, repeatability and ease-of-use. Although each of these attributes is difficult to perfect, improving video quality has been the primary focus of videoconferencing vendors. Telepresence (Polycom/Cisco) has been the upper-end of high-quality video conferencing and does not mark the end of improvements in video resolution. What high-end systems such as Telepresence show is that video quality is now sufficient for most use cases because they provide an experience that can effectively mimic a live interaction. Vendors have now shifted to multiple (and larger) displays and better bandwidth efficiency. Current developments aim to reduce bandwidth for high-definition conferencing with new codecs (*i.e.* H.264 based), to allow HD video below a data rate of 1.5 Mbit/s, approximately the maximum upload speed of current ADSL broadband offers.

Other traditional means of collaborative software in remote environments include classic asynchronous communication tools (email, bulletin boards, groupware or version control). One interesting toolkit for the support of creative teams is the Tele-Board research project of the German Hasso-Plattner-Institute. Tele-Board software allows remote teams to use the novel creative working mode of "Design Thinking", a process and set of methods for problem-solving and methodic innovation.[2]

The Tele-Board platform allows users to collaborate in globally dispersed teams by means of digital whiteboards. The software suite permits synchronous work with sticky notes and writing and painting on the board surface, while an integrated video conferencing client transmits the audio and gestures of the remote team members. The system also integrates tablets and smartphones (iOS and Android based) as personal sticky note pads (Figure 2.14).

Figure 2.14. **Remote collaboration with Tele-Board**


*Source: www.tele-board.de.*

Business intelligence services that help firms to visualise historical, current operations and future trends are also moving to mobile devices. A number of manufacturers have mature products on the market, such as CliqView, MicroStrategy and Roambi/SAP. One of the key benefits cited by managers is the "always on" behaviour of tablets, compared to traditional PC environments.

In addition to emerging company-specific solutions (business intelligence, business resource planning and CRM) are a number of other commonly used tablet/smartphone apps for business productivity: office suites for mobile devices (Google Docs, Apple's iWork), mind-mapping tools (Mind Manager) or diagramming/charting software (OmniGraffle for iOS or Smart Diagram for Android). Exchange integration for iOS and Android indicate the growing importance of modern smartphones for company communication and as groupware clients.

At the intersection of today's working practice and education is the requirement for life-long learning programmes. Technology changes rapidly and employees must dedicate a significant share of their time to further education to remain conversant with technological and methodological changes. Self and distance-learning courses are becoming more important and widely accepted, and are supported by technology advances in e-learning such as virtual and remote laboratories or mobile learning concepts. This trend is also supported by the growing dissemination of Learning Management Systems (*i.e.* Moodle) in business environments.

Social applications also drive recent innovations in e-learning. Innovative applications have emerged in particular in the sector of community language learning (CLL). A mature example is the web application busuu.com. The website provides learning units for several different languages (*e.g.* English, French, German or Spanish). Learners can set up a profile, add one or more of these languages to their learning portfolio, work through the units at their own pace, and keep track of their progress. For each unit, users benefit from several types of material, such as vocabulary and key phrases, dialogues, audio, podcasts and PDFs. Throughout their study users can test their progress through interactive reviews. The community aspect of the site enables each user to be simultaneously a foreign language "student" and a "tutor" of his or her own mother tongue. Tutors review assessment results of other users.

A more general example of a community-supported learning platform is AnkiSRS. Anki is an open-source flash-card learning system accompanied by desktop applications and a web interface. Users can create decks of flash cards (*e.g.* for language learning, studying medical or legal facts, etc.) and share those with other users.

Research is also focusing on domain-independent, autonomous learning systems that implement natural language and multimedia processing as well as deeper reasoning techniques to allow the emulation of natural student-teacher interaction.

### *E-government*

Governments face the double challenge of reducing expenditures while meeting expectations to improve public services and to increase citizen engagement (OECD, 2012b). Government bodies make wide use of ICTs; however, effective e-government also requires rethinking organisations and processes, and changing behaviour to ensure that public services are delivered more easily to the people who need them. E-government services could enable all citizens, companies and organisations to carry out their business with the government more easily, more quickly and at lower cost (EC, 2007). Moreover, effective e-government could also improve governance and enable citizens to become more involved in the activities of their governments.

As in other fields, a key driving force is the large potential cost savings. In Denmark, for example, electronic invoicing saves taxpayers EUR 150 million and businesses EUR 50 million a year. Projected annual savings for European OECD countries could exceed EUR 50 billion (EC, 2011a). In Italy alone, e-procurement systems cut over EUR 3 billion in costs. This represents a tremendous impetus to move forward with higher quality, cost-effective government services and a better relationship between citizens and government (Fang, 2002). E-government represents a big opportunity, however, certain challenging issues require consideration.

In a global, interconnected world, more citizens and businesses deal with public bodies outside their home regions or countries. This places emphasis on the need for interoperability with existing software and hardware platforms.

