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For more information on this reports, including the full text of this edition and statistical highlights, visit www.itu.int/digitalife. For previous titles in the series, visit www.itu.int/internetreports.

Foreword

This report, entitled "*digital.life*" is the eighth in the series of "ITU Internet Reports", originally launched in 1997 under the title "Challenges to the Network". This edition has been specially prepared for ITU TELECOM WORLD, to be held in Hong Kong, China, from 4-8 December 2006.

Today's digital world has transformed individual lifestyles the world over. The computing industry has long been all-digital, the telecommunications industry is almost fully digital and the broadcasting sector is well on the way to becoming digital. Always-on internet access has become the norm, with people spending more and more time consuming digital media than any other medium. Daily lives from China to Croatia are brimming with SMS, e-mail, chats, online dating, multiplayer gaming, virtual worlds and digital multimedia. Although these technologies mean added convenience and enjoyment for many, regulators and users alike are often a step behind fast-paced innovations in this field. Concerns over privacy and data protection are important examples, as is the role of regulation in relation to content convergence and distribution. Moreover, as the number of channels for service delivery diversifies, the sector's traditional and less traditional businesses face a number of new dilemmas.

The first chapter of the report, *Going digital*, explores the meaning and importance of being digital. Chapter two, *lifestyles.digital*, examines the key technologies and services enabling new digital lifestyles, including higher-speed networks and content distribution. Chapter three, *business.digital*, considers the challenges and opportunities facing businesses in adapting to fast-paced innovation, before addressing whether a fresh approach to policy-making might be required in light of rapid media convergence. Chapter four, *identity.digital*, explores the changing nature of the digital individual and the need for greater emphasis on the creation and management of digital identity. Chapter five, *Living the digital world*, concludes by examining the social impacts of digital technologies and imagining how lifestyles might further evolve in the digital age. The Information Society Statistics in the annex present the latest data and charts for some 206 economies worldwide in their use of digital technologies.

ITU, the United Nations specialized agency for telecommunications, is committed to playing a positive role in the development of the information society and to extending the benefits of advances in telephony and information and communication technologies (ICTs) and embracing the opportunities for telecommunication development that arise from the growth of IP-based services. The ITU Internet Reports are one contribution towards this commitment.

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Introduction

A number of economic and regional groupings are used in the report. Economic groupings are based on gross national income (GNI) per capita classifications used by the World Bank. Economies are classified according to their 2004 GNI per capita in the following groups:

Gross National Income (GNI) per capita of:

- Low Income USD 875 or less
- Lower middle USD 876–3'465
- Upper middle USD 3'466–10'725
- High USD 10'726 or more

See the Information Society Statistics in the Annex for the income classification of specific economies.

The classification developed and developing is also used in the report. Developed economies are classified as: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States. Advanced economies include Developed, plus Hong Kong, China; Republic of Korea; Singapore and Taiwan, China; as well as Cyprus and Israel. All other economies are considered developing for the purposes of this report. The classification least developed countries (LDCs) is also employed. The LDCs are Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Cape Verde, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gambia, Guinea, Guinea Bissau, Haiti, Kiribati, Lao People's Democratic Republic, Lesotho, Liberia, Madagascar, Malawi, Maldives, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Samoa, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Somalia, Sudan, Timor-Leste, Togo, Tuvalu, Uganda, United Republic of Tanzania, Vanuatu, Yemen, and Zambia. Emerging is also sometimes used in the report. These are countries that are neither developed nor LDCs. The grouping Organization for Economic Cooperation and Development (OECD) is also used. Members include all the developed countries plus the Czech Republic, Hungary, Republic of Korea, Mexico, Poland, Slovak Republic and Turkey. A number of regional groupings are used in the report. The main regional groupings are Africa, Asia, Americas, Europe and Oceania. Note that Pacific is also used in the report to refer to the Oceania region. See List of economies in the Information Society Statistics in the Annex for the primary regional classification of specific economies. The following sub-regional groupings are also used in the report:

- Arab region— Arabic-speaking economies;
- Asia-Pacific—refers to all economies in Asia east of, and including Iran, as well as Pacific Ocean economies;
- Central and Eastern Europe—Albania, Bosnia, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Serbia and Montenegro, Slovak Republic, Slovenia and The Former Yugoslav Republic of Macedonia;
- Commonwealth of Independent States—12 republics emerging from the former Soviet Union excluding the Baltic nations;
- Latin America and the Caribbean—Central (including Mexico) and South America and the Caribbean;
- North America—Generally, Canada and the United States, although in some charts, Bermuda and/or Mexico is also included (if so, this is noted);
- Southern Europe—Cyprus, Malta and Turkey;
- Western Europe—refers to the member states of the European Union, plus Iceland, Norway and Switzerland.

Data notes

- Billion is one thousand million.
- Dollars are current United States dollars (USD) unless otherwise noted. National currency values have been converted using average annual exchange rates (unless stated otherwise in the Technical notes; two tables of current prices use most recent exchange rates). Growth rates are based on current prices, unless otherwise noted.
- Thousands are separated by an apostrophe (1'000).
- Totals may not always add up due to rounding.

Additional definitions are provided in the technical notes of the *Indicators Handbook* at www.itu.int/ITU-D/ict/handbook.html. Note that data in some charts and tables referring to the same item may not be consistent and may also differ from the tables shown in the Information Society Statistics in the Annex. This can happen due to revisions to data that occurred after sections of the report were written, as well as different estimation techniques and/or exchange rates. Such variations tend to be insignificant in their impact on the analysis and conclusions drawn in the report. Finally, it should be noted that data generally refer to fiscal years as reported by countries.

Glossary

2G: Second-generation mobile network or service. Generic name for second generation networks, for example GSM.

3G: Third-generation mobile network or service. Generic name for third-generation networks or services under the IMT-2000 banner, for example W-CDMA and CDMA2000 1x.

3GPP: Third Generation Partnership Project. A cooperation between regional standards bodies to ensure global interworking for 3G systems.

Actuator: An actuator is the mechanism by which an agent acts upon an environment. The agent can be either an artificial intelligent agent or any other autonomous being.

ADSL: Asymmetric digital subscriber line. A technology that enables high-speed data services to be delivered over twisted pair copper cable, typically with a download speed in excess of 256 kbit/s, but with a lower upload speed. Corresponds to ITU Recommendation (standard) ITU-T G.992.1.

Analogue: Transmission of voice and images using electrical signals. Analogue mobile cellular systems include AMPS, NMT and TACS.

ARPU: Average Revenue Per User. Usually expressed per month but also per year.

Bandwidth: The range of frequencies available to be occupied by signals. In analogue systems it is measured in terms of Hertz (Hz) and in digital systems in bit/s per second (bit/s). The higher the bandwidth, the greater the amount of information that can be transmitted in a given time. High bandwidth channels are referred to as broadband which typically means 1.5/2.0 Mbit/s or higher.

Bit (binary digit): A bit is the primary unit of electronic, digital data. Written in base-2, binary language as a "1" or a "0".

Bit/s: Bits per second. Measurement of the transmission speed of units of data (bits) over a network. Also kbit/s: kilobits (1'000) per second; Mbit/s: megabits (1'000'000) per second, and Gbit/s: Gigabits (1'000'000'000) per second.

Broadband: Broadband is defined, for the purposes of this report, as internet access with a minimum capacity of greater or equal to 256 kbit/s in one or both directions (see Technical notes). Fixed broadband is implemented through technologies such as digital subscriber line (DSL), cable modem, fibre to the home (FTTH), metro ethernet, wireless local area networks (WLAN) etc. Mobile broadband is implemented through technologies such as wideband CDMA, HSDPA, CDMA 1x EV-DO, etc.

Broadcast: Point-to-multipoint video transmitted only once over the entire service area.

Browser: Application that retrieves WWW documents specified by URLs from an HTTP server on the internet. Displays the retrieved documents according to the Hyptertext Markup Language (HTML).