Digital identity is also becoming an increasingly important foundation for e-government, as many government services require a high level of assurance of a user's identity. New digital identity practices generally rely on an electronic proof of identity, which enables online identity confirmation. This allows authentication processes such as login and confirmation of age or place of residence to be more efficient and more secure. A comparative analysis of national strategies and policies for digital identity management in OECD countries highlighted e-government as the main driver for such strategies in most countries (OECD, 2011a, 2011b). However, countries are adopting various approaches regarding the management of digital identities online for transactions that carry a high level of risk, such as registering a company or buying a house. Governments tend to transpose existing identity management practices in the physical world to the digital world. For example, countries like Germany, Portugal and Spain, which have a pre-existing, paper-based national identity card, are replacing it with an electronic identity card (eID) that enables more secure online transactions. But countries such as Australia, Canada, the United Kingdom and the United States which lack such a tradition follow approaches that are more distributed and less centralised, where authentication credentials issued by some actors are recognised by others, enabling multiple credentials to coexist.

The European Union and its member states consider eIDs a key enabler to achieving the digital single market. The large-scale pilot STORK[3] aims to achieve interoperability among national eID systems to enable citizens to access online public services in another country regardless of his or her place of residence. In mid-2012, the European Community will propose a legislative framework that aims, among other items, to ensure mutual recognition of eID and eAuthentication systems across the European Union.

### Box 2.6. **Electronic IDs in Germany**

Germany introduced electronic identity cards on 1 November 2010. The cards are called nPAs. The German system to identify individuals electronically was established with particular emphasis on compliance with data protection regulations: only authorised service providers are allowed to request the data on the identity card. Identity cardholders retain full control over which of their personal data are transferred to the service provider. The security concept of the new card is designed as an aid in the fight against Internet crime and to increase confidence in electronic transactions. It is also designed to increase protection against identity theft and provide new options for ensuring the protection of minors at places such as vending machines that sell cigarettes.

Service providers offer an online identity function to increase the convenience and security of user registration procedures. These providers include banks, insurance companies, online shops, e-mail providers and social networks. Public authorities may also use online identity cards for e-government services, such as vehicle registration or child allowance applications. Identity confirmation can also be integrated into ticket machines, car and bicycle rental services and hotel checking-in procedures. In Germany, more than 25 applications currently support the electronic identity card (Der neue Personalausweis, 2010). As in other countries, it is not yet possible to measure the success of these services as there is no comparative data available on their use in specific areas.

The number of issued cards does not necessarily correlate with their level of use for e-government, as many citizens receiving a new electronic identity card on the expiration of their old paper-based identity card are unfamiliar with its digital features and do not actively use them (Kubicek and Torsten, 2009). Clear communication of e-government services is crucial for wide acceptance, as the perceived added value of the new services may not outweigh the potential reservations of users (Grote *et al.*, 2010).

E-participation is another promising area facilitated by digital identity management. Public resistance to disputed government initiatives within the OECD states (*e.g.* the Stuttgart 21 project in Germany, the Digital Economy Act in the United Kingdom, and healthcare reform in the United States) is clear evidence of the willingness of many citizens to participate in democratic processes. The e-identity functionality provides a basis to develop participation and provide interested citizens with relevant information on projects in their area. These tools can be used to build a bridge between citizens and government, and thereby increase the confidence of the population in decisions relevant to them and in politics in general.

E-Participation was a priority in the previous EU eGovernment Action Plan, and also features prominently in the current one. The aim is to demonstrate tools for effective public debate and participation in democratic decision-making. In recent years, the European Union and its member states have mounted a concerted effort to find workable mechanisms and solutions to boost e-participation. An existing range of great and small initiatives aims to enhance this intention (EC, 2007). The European Commission supported 21 eParticipation projects between 2006 and 2009. The launch of the European Citizens Initiative in April 2012 is a major project, which promotes citizen engagement in EU-level decision-making processes (EC, 2011b).

One example of innovative e-participation services is the project bePart in Germany. This project provides citizens in Berlin and the surrounding area with the option of requesting, viewing and evaluating targeted information. This can create a basis for discussions at an early stage, thereby avoiding unnecessary costs and misunderstandings, and facilitate the reaching of consensus between the population and the government. bePart also provides the government with an ongoing barometer of sentiment, giving it access to current, anonymous opinions of citizens. It also provides citizens with the option to present proposals for improvement on their own initiative, to enable them to actively shape urban development (bePart, n.d.).

At present, regions provide information on infrastructure projects in different forms. Potsdam, for example, provides an option for participation with the "citizens' budget", but only provides information on infrastructure and urban development plans indirectly in its official journal. Berlin, in contrast, provides urban development plans online, but does not provide information on infrastructure projects in centralised form. Thus, citizens do not have a simple way of accessing information on projects planned for their area. bePart aggregates data on infrastructure projects from planning approval procedures, building plans and land development plans. The government has to aggregate the data from existing e-government sources and enter any missing data.