Byte: (1) A set of bits that represent a single character. A byte is composed of 8 bits.

(2) A bit string that is operated upon as a unit and the size of which is independent of redundancy or framing techniques.

CAGR: Compound annual growth rate. See the Technical notes.

Cable modem: A technology that allows high-speed interactive services, including internet access, to be delivered over a cable TV network.

CDMA: Code division multiple access. A technology for digital transmission of radio signals based on spread spectrum techniques where each voice or data call uses the whole radio band and is assigned a unique code.

CDMA2000: Code division multiple access 2000. A third-generation digital cellular standard under the IMT-2000 banner, first deployed in Korea, includes

CDMA2000 1x and 1xEV-DO (Evolution, Data Optimized).

Cellular: A mobile telephone service provided by a network of base stations, each of which covers one geographic cell within the total cellular system service area.

Channel: One of a number of discrete frequency ranges utilized by a base station to transmit and receive information from cellular terminals (such as mobile handsets).

Circuit-switched connection: A temporary connection that is established on request between two or more stations in order to allow the exclusive use of that connection until it is released. At present, most voice networks are based on circuit-switching, whereas the internet is packet-based. See also Packet-based.

Connectivity: The capability to provide, to end-users, connections to the internet or other communication networks.

Coverage: Refers to the range of a mobile cellular network, measured in terms of geographic coverage (the percentage of the territorial area covered by mobile cellular) or population coverage (the percentage of the population within range of a mobile cellular network).

Digital: Representation of voice or other information using digits 0 and 1. The digits are transmitted as a series of pulses. Digital networks allow for higher capacity, greater functionality and improved quality.

DSL: Digital subscriber line. DSL is a technology for bringing high-bandwidth information to homes and small businesses over ordinary copper telephone lines. See also xDSL, which refers to different variations of DSL, such as ADSL, HDSL, and RADSL.

E-commerce: Electronic commerce. Term used to describe transactions that take place online where the buyer and seller are remote from each other.

Encryption: The process of converting plain text into code to secure information from being read by unauthorized persons or those without special computing knowledge.

Fixed line: A physical line connecting the subscriber to the telephone exchange. Typically, fixed-line network is used to refer to the PSTN (see below) to distinguish it from mobile networks.

Frequency: The rate at which an electrical current alternates, usually measured in Hertz (see Hz). It is also used to refer to a location on the radio frequency spectrum, such as 800, 900 or 1'800 MHz.

FTTx: generally refers to broadband telecommunications systems based on fibre-optic cables directly to the homes or business.

GDP: Gross domestic product. The market value of all final goods and services produced within a nation in a given time period.

GNI: Gross national income. The market value of all final goods and services produced in a nation's economy, including goods and services produced abroad. GNI in constant prices, differs from GNP in that it also includes a terms of trade adjustment; and gross capital formation which includes a third category of capital formation: net acquisition of valuables.

GNP: Gross national product. The market value of all final goods and services produced in a nation's economy, including goods and services produced abroad.

GPRS: General Packet Radio Service. It refers to a standard for wireless communications that supports a wide range of bandwidths. It runs at speeds up to 115 kilobits per second and is particularly suited for sending and receiving small bursts of data, such as e-mail and Web browsing, as well as large volumes of data.

GPS: Global positioning system. Refers to a "constellation" of 24 "Navstar" satellites launched initially by the United States Department of Defense, that orbit the Earth and make it possible for people with ground receivers to pinpoint their geographic location. The location accuracy ranges from 10 to 100 metres for most equipment. A Russian system, GLONASS, is also available, and a European system, Galileo, is under development.

GSM: Global System for Mobile communications. European-developed digital mobile cellular

standard. The most widespread 2G digital mobile cellular standard, available in over 170 countries worldwide. For more information see the GSM Association website at www.gsmworld.com/index.html.

Host: Any computer that can function as the beginning and end point of data transfers. Each internet host has a unique internet address (IP address) associated with a domain name.

HTML: Hypertext Markup Language. A Hypertext document format used on the World Wide Web. Mark-up languages for translating Web content onto mobile phones include cHTML, WML and xHTML.

HSDPA: High-Speed Downlink Packet Access. An enhancement protocol to W-CDMA networks that allows a higher data capacity in the down link up to 14.4Mbit/s.

HSUPA: High-Speed Uplink Packet Access. An enhancement protocol to W-CDMA networks that allows a higher data capacity in the up link up to 5.76 Mbit/s.

HTTP: Hypertext Transfer Protocol. Hypertext is any text that cross-references other textual information with hyperlinks.

Hz: Hertz. The frequency measurement unit equal to one cycle per second.

IM: Instant Messaging. It refers to programs such as AOL Instant Messenger and ICQ that allow users to exchange messages with other users over the internet with a maximum delay of one or two seconds at peak times.

IMS: IP Multimedia Subsystem. Framework originally developed by the 3rd Generation Partnership Projects (3GPP and 3GPP2) for their third generation mobile networks.

IMT-2000: International Mobile Telecommunications-2000. Third-generation (3G) "family" of mobile cellular standards approved by ITU. For more information see the website at www.itu.int/imt.

Infotainment: The combination of information on current event and entertainment content or of their formats.

internet: Interconnected global networks that use the internet protocol (see IP).

IP Telephony: internet protocol telephony. IP telephony is used as a generic term for the conveyance of voice, fax and related services, partially or wholly over packet-based, IP-based networks. See also VoIP and Voice over broadband.

IPv4: Internet protocol version 4. The version of IP in common use today.

IPv6: Internet protocol version 6. The emerging standard, which aims to rectify some of the problems seen with IPv4, in particular the shortage of address space.

IPTV: The generic term describes a system where a digital television service is delivered using the Internet Protocol over a network infrastructure.

ITU: International Telecommunication Union. The United Nations specialized agency for telecommunications. See www.itu.int.

LAN: Local area network. A computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANs over any distance via telephone lines and radio waves. A system of LANs connected in this way is called a wide-area network (WAN).

LBS: Location-based services. LBS make use of information on the location of a mobile device and user, and can exploit a number of technologies for the geographic location of a user. Some of these technologies are embedded in the networks and others in the handsets themselves. Location capability is already available to some level of accuracy (approx. 150 m) for most users of cellular networks. Increased accuracy can become available through location technologies such as GPS.

Main telephone line: Telephone line connecting a subscriber to the telephone exchange equipment. This term is synonymous with the term 'fixed line' used in this report.

MMS: Multimedia Message Service. MMS will provide more sophisticated mobile messaging than SMS or EMS. A global standard for messaging, MMS will enable users to send and receive messages with

formatted text, graphics, audio and video clips. Unlike SMS and most EMS, it will not be limited to 160-characters per message.

Mobile: As used in this report, the term refers to mobile cellular systems.

NGN: Next generation networks. These are packet-based networks in which service-related functions are independent from underlying transport-related technologies. They are able to provide telecommunication services and make use of multiple broadband transport technologies.

Packet: Block or grouping of data that is treated as a single unit within a communication network.

Packet-based: Message-delivery technique in which packets are relayed through stations in a network. See also Circuit-switched connection.

PDA: Personal digital assistant. A generic term for handheld devices that combine computing and possibly communication functions.

Penetration: A measurement of access to telecommunications, normally calculated by dividing the number of subscribers to a particular service by the population and multiplying by 100. Also referred to as teledensity (for fixed-line networks) or mobile density (for cellular ones), or total teledensity (fixed and mobile combined).

PETS: Privacy enhancing technologies. Either stand alone solutions helping individuals and companies protect their privacy or add-on features designed to enhance the privacy of an existing system.

PPP: Purchasing power parity. An exchange rate that reflects how many goods and services can be purchased within a country taking into account different price levels and cost of living across countries.

Protocol: A set of formal rules and specifications describing how to transmit data, especially across a network.