The projects are marked online with a zone of influence. Citizens can locate projects that affect their current location either on a map or as an "augmented reality" view. They can then select a detailed view for information on the costs and schedule of the project. A timeline gives citizens information on project steps that have already taken place or are planned (such as meetings, minutes, hearings, etc.). The project can be re-evaluated by citizens at any point. Citizens can also subscribe to projects via a "favourites view". bePart also goes one step further and provides a "map view", as well as an option to propose new projects. The aim is to encourage both participation and initiative in infrastructure policy. Projects may address road damage caused by adverse weather conditions, inadequate waste disposal facilities or insufficient municipal facilities.

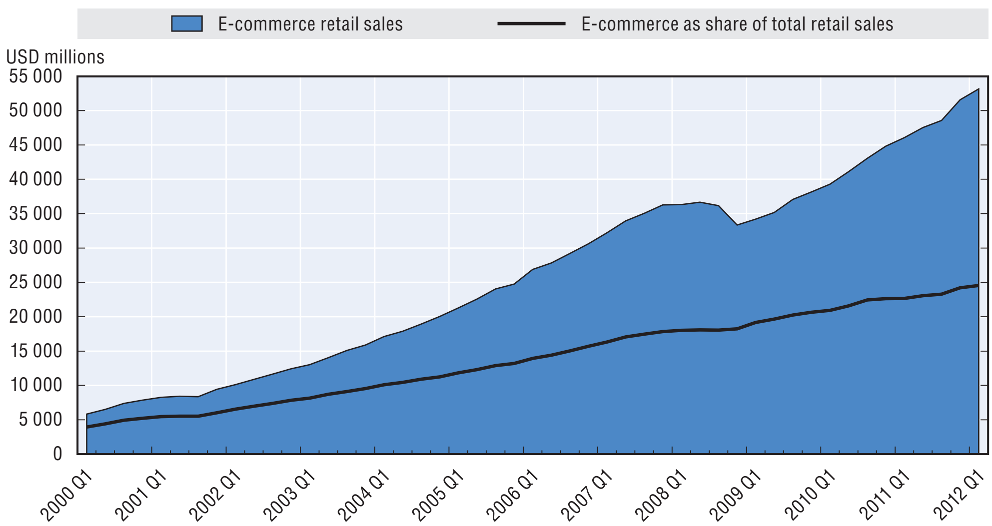
#### *E-commerce and payment services*

The path of online shopping has not been entirely smooth since its debut more than a decade ago. But after a stuttering start, e-commerce levels are experiencing robust growth worldwide. The increased uptake of broadband, a more technologically aware population, and improved e-commerce infrastructure has made this growth possible. Various research studies demonstrate the impressive rise of global e-commerce services.

For example, in 2010 the industry analyst Marketer estimated that global e-commerce would reach USD 711 billion in sales by the end of the year with an annual growth rate (CAGR) of 19%. The US Department of Commerce reported that e-commerce in the United States reached over USD 53 billion for the first quarter of 2012, accounting for almost 5% of total commerce (Figure 2.15) (US Department of Commerce, 2012). According to CRR research, e-commerce is one of the fastest growing markets in Europe (see Figure 2.16). Forrester Research also estimated that 32 million UK consumers shopped online in 2011. The research firm IDC predicts that USD 134 billion will be spent online in China in 2012.

Figure 2.15. **Evolution of US retail e-commerce sales, Q1 2000-Q1 2012**

As a percentage of total retail sales



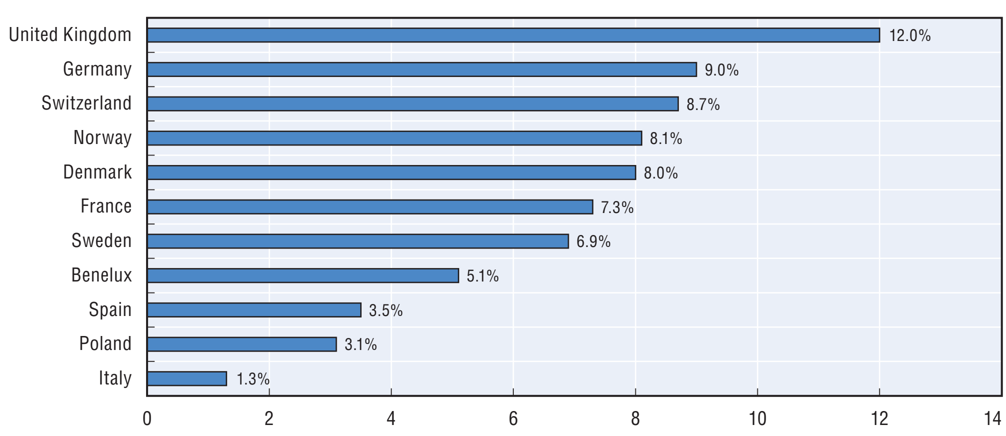

*Note:* E-commerce sales are sales of goods and services where an order is placed by the buyer or price and terms of sale are negotiated over an Internet, extranet, Electronic Data Interchange (EDI) network, electronic mail, or other online system. Payment may or may not be made online. Estimates are adjusted for seasonal variation, but not for price changes. Total sales estimates are also adjusted for trading-day differences and moving holidays.