RFID: Radio frequency identification. A system of radio tagging that provides identification data for goods in order to make them traceable. Typically used by manufacturers to make goods such as clothing items traceable without having to read bar code data for individual items.

Robotics: A branch of engineering that involves the conception, design, manufacture, and operation of robots which is a mechanical device that performs a variety of often complex human tasks on command or through advanced programming.

Sensor: A device, such as a photoelectric cell, that receives and responds to a signal or stimulus.

Server: (1) A host computer on a network that sends stored information in response to requests or queries.
(2) The term server is also used to refer to the software that makes the process of serving information possible.

SIM: Subscriber identity module (card). A small printed circuit board inserted into a GSM-based mobile phone. It includes subscriber details, security information and a memory for a personal directory of numbers. This information can be retained by subscribers when changing handsets.

Skimming: Refers to the unauthorized capture by an intruder of electronic information contained in a chip or tag, such as a passport chip.

SMS: Short Message Service. A service available on digital networks, typically enabling messages with up to 160 characters to be sent or received via the message centre of a network operator to a subscriber's mobile phone.

Spectrum: The radio frequency spectrum of hertzian waves used as a transmission medium for cellular radio, radiopaging, satellite communication, over-the-air broadcasting and other services.

TD-SCDMA: Time Division Synchronous Code Division Multiple Access. A third-generation mobile standard under the IMT-2000 project. It uses spread spectrum CDMA technology in the TDD technique.

Teledensity: Number of main telephone lines per 100 inhabitants within a geographical area. Effective teledensity reports fixed-line teledensity or mobile density—whichever is higher—in a particular geographical region. See Penetration and Total teledensity.

Total teledensity: Sum of the number of fixed lines and mobile phone subscribers per 100 inhabitants. (See Technical notes). See Penetration.

Trust: The property of a system that it will behave in the expected manner for the intended purpose.

Universal Access: Refers to reasonable telecommunication access for all. Includes universal service for those that can afford individual telephone service and widespread provision of public telephones within a reasonable distance of others.

UWB: Ultra-Wide Band. Wireless communications technology that can currently transmit data at speeds between 40 to 60 megabits per second and eventually up to 1 gigabit per second. It uses ultra-low power radio signals.

VoIP: Voice over IP. The generic term used to describe the techniques used to carry voice traffic over IP (see also IP telephony).

W-CDMA: Wideband code division multiple access. A third-generation mobile standard under the IMT-2000 banner, first deployed in Japan. Known as UMTS in Europe. See also CDMA.

Wi-Fi: Wireless fidelity. A mark of interoperability among devices adhering to the 802.11b specification for Wireless LANs from the Institute of Electrical and Electronics Engineers (IEEE). However, the term Wi-Fi is sometimes mistakenly used as a generic term for wireless LAN.

WiMAX: Fixed wireless standard IEEE 802.16 that allows for long-range wireless communication at 70 Mbit/s over 50 kilometres. It can be used as a backbone internet connection to rural areas.

Wireless: Generic term for mobile communication services which do not use fixed-line networks for direct access to the subscriber.

WLAN: Wireless local area network. Also known as Wireless LAN or Radio LAN. A wireless network whereby a user can connect to a local area network (LAN) through a wireless (radio) connection, as an alternative to a wired local area network. The most popular standard for wireless LANs is the IEEE 802.11 series.

WLL: Wireless local loop. Typically a phone network that relies on wireless technologies to provide the last kilometre connection between the telecommunication central office and the end-user.

WMAN: Wireless Metropolitan Access Network. Refers to a wireless communications network that covers a geographic area, such as a city or suburb.

WSIS: The United Nations World Summit on the Information Society. The first phase of WSIS took place in Geneva (hosted by the Government of Switzerland) from 10 to 12 December 2003. The second phase will take place in Tunis (hosted by the Government of Tunisia), from 16 to 18 November 2005. For more information see: www.itu.int/wsis.

WWW: World Wide Web. (1) Technically refers to the hypertext servers (HTTP servers) which are the servers that allow text, graphics, and sound files to be mixed together.
(2) Loosely refers to all types of resources that can be accessed.

xDSL: While DSL stands for digital subscriber line, xDSL is the general representation for various types of digital subscriber line technology, such as ADSL (asynchronous digital subscriber line), such as VDSL (very high-speed digital subscriber line).

List of abbreviations & acronyms

Note: This list includes abbreviations and acronyms not otherwise mentioned in the glossary. The list aims to cover the main terms used in this report, but is not exhaustive.

2G	2nd Generation
3G	3rd Generation
CCTV	Closed caption television
COFDM	Coded orthogonal frequency division multiplexing
DAB	Digital audio broadcasting
DMB	Digital multimedia broadcasting
DSL	Digital subscriber line
DVB	Digital video broadcasting
DVD	Digital videodisc
EC	European Commission
EFF	Electronic Frontier Foundation
E-mail	Electronic mail
EPIC	Electronic Information Privacy Organization
ETRI	Electronics and Telecommunications Research Institute
ETSI	European Telecommunications Standards Institute
EU	European Union
EV-DO	Evolution data optimized
FDD	Frequency division duplex
GHz	Gigahertz
GSM	Global System for Mobile Communications
HDTV	High definition television
ICT	Information and communication technologies
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMS	IP multimedia subsystem
IMT-2000	International mobile telecommunications-2000
IP	Internet protocol
IPR	Intellectual property rights
ISO	International Organization for Standardization
ISP	internet Service Provider
ITU	International Telecommunication Union
kHz	kiloHertz
LAN	Local area network

LDC	Least developed countries
MHz	Megahertz
MMS	Multimedia message service
MP3	MPEG-1 Audio Layer-3
MP4	MPEG-4 Part 14
MPEG	Moving Picture Experts Group
NFC	Near Field Communication
OECD	Organisation for Economic Co-operation and Development
P2P	Peer-to-peer
P3P	Platform for privacy preferences
PDA	Personal digital assistant
PKI	Public key infrastructure
PSTN	Public switched telephone network
PTO	Public telephone operator, also public telecommunications operator
SIN	Single identification number
SPU	ITU Strategy and Policy Unit
TDD	Time division duplex
UN	United Nations
URL	Uniform resource locator
USD	United States dollars
W3C	World Wide Web Consortium
Wi-Fi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless local area network
WLL	Wireless local loop
XML	Extensible markup language

chapter one
going digital

1.1 The importance of being digital

We are in the middle of a digital revolution. Around one in every three people on the planet now carries a digital mobile phone around with them wherever they go. Globally, more hours are spent consuming digital media, such as the internet, than any analogue media, including television and radio. Digital technologies are transforming businesses and governments, and changing the ways we live and interact. The 2006 ITU TELECOM WORLD event, in Hong Kong, China (4-8 December 2006) for which this report has been prepared has the tagline "Living the Digital World". But what does it mean to be "digital"?[1]

In a sense, humans have always been digital, but this magical word "digital" needs some demystification. The word "digital" arises from the Latin "*digitus*", meaning "finger". This, then, is its first meaning. Fingers have always been used to signal, among other things, numerical data such as number and quantity. Later, the notion of a number, as expressed by the finger, was transferred to the written or oral symbol, i.e. number or digit. This is the second meaning. The decimal system, or the system based on ten digits, is the one most of us use and are familiar with.

From days immemorial, the digits of the hand have been used to create, to innovate, and to communicate. And just as they were used to represent discrete numbers, in recent times, a system of discrete binary digits (limited to the two digits: zero and one) has been developed to which all transmissible data can be reduced. This binary digit system is the modern and third meaning of this widely used word. Otherwise stated, in ordinary technological parlance today, when speaking of "digital", we mean machines capable of recording, transmitting, or receiving data in binary digit form.

The various advantages of the use of this method for data storage and transmission are discussed further in this publication. In this context, it is striking that smoke signals and even the Morse and Murray codes relied upon the binary idea (off and on, dot or dash). And one may say that, in this sense, technology has come around full circle.