*Source:* Based on US Census Bureau, Quarterly Retail E-Commerce Sales, 1st quarter 2012, May 2012.

StatLink http://dx.doi.org/10.1787/888932693075

Figure 2.16. **Online share of retail trade, 2011**

Percentage of total retail sales




*Source:* Based on Centre for Retail Research (CRR), Online Retailing: Britain and Europe, May 2012.

StatLink http://dx.doi.org/10.1787/888932693094

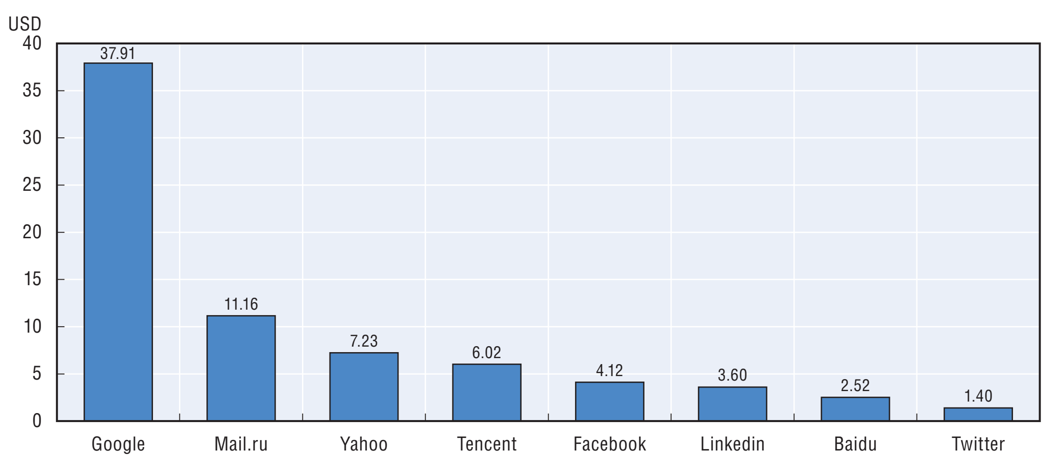
Nevertheless, the market remains highly polarised geographically, with a "digital divide" clearly evident. For example, nearly half of the Swedish adult population made an online purchase in 2010, compared to just one in ten Italians, (OECD, 2011c). A lack of infrastructure may play a role in this divide, but so do cultural factors, such as trust levels in businesses and attitudes towards distance shopping.

According to nVision, personal country-of-origin proves to be the most accurate indicator of e-commerce uptake. Other variables, such as age and gender, are seeing their influence lessen as the online population diversifies, with online shopping set to grow fastest amongst older age groups over the next few years (nVision, 2008). This can be explained by the group's increased level of online experience, a factor that has an essential influence on every group's propensity to shop online. As stated above, broadband access is a major driver of e-commerce participation.

In surveys across countries, consumers say that saving time and money and convenient search options are among the top reasons for shopping online. Amazon is one of the leading online retailers worldwide, and was able to sustain high growth levels in 2011 despite challenging economic conditions. Net sales increased 40% to USD 34.20 billion, compared with USD 24.51 billion in 2009 (Amazon, 2011a). The world's largest online retailer performs exceptionally efficiently measured against revenue per visitor, which is one of the key measures for any commercial website, regardless of whether it is a media site, search engine, social network, a transactional retailer or offers travel or financial services. Globally, Amazon generates almost 3.3 times more revenue per user than eBay, Facebook, Google and Mail.ru combined (Figure 2.17).

While factors such as the wider selection of goods, convenience and the ability to simultaneously compare prices have been crucial in driving online shopping, a number of issues still limit the market's development. Despite significant strides forward in the

Figure 2.17. **Revenue per unique user for tech companies, 2011**




*Notes:* For Tencent & Baidu, revenues were converted from RMB to USD. US dollars in this annual report is based on the noon buying rate in New York City for cable transfers in RMB as certified for customs purposes by the Federal Reserve Board. Unless otherwise noted, all translations from RMB to U.S. dollars and from U.S. dollars to RMB in this annual report were made at a rate of RMB 6.2939 to USD 1.00, the noon buying rate in effect as of 30 December 2011. For public companies data was retrieved to company's annual reports to stakeholders for the closing year 2011. Data for number of users was retrieved both from company's annual reports, and comScore's ARPU (Average revenue per user) reports. Data for number of users is considered for ending December 2011, with the exception of Facebook (March 2012), Google & Yahoo (May 2011) and Baidu (June 2009).
*Source:* OECD based on comScore, Bloomberg, Companies financial annual statements, June 2012
StatLink http://dx.doi.org/10.1787/888932693113

domain of security, a significant number of consumers have fears about releasing personal details online (HPI, 2011). Low credit card ownership is also proving to be a barrier in some of Europe's largest economies, with a lack of alternative payment mechanisms hindering development (nVision, 2008).