Digital technologies have been crucial in the distribution of knowledge and information, which many argue are at the core of power in society. Through the use of communication technologies like the internet and the mobile phone, the reach of our relatively short digits has been extended to a much larger sphere—that of the global digital world.

1.1.1 The rule of the thumb

As a digit, the human thumb (also known as pollex) merits special attention. It is unique in that it has much more freedom of movement and is opposable to the tips of all of the other fingers. This has distinguished human beings from other members of the animal kingdom, including primates. Charles Darwin pointed to the pivotal role of the opposable thumb in the evolution of the human species[2].

In English, the alternative word for "thumb" is "*pollex*", from the Latin. In Latin, the derivation of the

latter from "*polleo*" meaning "powerful" is significant, revealing the singular importance assigned to this digit. In Roman times, the thumb was used in many aspects of culture–it played a prominent role for the preparation of medicines[3] and in voting for death in the gladiatorial arena.

The Greeks were no less attached to their thumbs, calling them "*αντιχειρας*" or "*anticheir*" meaning "another hand"[4]. If one is adept at making plants grow, one is said to have a "green thumb". As Isaac Newton once remarked–"in the absence of any other proof, the thumb alone would convince me of God's existence". Indeed, in many cultures, the thumb has become a vital tool for social relationships. In Europe and the Americas, it is used for hitchhiking or as a signal for victory, agreement, or going ahead ("thumbs up"). In India, the thumb has long been used by priests, and other authorized persons, to place the sacred mark on the forehead.

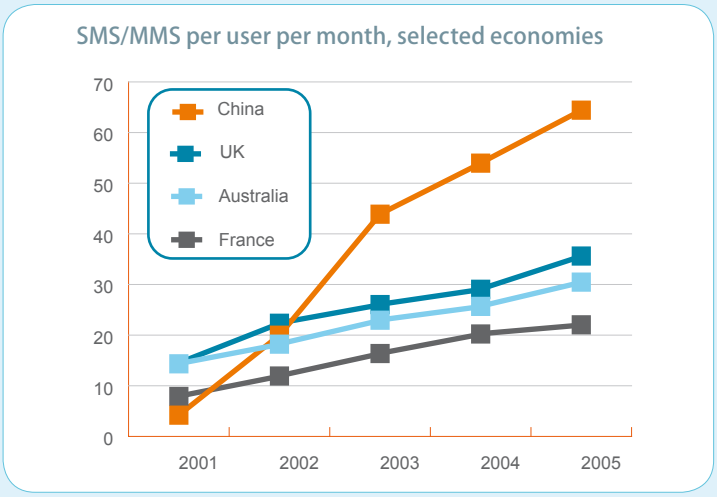
Today, the thumb can be seen as a cementing force in human society. From the narrow streets of Varanasi (India) to the wide avenues of Barcelona (Spain), people are regularly seen walking, eating, talking and even driving while their thumbs busily tap on the keypads of handheld digital devices. As an industry sector, messaging on mobile phones has in the space of just a few years become a global industry generating around USD 80 billion annually in revenue[5]. Interestingly, it has also taken off faster in some developing countries, like China or the Philippines, than in many developed countries (figure 1.1 and box 3.2). Expressions like "thumb culture" and "thumb tribes"[6] are widespread, as the mobile phone gets closer to the human body[7], providing a digital extension of the physical self.

Due to the thumb's important role in digital messaging (and also gaming), it has been observed that it is replacing other digits in different categories of tasks, from pointing to ringing doorbells, e.g. in countries like Japan[8]. So it is no wonder that people have been known to complain of the occasional repetitive strain injury due to overuse[9]. In his book "The Singularity is Near"[10], Ray Kurzweil talks about the role of this important digit in enabling humans to evolve far ahead of animals, allowing them to experiment and build things. The thumb has long been a catalyst for innovation and invention, and it seems it will continue to be so for some time to come.

1.1.2 From digits to digital

Digital technologies, as they are known today, have radically transformed businesses and individual

Figure 1.1: Thumb culture
Growth in SMS/MMS usage in selected economies, 2001-2005



Source: ITU, adapted from Eurostat, OECD, OFCOM, China Mobile, China Unicom

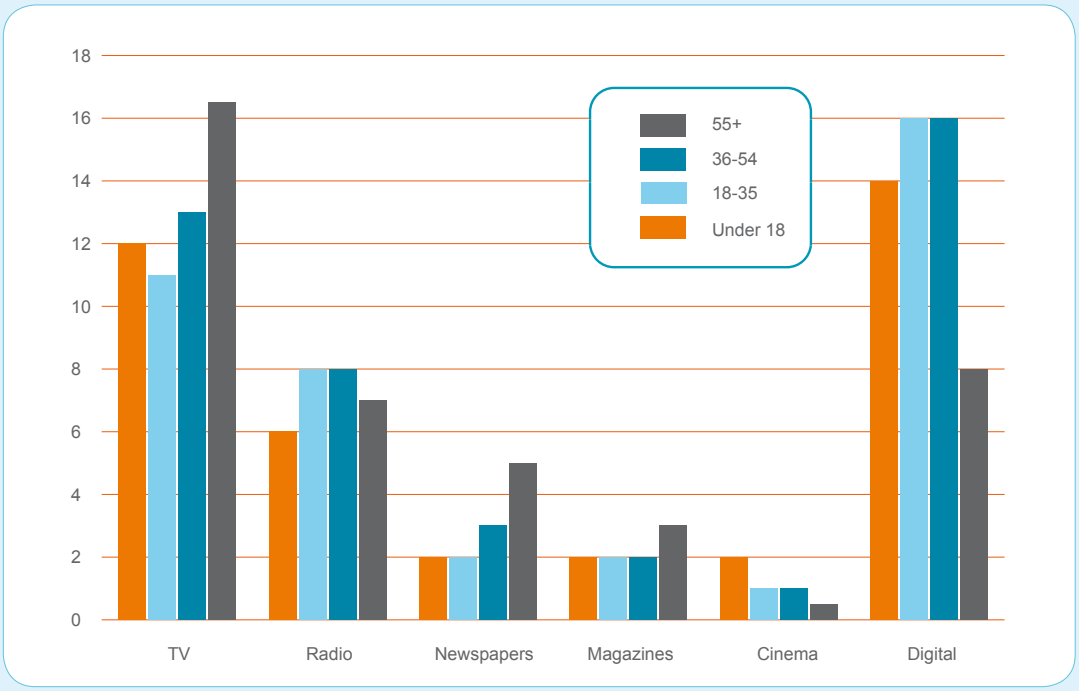
lifestyles alike. Storage and communications have been made much more efficient. The digitization of information also makes it more easily transferable between media, reduces information loss, and is more suitable for remote or distributed access. Underlying these developments was the microprocessor—a catalyst for technological development and at the heart of Moore's law, which stipulates that processing power will double every 18 months. The internet, especially since the creation of the World Wide Web (WWW), has allowed humans to create and share information and knowledge instantly on a global scale. The advent of digital mobile technologies was an equally revolutionary development, as technologies like GSM and CDMA heralded the dawn of an entirely new world of digital individuals who, even on the move, remain constantly networked and connected.

The use of digital techniques offers a number of advantages over the analogue equivalent:

- Digital techniques can enable large numbers of copies to be produced at low cost;
- Digital copies are more faithful to the original;
- Digital media makes it easier for virtually anyone to create, save, edit, and distribute any document or part thereof;
- Digital storage allows a greater volume of information to be stored and made available with the same resources;
- Digital signals are more robust and less vulnerable to static and noise or degradation over time;
- Digital technologies enable greater speeds of communication, a higher number of channels and frequencies, and a higher resolution of images and sounds.

Not surprisingly, the global consumption of media today is primarily in digital form, with those under the age of 55 spending more time consuming digital media than any other type of media, including traditional television and radio (figure 1.2). Broadband is leading to more diverse and

Figure 1.2: Going digital
Global consumption of media during leisure time by age group (hours per week)



Source: Adapted from *Financial Times*, "Advertisers in search of revenues look to web's latest heroes", 23 August 2006, based on figures from Nielsen/Net Ratings & Credit Suisse

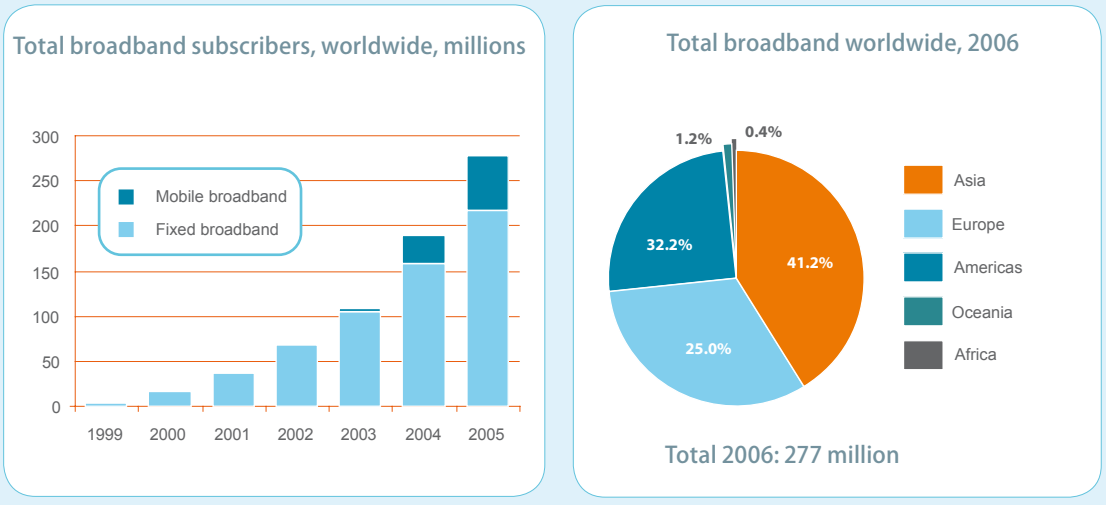
on-demand content services. Moreover, digital platforms are being used for banking and other transactions: from e-commerce to new mobile payment systems. We are witnessing what has been termed a "digital revolution", which had its beginnings in the early 1980s and refers to the replacement of analogue devices and services with their digital successors. This technological shift has brought about considerable change in the human condition itself, especially in its socio-economic and cultural aspects.

The transition from narrowband to broadband[11] digital networks (figure 1.3) is now well-advanced in the fixed-line world where there were some 216 million broadband subscribers across the world at the end of 2005 (see data table 6), amounting to just over half the total number of internet subscribers and around one-fifth of total fixed lines. In the mobile network, the transition to broadband has been slower, but as of the end of 2005 there were just over 60 million mobile broadband users in around 60 different economies, representing almost three per cent of total mobile users (see data table 4).

1.2 Digital, invisible and ubiquitous

The next step in the digital revolution is digital ubiquity. Technical innovation based on advances in, *inter alia*, radio-frequency identification (RFID) and sensor technologies, are giving rise to a new paradigm for the digital age, in which information and communications capabilities would be invisibly embedded in the environment around us. In this future "internet of things"[12], mundane daily tasks would be fully automated and no longer require manual input. Technology would seem to slowly fade and disappear from the consciousness of the user. This notion of "ubiquitous computing", which was first expounded by Mark Weiser, points to the "invisibility" of technology through the transformation of everyday items into tiny computers[13]. We should thus expect to see the computer, which has already transformed itself from the mainframe (one computer for many people) to the personal computer (one computer per person), to proceed to the phase of the ever-present (ubiquitous) computer (many computers per person) (figure 1.4).

Figure 1.3: Broadening the scope
Development of broadband networks, worldwide, 1999-2005 and by region, 2006

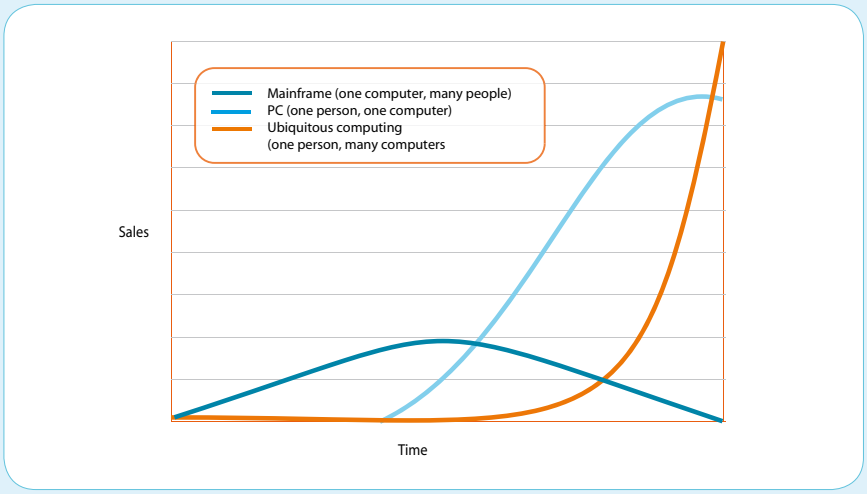


Note: "Broadband" in this context means networks offering capacity equal to or greater than 256 kbit/s in one or both directions. For mobile services, this includes W-CDMA, CDMA 1x EV-DO and CDMA 1x EV-DV. For fixed-line broadband it includes DSL, cable modems, metro ethernet, fixed wireless access, fibre to the home, etc. (see Technical notes).

Source: ITU (see data tables 4 and 6)

Figure 1.4: The ubiquity of digital

From one computer for many people to many computers for one person



Source: Adapted from Ignas G. Niemegeers, "The Invisible Network", TU Delft, 2005

People today have a large number of personal devices that they carry around with them daily, what with laptops and mobile phones, digital cameras and portable music players, to name the popular items. One out of every three human beings on the planet is a mobile user[14], and more and more mobile phones are coming equipped with digital cameras and music-playing capabilities. As such, the mobile phone has begun to resemble a pocket computer more than a telephone. Household appliances have also begun taking a similar route, with audio/video devices embracing digital and processing capabilities, together with other white goods such as fridges and ovens. Not only is the workplace being increasingly equipped with digital information and communication technologies, but so too are our cars and homes. Passengers in moving vehicles might enjoy internet access and digital television, before heading home to a fridge stocked with fruit juices pre-ordered via the internet, and an oven that has been pre-set to cook a casserole.

1.3 Digital dilemmas, digital dexterity

As the world becomes increasingly digital, new challenges and important dilemmas arise for businesses and policy-makers. Private individuals, too, are faced with a bewildering number of choices for their information and communications needs.

For businesses, one of the main areas of concern is deploying services that are of interest to the end-user, while providing an adequate return on investment. In this context, customer retention is more to the point than customer acquisition, at least in the long-run and particularly in markets nearing saturation.

A level-playing field is considered to be vital to stimulating investment, affordability and innovation. This holds no less true for the information and communication sector. As such, policy-makers have been increasingly relying on general principles of competition policy to ensure that incumbents do not possess undue advantages over their competitors and that new entrants are not squeezed out of the market. In an era of digital convergence, these tasks are rendered all the more complex, due to services having to be delivered through a complex array of channels and media. Moreover, deriving value from these services is no longer as straightforward as it has been in the past, when there was typically one network per service provided. In today's multi-service and multi-network environment, operators and service providers are faced with important choices: collaboration, competition, innovation or a combination?

Nowhere is this more evident than in the content market. The role of content provider, network operator and service provider are not yet distinctly clear and this is so not only among businesses themselves, but also among regulators and industry watchdogs. For instance, the allocation and degree of responsibility for content transmitted over a network remains a grey area. Both regulators and businesses need added flexibility and dexterity in dealing with these new and important issues. Change, which lies at the very foundation of the new digital world, will be a constant driving force and will require continuous adaptation and rapid response.