One of the most important trends is the ability to make payments via a mobile phone. The payment service provider Ogone currently offers an iPhone app for mobile payment transactions. Retailers and service providers can use their Apple smartphone as a virtual mobile card reader to accept credit and debit card payments (direct debit). Taxi drivers and pizza and furniture deliverers can process PCI-secured payments via their iPhone without the need for a traditional terminal. One promising advance is near-field communications (NFC), a short-range wireless technology that uses interacting electromagnetic radio fields instead of radio transmissions to exchange information. Typically, NFC devices must be held next to each other to exchange information, such as a mobile phone held next to a reader to make payments for public transport.

Visa has begun NFC payments via an iPhone accessory. In Turkey, iPhone users can also make non-touch payments. In cooperation with Visa Europe, the bank Yapi Kredi and the Turkish mobile phone operator Turkcell offer their customers the "iCarte" accessory. This plug-on module produced by Wireless Dynamics adds the NFC wireless technology and Radio Frequency IDentification (RFID) support to the iPhone, and contains an integrated smart chip that makes the data from the Visa card available for payment transactions.

In September 2011, Google and the wireless carrier Sprint in the United States launched an NFC payment option using the Google Nexus S mobile phone. Apple is also implementing an NFC-based payment system: the new iPad3 supports NFC wireless technology and will thus enable mobile payment transactions, and it seems likely that the next version of the iPhone5 will follow suit.

In many OECD countries, payment options such as bank transfers and direct withdrawals continue to dominate, but there has been a marked increase in the use of alternative payment options. The most popular of these is the online payment system PayPal, which has grown rapidly in recent years. In 2011, the eBay subsidiary reported a 32% increase in turnover to USD 1.1 billion. The value of its transactions increased by 31% to USD 29.3 billion, and the number of active account holders increased by 14% to 103 million. The company is currently developing an identification service that will allow customers to authenticate themselves and buy in various online stores after entering their e-mail address and password only once. In addition, a new platform is due to be introduced in some markets, which will allow face-to-face retailers to accept mobile payments without having to invest in new hardware. The new PayPal payment platform can be used via mobile phones and smartphones, as well as via special PayPal cards. In-store terminals, where users type in their telephone number and a PIN code, will also be available. To complete payments, users just scan the bar or quick response (QR) code with their mobile phone, or use an NFC chip if one is installed.

Mobile payment services are commonly viewed as an important market for growth. Service providers are focusing primarily on user-friendliness, convenience, reliability and a sense of security. For example, customers feel more secure when they do not have to give unknown retailers their confidential data, such as account or credit card numbers.

### *Internet in business: Supply chain management*

Today, e-commerce and ICTs are fundamentally changing the nature of supply chains. They are redefining how consumers learn about, select, purchase and use products and services. The result has been the emergence of new business-to-business supply chains that are consumer focused rather than product focused.

Increasingly rigorous competition in global markets, short time-to-market, short product lifecycles and high customer expectations are forcing companies to become more cost effective. The necessary cost reductions can be made by optimising corporate processes (Simchi-Levi, Kaminsky and Simchi-Levi, 2008). Specifically, improving the predictability of material flows between source suppliers and consumers helps balance out customer-side fluctuations in demand and supply-side difficulties. The speed and quality of information exchange is becoming an increasingly decisive factor for competitive advantage.

However, many companies are still a long way off from end-to-end solutions, and only use individual automated purchasing and sales processes involving computer-aided exchange of data either internally or with business partners (B2B). Most e-business applications are still used as standalone solutions.

Standards play a crucial role in integrating e-business solutions, as these require homogeneous information to be available at the right place at the right time along the whole value chain. The main task of standards is to define data flows between the systems involved. The benefit of applying standards is accelerated business processes, improved data quality and lower IT complexity, which in turn cut costs and increase investment security.

However, the cost involved in applying standards will be high, particularly with regard to implementation, maintenance of ongoing operations, and above all, the wide range of available standards. The number of standards also increases the time and expense needed for coordination. This explains why many companies find it difficult to accurately assess the expenses and investment costs needed to apply them. In fact, the unclear cost-benefit ratio is the reason why many businesses are against the application of standards.

To enable the widespread application of standards, it is important to provide companies with tools that can deliver realistic cost-benefit and return-on-investment analyses. E-business standardisation therefore harbours great market potential for IT service providers and technology providers, and support of these standards opens up new segments and business areas for them.

Furthermore, the standardisation of e-business will also drive growth in the software-as-a-service and cloud models, currently the subject of widespread debate. The support of standards simplifies and speeds up internationalisation and thereby opens up markets abroad. IT service providers and technology providers should tap this potential and consistently support their customers in introducing and implementing standards-based e-business solutions.

## Conclusion

Some of the Internet developments across the economy highlighted in this chapter are also areas that OECD governments have assigned a high priority in the 2012 OECD ICT policy questionnaire. Rolling out broadband infrastructure remains the highest priority over with 21 out of 23 countries assigning it a high priority. In addition, 19 countries that responded to the questionnaire stated that e-government continues to be a high strategic priority. Green growth and public-sector information are also important priorities emerging from the questionnaire responses. A discussion of these priorities and specific examples from OECD countries can be found in Chapter 8 focusing on policy.

### *Notes*

1. 1 zettabyte is equivalent to 1 billion terabytes or roughly the capacity of 213 million DVDs.
2. Methodic innovation is a suite of methods that allows teams to improve their work and innovate by giving participants the ability to define their job or role in a way that best suits their talents.
3. For further information on STORK, see: *www.eid-stork.eu*.

### *References*

Agilent (2011), “Agilent Technologies Introduces Industry’s First LTE-Advanced Signal Generation, Analysis Solutions”, *www.agilent.com/about/newsroom/presrel/2011/02feb-em11015.html*, accessed 1 November 2011.

Amazon (2011a), *Annual Report Summary for 2011*, Amazon.com Inc., Seattle, United States.

Amazon (2011b), *Amazon Silk: The Official Blog of the Silk Team*, *http://amazonsilk.wordpress.com*, accessed 14 November 2011.

AppBrain, (2012), “Number of available Android applications”, *www.appbrain.com/stats/number-of-android-apps*, accessed 4 June 2012.

Apple (2011a), “iCloud – Keep the Same Documents Up-to-date Everywhere”, *www.apple.com/icloud/features/documents.html*, accessed 25 October 2011.

Apple (2011b), “Apple’s Mac App Store Downloads Top 100 Million”, press release, *www.apple.com/pr/library/2011/12/12Apples-Mac-App-Store-Downloads-Top-100-Million.html*, accessed 22 March 2012.

Apple (2011c), “iTunes in the Cloud”, *www.apple.com/icloud/features, accessed 22 March 2012*.

Augsten, T., K. Kaefer, R. Meusel, C. Fetzer, D. Kanitz, T. Stoff, T. Becker, C. Holz and P. Baudisch. (2010), “Multitoe: High-precision Interaction with Back-projected Floors Based on High-resolution Multi-touch Input”, *Proceedings of the 23nd Annual ACM Symposium on User Interface Software and Technology*, ACM Press, New York.

Barret, V. (2011), “Dropbox: The Inside Story of Tech’s Hottest Start-Up”, *Forbes*, 18 October 2011, *www.forbes.com/sites/victoriabarret/2011/10/18/dropbox-the-inside-story-of-techs-hottest-startup/*, accessed 25 October 2011.

Baudisch, P. (2010), “My New PC is a Mobile Phone: Techniques and Technology for the New Smallness”, opening keynote at MobileHCI 2010, Lisbon, 7-10 September, 2010, *www.patrickbaudisch.com/publications/talks.html*, accessed 22 March 2012.

bePart (n.d.), “bePart – Mobile eParticipation for Urban Development”, *be-part.info*, accessed 22 March 2012.

Buckland, M. and P. Langley (2010), “The Future of Social Networking – A Concept Investigation with Augmented Reality”, *matthewbuckland.com/?p=1041*, accessed 22 August 2010.

CEDIA (Custom Electronic Design & Installation Association) (2011), “Industry Experts Forecast 2012 Home Electronic Trends”, *www.pitchengine.com/cedia/industry-experts-forecast-2012-home-electronic-trends*, accessed 10 November 2011.

Cisco (2011), “Visual Networking Index: Forecast and Methodology, 2010-2015”, *www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-481360_ns827_Networking_Solutions_White_Paper.html*, accessed 22 March 2012.

Cooney, M. (2011), “Gartner: The Top 10 Strategic Technology Trends for 2012”, *Network World*, *www.networkworld.com/news/2011/101811-gartner-technology-trends-252100.html*, accessed 14 November 2011.

CRR (Centre for Retail Research) (2011), Official website, CRR, Nottingham, United Kingdom, *http://retailresearch.org*.

Darby, S. (2006), *The Effectiveness of Feedback on Energy Consumption*, Environmental Change Institute, University of Oxford, Oxford, United Kingdom.

Dediu, H. (2012), "The US Smartphone Landscape", *Asymco*, *www.asymco.com/2011/11/06/the-us-smartphone-landscape*, accessed in June 2012.

Der neue Personalausweis (2010), Official website, *www.personalausweisportal.de/DE/Home/home_node.html*, accessed 22 March 2012.

*DiePresse* (2011), "Handy-App "mytaxi": Funkzentralen drohen Taxlern", *diepresse.com/home/panorama/wien/704219/HandyApp-mytaxi_Funkzentralen-drohen-Taxlern* (in German), accessed 30 November 2011.

Dignan, L. (2011), "The Mobile Enterprise App Tipping Point is Here: Can Business Tech Learn UI?", *ZDnet*, *www.zdnet.com/blog/btl/the-mobile-enterprise-app-tipping-point-is-here-can-business-tech-learn-ui/49059*, accessed 20 May 2011.

EC (European Commission) (2007), "Information Society Activities at a Glance", *ec.europa.eu/information_society/activities*, accessed 22 March 2012.

EC (2011a), *eGovernment on the Fast Track*, *http://ec.europa.eu/information_society/activities/egovernment/policy/index_en.htm*, accessed 4 April 2012.