As always-on digital access becomes the norm, users must learn to manage a new digital lifestyle—both in terms of the benefits it yields but also the threats it poses. One of the most important areas in this regard is the protection of privacy and identity. In the digital world, there are times when people need to represent themselves accurately and securely, for instance, for the purposes of e-commerce. However, there are other circumstances in which people may want to have the freedom to project a persona in cyberspace which is quite different to that in the real world. Being able to distinguish between the two in a manner which is predictable, proportional, manageable, and socially acceptable is important for maintaining human dignity in an ever deepening sea of digits.

1.4 About this report

This report, entitled digital.life, is the eighth in the series of ITU Internet Reports. The reports series, which was launched in 1997, has been tracking the development of the internet worldwide. This edition focuses on consumers and looks at how human lives are being shaped and re-shaped by advances in digital technologies:

- Chapter two, lifestyles.digital, begins by examining the underlying technological enablers of new network infrastructures and content diversification;
- Chapter three, business.digital, considers how businesses are adapting to fast-paced digital innovation, how digital access can be extended to underserved areas, and how policy-making might need to adapt in light of rapid media convergence;
- Chapter four, identity.digital, explores the changing nature and role of the digital individual and of digital identity (both abstract and practical) as human lives become increasingly mediated by technology;
- Chapter five, living the digital world, concludes by putting forth a number of important challenges to be addressed, and imagining how our lifestyles might evolve in the digital age.

The Information Society Statistics in the annex to the report present the latest available data for more than 200 economies worldwide in terms of their use of digital information and communication services.

Endnotes for Chapter one

1 "Being digital" was the title of a seminal book by Nicholas Negroponte published in 1995.

2 Charles Darwin, The Descent of Man, 1871.

3 Anthony Corbeill, Nature Embodied: Gesture in Ancient Rome, Princeton University Press, 2004.

4 Michel de Montaigne, "Of Thumbs", Essays, 1533-1592.

5 There are many different and wildly varying estimates of the size of the global market for SMS and MMS traffic. For instance, Portia Research estimate the global market for mobile messaging to have been worth USD 55bn in 2005 (see www.portioresearch.com/Mob_Mess_Fut_brochure.pdf). IMImobile estimates that 92 billion SMS/MMS were generated each month in 2005 (see www.imimobile.com/whitepapers/MMSC%20Whitepaper.pdf#search=%22sms%20market%20size%22). The GSM Association estimates a total of one trillion SMS were sent during 2005 (see www.gsmworld.com/services/messaging.shtml). At a conservative estimate of USD 0.08 per message, this generates a total market size of USD 80 billion. The global average price for an SMS was around USD 0.12 in 2006 (see data table 3).

6 Howard Rheingold, Smart Mobs: The Next Social Revolution, Perseus Books, 2002.

7 Lara Srivastava, "Mobile manners, mobile mania", in P. Glotz, S. Bertschi, C. Locke (eds), Thumb Culture: The meaning of Mobile Phones for Society, Transcript, 2005.

8 Sadie Plant, On the Mobile, Motorola, 2002.

9 New York Times, "All thumbs, without the stigma", 12 August 2004.

10 Ray Kurzweil, "The Singularity is Near: When Humans Transcend Biology", Penguin Group, 2005.

11 In this content, "broadband" is defined as a network offering a combined speed of equal to, or greater than, 256 kbit/s in one or both directions.

12 ITU Internet Report 2005: The Internet of Things, November 2005 (available at www.itu.int/internetofthings).

13 Mark Weiser, The Computer for the 21st Century, Scientific American, September 1991.

14 ITU Information Society Statistics Database. There were 2.17 billion mobile phone subscribers in January 2006.

chapter two
lifestyles.digital

This chapter examines the key digital enablers that constitute the platforms for our new digital lifestyle. It discusses how digitization has changed the way we communicate and the astonishing growth in digital content worldwide, generated both by companies and end-users themselves. It ends with an exploration of promising recent developments in the area of digital transactions.

2.1 Digital enablers

Long anticipated, digital convergence is now becoming a reality in many areas. Formerly segregated user services are merging due to network convergence between fixed line and wireless networks. Advances in connected computing will further enable networks of composed of millions of tiny devices with the ability to compute and to communicate via the internet. Media convergence is generating new avenues for distributing digital entertainment. User devices, as the entry point for these networks, are transforming into multi-functional gadgets but, at the same time, allowing for more personalization of features. The process of digital transformation, driven by technology and innovation, is only just beginning.[1]

2.1.1 From narrowband to broadband

Faced with the relentless growth in demand for bandwidth across all types of network, operators are pushing for ever more powerful infrastructure. "Broadband" connections, on both fixed and mobile networks, are becoming the norm in the industrialized world and beyond. As of the end of 2005, some 166 economies had launched fixed-line broadband services (figure 2.1, left chart) and a further 60 or so economies had launched mobile broadband services (see data table 4). In both fixed line and cellular markets, the transition to higher capacity networks is accompanied also by a shift to IP-based networks.

2.1.2 Mobile broadband

The number of mobile phones users worldwide passed the 2 billion mark in late 2005. While it took around 21 years to reach the first billion users, the second billion signed up in just the three years (figure 2.2). By contrast, it took some 125 years to reach the first billion fixed lines users. In the cellular industry, the evolution from second to third generation networks is arguably just as important as the jump from analogue to digital (which took place more than a decade ago) and is proceeding much more rapidly. By the end of 2005, the number of subscribers to 3G mobile networks of broadband speed (equal to or greater than 256 kbit/s in one or both directions) was just over 60 million and a further 50 million or so were added during the first six months of 2006, passing the 100m subscribers mark.[2] This is a significant milestone and illustrates that this technology is approaching maturity.

Although 2G networks are adequate for voice, there is a growing interest in shifting from 2G to 3G, based on a number of important drivers. First, the higher speed of 3G technologies translates into added convenience, capacity and functionality for the user. Second, there is much excitement over adding IP capability, and hence internet access, to the mobile phone. 3G networks also use the spectrum more efficiently, and support a family of global standards to facilitate roaming. In developing 3G standards, ITU worked with regional bodies and industry associations to reduce a large number of initial proposals to a smaller number of global standards (the IMT-2000 family[3]) to ensure interoperability.

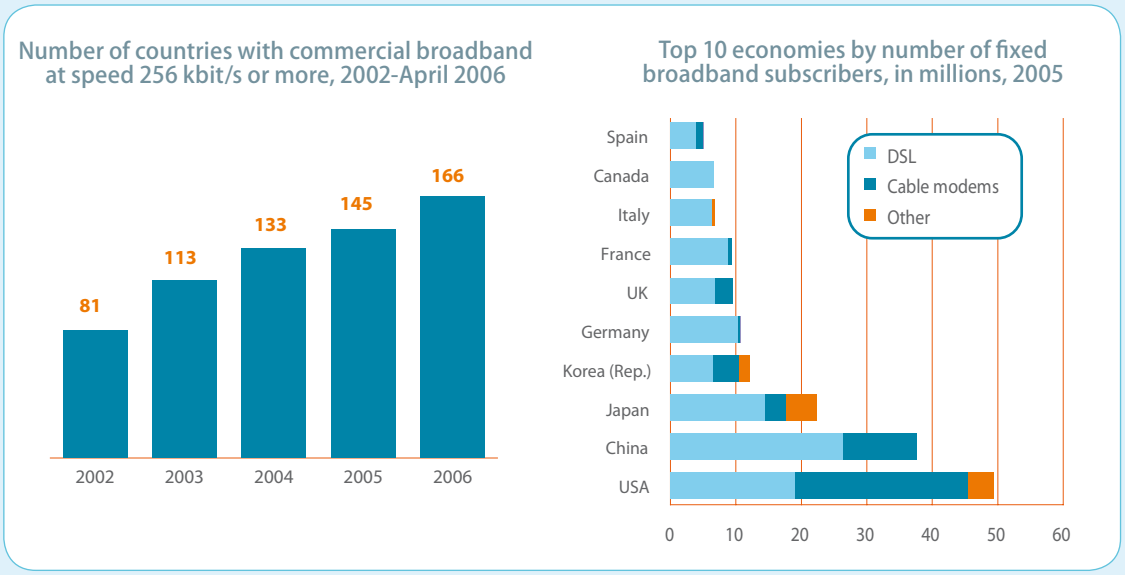
The goal of the IMT-2000 project was to harmonize different radio interfaces and produce a single family of 3G standards that would be able to cover future value-added services and applications. Three different access technologies (TDMA, CDMA and FDMA) for five radio interfaces were included in the IMT-2000 family. Most 3G deployments to date have used one of two interfaces, CDMA 2000 and W-CDMA (also known in Europe as UMTS). China has chosen a third interface, TD-SCDMA, for its national deployment of 3G mobile. GSM EDGE handsets are also now available in many countries, but because of the methodological difficulty in tracking sales of handsets, consideration of EDGE is not covered in the statistics presented here.