EC (2011b), *The European Citizens Initiative*, *ec.europa.eu/dgs/secretariat_general/citizens_initiative*, accessed 22 March 2012.

EuroCloud (2012), Official website, *www.eurocloud.org/about-eurocloud, accessed 22 March 2012.*

Fang, Z. (2002), "E-Government in Digital Era: Concept, Practice and Development", *International Journal of the Computer*, Vol. 10, No. 2, pp. 1-22.

Future Shape (2005), "SensFloor", *www.future-shape.com/en/technologies/23/sensfloor*, accessed 22 March 2012.

Gartner Research (2011a), "Gartner Says Worldwide PC Shipments in First Quarter of 2011 Suffer First Year-Over-Year Decline in Six Quarters", press release, *www.gartner.com/it/page.jsp?id=1632414*, accessed 14 November 2011.

Gartner Research (2011b), "Gartner Says the Market for Social CRM Is on Pace to Surpass $1 Billion in Revenue by Year-End 2012", press release, *www.gartner.com/it/page.jsp?id=1777938*, accessed 30 November 2011.

Global FTTH Council (2011), "Global FTTH Councils' Latest Country Ranking Shows Further Momentum on All-Fiber Deployments", *www.ftthcouncil.org/en/newsroom/2011/02/10/global-ftth-councils-latest-country-ranking-shows-further-momentum-on-all-fiber-*, accessed 20 October 2011.

Goderbauer, M. (2011), "Diagram Editor for Google+ Hangouts", *http://code.google.com/p/diagram-editor-for-google-plus*, accessed 30 November 2011.

Google (2011), *Chromebook*, official website, *www.google.com/chromebook*, accessed 25 October 2011.

Grose, T.K. (2011), "10 Start-Ups That Will Change Your Life", *Time*, *www.time.com/time/specials/packages/article/0.28804.2017050_2017049_2017043.00.html*, accessed 30 October 2011.

Grote, J.H. *et al.* (2010), HPI Studie. "Vom Client zur App: Ideenkatalog zur Gestaltung der Software zum Einsatz des neuen Personalausweises", *www.bmi.bund.de/SharedDocs/Downloads/DE/Themen/Sicherheit/PaesseAusweise/studie3_npa.html?nn=294838* (in German), accessed 22 March 2012.

IDC (International Data Corporation) (2011a), "Global PC Market Contracts in the First Quarter, But Swaths of Growth Remain, According to IDC", press release, *www.idc.com/getdoc.jsp?containerId=prUS22790811*, accessed 14 November 2011.

IDC (2011b), "Extracting Value from Chaos", *idcdocserv.com/1142*, accessed 22 March 2012.

International Energy Agency (IEA) (2011), *Technology Roadmap. Smart Grids*, Paris, IEA.

IEEE (Institute of Electrical and Electronics Engineers) (2008), *The Draft IEEE 802.16m System Description Document*, *www.ieee802.org/16/tgm/docs/80216m-08_003r1.pdf*, accessed 1 November 2011.

IPCC (Intergovernmental Panel on Climate Change) (2007), *Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, (edited by B. Metz, O.R. Davidson, P.R. Bosch, R. Dave and L.A. Meyer), Cambridge University Press, Cambridge, UK.

Kellogg, D. (2011), "40 Percent of U.S. Mobile Users Own Smartphones; 40 Percent are Android", *Wire*, *blog.nielsen.com/nielsenwire/online_mobile/40-percent-of-u-s-mobile-users-own-smartphones-40-percent-are-android*, accessed 15 November 2011.

Kubicek, H. and T. Noack (2009), "Elektronische Identität im Scheckkartenformat – was Deutschland von anderen Ländern lernen kann" (in German), *Vitako Aktuell*, Vol. 1/2009, pp. 8-9.

Lomas, N. (2011), "Android, Chrome OS to Converge, Says Google's Eric Schmidt", *silicon.com*, *www.silicon.com/technology/software/2011/02/16/android-chrome-os-to-converge-says-googles-eric-schmidt-39746988, accessed 14 November 2011.*

Mell, P. and T. Grance (2011), *The NIST Definition of Cloud Computing*, *csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf*, accessed 22 March 2012.

NetHosting (2011), "DropBox Case Study", *www.nethosting.com/buzz/case-studies/dropbox-case-study*, accessed 22 March 2012.

Niemand, T. (2011), *Smart Grids – Hype oder heute schon Realität?*, RWE Deutschland AG, Deutsche Kommission Elektrotechnik Elektronik Informationstechnik (DKE), Frankfurt, Germany, *www.dke.de/de/Wirueberuns/MitteilungenderDKEGeschaeftstelle/2011/Documents/Niemand.pdf* (in German), accessed 22 March 2012.

NIST (National Institute for Standards and Technology) (2010), "NIST & the Smart Grid", *www.nist.gov/smartgrid/nistandsmartgrid.cfm*, accessed 16 November 2011.

nVision (2008), *E-commerce across Europe: Progress and prospects*, *www.eaca.be/_upload/documents/publications/E-commerce%20across%20Europe.pdf*, accessed 22 March 2012.

OECD (2009), "Smart Sensor Networks: Technologies and Applications for Green Growth", *OECD Digital Economy Papers*, No. 167, OECD Publishing. doi: *http://dx.doi.org/10.1787/5kml6x0m5vkh-en*.

OECD (2010), *Greener and Smarter. ICTs, the Environment and Climate Change*, OECD, Paris, *www.oecd.org/dataoecd/27/12/45983022.pdf*, accessed 22 March 2012.

OECD (2011a), "National Strategies and Policies for Digital Identity Management in OECD Countries", *OECD Digital Economy Papers*, No. 177, OECD Publishing. doi: *http://dx.doi.org/10.1787/5kgdzvn5rfs2-en*.

OECD (2011b), "Digital Identity Management for Natural Persons: Enabling Innovation and Trust in the Internet Economy – Guidance for Government Policy Makers", *OECD Digital Economy Papers*, No. 186, OECD Publishing. doi: *http://dx.doi.org/10.1787/5kg1zqsm3pns-en*.

OECD (2011c), "The Future of the Internet Economy: A Statistical Profile", June 2011 Update, OECD, Paris. *www.oecd.org/dataoecd/24/5/48255770.pdf*.

OECD (2011d), "National Broadband Plans", *OECD Digital Economy Papers*, No. 181, OECD Publishing. doi: *http://dx.doi.org/10.1787/5kg9sr5fmqwd-en*.

OECD (2012a), "ICT Applications for the Smart Grid: Opportunities and Policy Implications", *OECD Digital Economy Papers*, OECD, Paris.

OECD (2012b), "New ICT Solutions for Public Sector Agility", summary report of OECD E-leaders meeting, Mexico City, 26-27 March, *www.oecd.org/governance/eleaders*.

OECD (forthcoming), "Cloud Computing: The Concept, Impacts and the Role of Government Policy", *OECD Digital Economy Papers*, OECD, Paris.

OPTIMIS (2011), Official website, *www.optimis-project.eu*, accessed 22 March 2012.

Parkvall, S., et al. (2008), "LTE Advanced – Evolving LTE towards IMT-Advanced", *Vehicular Technology Conference, 2008. VTC 2008-Fall. IEEE 68th*, Stockholm, Ericsson Research.

Perset, K. (2010), "Internet Addressing: Measuring Deployment of IPV6: Measuring Deployment of IPV6", *OECD Digital Economy Papers*, No. 172, OECD Publishing.
doi: *http://dx.doi.org/10.1787/5kmh79zp2t8w-en*.

Point Topic Ltd. (2012), IPTV: *Short Report – Q4 2011. April 2012*, Point Topic, London.

Schonfeld, E. (2011), "Will Windows 8 Merge The Desktop With The Smartphone?" *Seeking Alpha*, *seekingalpha.com/article/291769-will-windows-8-merge-the-desktop-with-the-smartphone*, accessed 14 November 2011.

Simchi-Levi, D., P. Kaminsky and E. Simchi-Levi (2008), *Design and Managing the Supply Chain: Concepts, Strategies and Case Studies*, McGraw-Hill/Irwin, Boston.

Sonos Inc. (2011), *Sonos – The Wireless HiFi System*, official website, *www.sonos.com*, accessed 22 March 2012.

TechCrunch (2011), "Android Market: 10 Billion Apps Served So Far, And Another 1 Billion Each Month", *TechCrunch*, *techcrunch.com/2011/12/06/android-market-10-billion-apps-served-so-far-and-another-1-billion-each-month, accessed 22 March 2012.*

Treiss, F. (2011), "Mobilbranche hält HTML5, Location-based Services und Mobile Payments für die wichtigsten Zukunftstrends", *Mobilbranche*, *mobilbranche.de/2011/10/mobilbranche-halt-html5-location-based-services-und-mobile-payments-fur-die-wichtigsten-zukunftstrends/7790* (in German), accessed 30 November 2011.

US Department of Commerce (2012), *Quarterly Retail E-Commerce Sales, 1st quarter 2012*, US Government, Washington, DC, *www.census.gov/retail/mrts/www/data/pdf/ec_current.pdf*, accessed 17 May 2012.

Waterfall Mobile (2011), "Smartphone Penetration Stats: Comparing Then And Now", *blog.msgme.com/2011/09/01/smartphone-penetration-stats-comparing-then-and-now*, accessed 14 November 2011.

Weigert, M. (2011), "Callcenter Adé: Wie die Taxi-Branche auf myTaxi reagiert", *Netzwertig.com*, *netzwertig.com/2011/10/31/callcenter-ade-wie-die-taxi-branche-auf-mytaxi-reagiert* (in German), accessed 30 November 2011.

Wheelock, C. et al. (2011), Smart Grid Apps: Six Trends That Will Shape Grid Evolution, Pike Research, Boulder, USA.

Zickuhr, K. and A. Smith. (2011), *PewInternet and American Life Project: 28% of American adults use mobile and social location-based services*, Technical Report, PewResearchCenter, Washington, DC.