W-CDMA (wideband code division multiple access)

Although 3G mobile services are a new departure for mobile communications, in practice, W-CDMA is perceived as the logical upgrade for GSM, which is the dominant 2G mobile standard worldwide with over 80 per cent of the installed base and more than two billion users worldwide[4]. In fact, W-CDMA has been dubbed "3GSM" for marketing purposes. W-CDMA was launched in Japan in 2001, when NTT DoCoMo launched its FOMA service. W-CDMA initially experienced a slow start in the global market, due to the high costs of building an entirely new network and some early difficulties in standardizing handsets and manufacturing them in bulk at a price that is competitive with 2G handsets. A further constraint, especially in Europe, was the huge amount of money committed by operators to obtain their 3G licenses at auctions. The value of licences exceeded USD 100 billion in Europe alone,

Figure 2.1: Building the broadband platform

Number of economies offering a commercial fixed-line broadband service, 2002-2006, and top ten broadband economies, 2005



Note: The charts cover fixed broadband services, at capacity equal to or greater than 256 kbit/s in one or both directions (see Technical notes).

Source: ITU World Information Society Report 2006 (left chart) and ITU Information Society Statistics Database (right chart)

and this was committed during the early part of the current decade and coincided with the bursting of the *dot.com* bubble, which saw billions of dollars wiped off the value of ICT companies (see chapter three).

Despite these early difficulties, W-CDMA has subsequently grown more rapidly and now constitutes around 60 per cent of the mobile broadband market (figure 2.3). It is the preferred technology in Europe and shares the market in Asia. W-CDMA is theoretically able to achieve a data rate of 2 Mbit/s for low-mobility environment, and 384 kbit/s for mobile systems and therefore fits within the adopted definition of "broadband". These speeds are adequate for downloading music and video to a handset. However, speeds achieved in the laboratory are not always matched in actual use.

For this reason, W-CDMA operators in many economies are already pressing ahead with a further upgrade to HSDPA (high-speed downlink packet access), a W-CDMA enhancement that promises to boost the download rate to a theoretical maximum of 14 Mbit/s. HSDPA is a software upgrade that can be deployed rapidly and cost effectively without the need for substantial infrastructure investment. It doubles network capacity, making the transmission of everything from voice calls to video pictures more efficient. HSDPA can boost download speeds as much as fivefold (box 2.1). An estimated 44 HSDPA networks were in service, and a further 70 networks were planned, in deployment or in trial by August 2006[5].

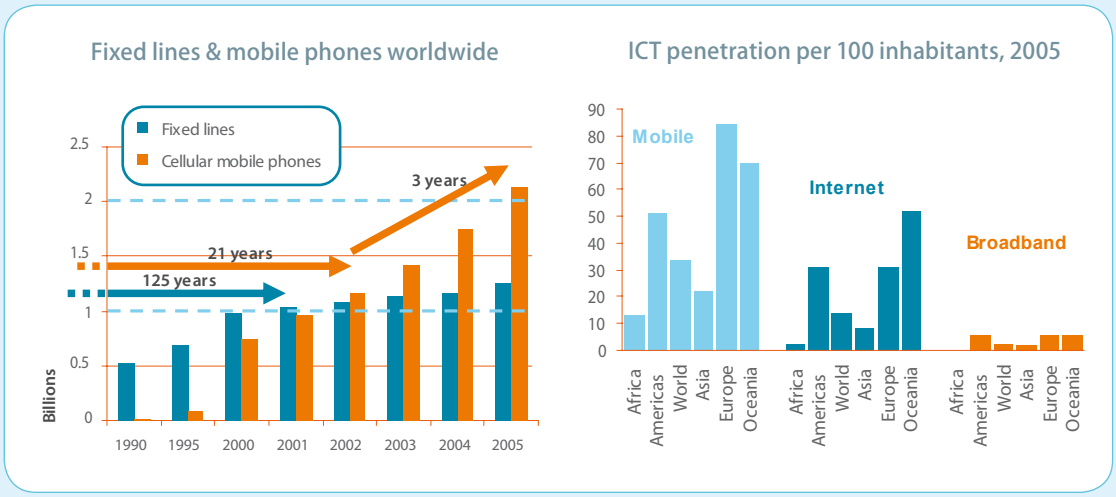
As the download speed of networks increases, user demand for higher speeds also increases, with users wishing not only to receive, but also transmit, more music and video. High-speed uplink packet access (HSUPA), as its name suggests, is the twin of HSDPA, offering uplink capacity of up to 5.76 Mbit/s. It provides a more efficient procedure for sending data through W-CDMA devices, ideal for data-intensive symmetrical data communications such as video over IP and interactive multimedia.

CDMA 2000 1x

In the same way that W-CDMA is perceived as the logical upgrade for 2G GSM networks, CDMA 2000 is the logical upgrade for 2G CDMA networks. CDMA2000 is also a member of the IMT-2000 family. The most widely deployed version—CDMA 1x—was the early winner in the race to 3G since the existing CDMA network, IS-95, can be relatively easily upgraded to CDMA2000 1x without requiring mobile network carriers to invest heavily in new infrastructure.

Figure 2.2: Beyond the first billion

Penetration rates of main fixed line and mobile networks, worldwide and by region



Source: ITU Information Society Statistics Database

Box 2.1: High-speed wireless internet: not the preserve of the rich world

HSDPA deployment in townships in South Africa where fixed-line connections are lacking

MTN, a mobile operator based in South Africa, is using HSDPA to provide a high-speed connection to a local entrepreneur's payphone shop in the Alexandra township near central Johannesburg—one of the first 'internet cafes' in the world to use HSDPA. People renting time on the computers situated in the booth will be able to access the internet at speeds of up to 1.8 Mbit/s. Another nine sites are connected to the internet via a GSM EDGE network, allowing download speeds at about 120 kbit/s.

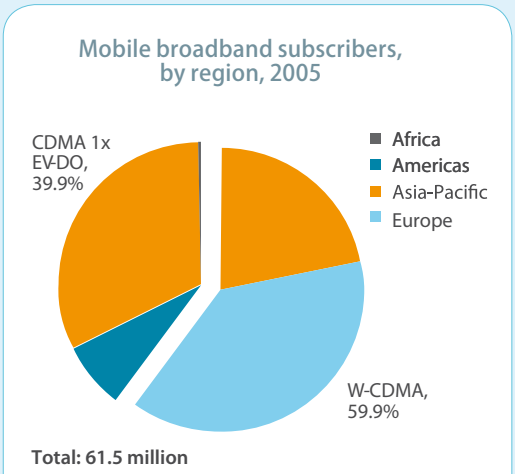
The early rollout of high-speed internet services by South African mobile operators demonstrates that technologies, such as HSDPA, are not solely the preserve of affluent developed countries and that mobile networks can bring far more than voice and text services to people in developing countries. To help accelerate the take-up of 3G in both the developing world and the developed world, the GSM Association recently launched a '3G for all' programme designed to make 3G services and handsets more affordable.

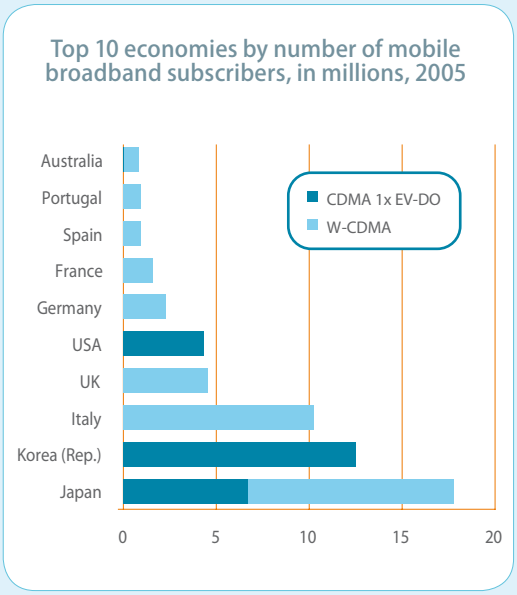
Image source: sxc.com

Source: mobileafrica.net

Figure 2.3: Broadband goes mobile

Breakdown of mobile broadband networks, by technology, and top ten mobile broadband economies, 2005





Note: Mobile broadband is defined here as services offering a minimum speed equal to, or greater than, 256 kbit/s in one or both directions.

Source: ITU Information Society Statistics Database

The world's first commercial IMT-2000 (3G) system was launched by SK Telecom (South Korea) in October 2000 using CDMA20001x. According to the CDMA Development Group, by mid 2006 there were some 164 commercial CDMA2000 systems serving more than 275 million users worldwide[6].

CDMA 2000 1x EV-DO

Although CDMA 1x is a part of the IMT-2000 family, it does not qualify as a mobile broadband system in that it offers capacity of below 256 kbit/s (see table 2.1). In order to compare the CDMA family with W-CDMA, it is more accurate therefore to compare CDMA 1x EV-DO (Evolution Data-Optimised). All of these networks require a major system upgrade or a radio overlay network, covering both hardware and software, and offer similar transmission speeds. ITU estimates that CDMA 1x EV-DO constitutes around 40 per cent of the global market for mobile broadband, and is currently the dominant technology in the USA and the Republic of Korea (figure 2.3). More information about CDMA 1x and the various releases is available in Table 2.1.

Table 2.1: The CDMA 1x family
CDMA 2000 1x standards and data rates

Standard	Data rate	Description
1x	Max. 153kbit/s (Release 0) or 307kbit/ s (Release 1) in a single 1.25 MHz channel.	Nearly doubles the voice capacity of 2G CDMA networks.
1xEV-DO Release 0	Theoretically up to 2.4 Mbit/s. In commercial networks it delivers 300-600 kbit/s on average in a single 1.25 MHz channel.	Supports advanced data applications, such as MP3 transfers, video conferencing, TV broadcasts, video and audio downloads. Commercially available since 2002.
1xEV-DO Revision A	Up to 3.1 Mbit/s on the downlink and 1.8 Mbit/s on the uplink, with quality of service (QoS) controls to manage latency on the network.	With Rev A, operators are able to introduce advanced multimedia services, including voice, data and broadcast over all-IP networks in commercial service now.
1xEV-DO Revision B	Forward link: 73.5 Mbit/s; Downlink: 27 Mbit/s. Combines fifteen 1.25 MHz carriers in a 20 MHz band. A single 1.25 MHz carrier and an aggregated 5 MHz carrier in the forward link will deliver a peak rate of up to 4.9 Mbit/s and 14.7 Mbit/s, respectively.	In addition to supporting mobile broadband data and OFDM-based multicasting, the lower latency characteristics of Rev B will improve the performance of delay-sensitive applications such as VoIP, push-to-talk over cellular, video telephony, concurrent voice and multimedia, and massive multiplayer online gaming. Rev B will be commercially available in 2008.

Source: CDMA Development Group

TD-SCDMA (time division synchronous code division multiple access)

The third main 3G mobile standard, which is recognised by ITU as part of the IMT-2000 family of standards, is TD-SCDMA (Time division synchronous code division multiple access). Time division multiplexing alternates time slots for sending and receiving data. As of October 2006, there were no commercial deployments of TD-SCDMA, but China has endorsed the standard. China has the world's largest mobile market, with some 395 million users at the end of 2005. This gives China tremendous bargaining power in shaping future mobile standards worldwide. It also means that Chinese manufacturers can achieve economies of scale just by serving their domestic market. A home-grown standard also benefits local equipment vendors by reducing the payment of royalties and patent fees.

2.1.3 Fixed broadband

The proliferation of new internet services, such as audio and video streaming, has boosted commercial and household broadband demand, stimulating infrastructure investment for fixed broadband, just as it has for mobile, albeit in a different way. The number of fixed broadband users surpassed the 200 million mark worldwide in late 2005, and broadband subscribers now outnumber narrowband internet subscribers (e.g. dial-up) on a global basis (figure 5.2). The preferred technologies are xDSL and cable modems which together accounted for around 94 per cent of the fixed broadband market at the end of 2005 (see data table 6). However, some of the fastest growth is now in other broadband technologies, in particular fibre to the home, office, curb and so on (FTTx).

Digital subscriber line technologies (xDSL)

The dial-up modem is being made obsolete by its speed limitations (typically 56 kbit/s). The Integrated services digital network (ISDN), at speeds of up to 144 kbit/s, offered some improvement, but generally not sufficient to make up for the higher price. Instead, an increasing number of users are moving directly from dial-up to digital subscriber line (DSL) technology, which uses the same twisted-pair copper telephone lines, but offers much higher speeds, suitable for multimedia and video applications. DSL deployment began in 1998, with the Republic of Korea taking an early lead which it has since maintained. The term xDSL covers a number of flavours of DSL technology, including ADSL, SHDSL and VDSL (see table 2.2).

The most popular DSL technology is ADSL (asymmetrical digital subscriber line) which has the bandwidth provision slanted in favour of downstream traffic. This asymmetry, combined with always-on access, makes ADSL ideal for web-browsing, file downloads, video-on-demand, remote LAN access etc. These applications typically have much greater download traffic than upload.

Basic ADSL can transmit at up to 6 Mbit/s to a subscriber, and a further 640 kbit/s for uplink, depending upon the distance of the subscriber from the nearest exchange, although these high speeds are rarely offered commercially (typically, commercial ADSL speeds are below 3 Mbit/s). In 2002, ITU-T completed the revision of new international ADSL standards, introducing ADSL2 (ITU G.992.3 and G.992.4) and bringing new features and functionality to improve performance and interoperability. ADSL2+ (G.992.5) doubles the downstream bandwidth and increases the data rate on telephone lines up to almost 3 kilometres. ADSL2+ specifies a downstream bit rate of up to 16 Mbit/s, resulting in a significant increase in data rates for subscribers close to the exchange. ADSL2+ also includes an optional mode that doubles the upstream data rate.

Cable modem service

Cable TV service has been widely available since the 1950s in the United States, Canada and some other countries, where it has a high penetration rate. Cable modems use the existing cable TV networks and coaxial cable to give subscribers

Table 2.2: The flavours of DSL
Description of selected xDSL technologies with data rate

xDSL	Description	ITU Recommendation	Net data rate
SHDSL	Single-pair high-speed digital subscriber line	G.991.2	192 kbit/s to 2.312 Mbit/s
ADSL	Asymmetric digital subscriber line	G.992.1	1.5 to 6.1 Mbit/s downstream 16 to 640 kbit/s upstream
ADSL2	Asymmetric digital subscriber line	G.992.3	up to 8 Mbit/s downstream up to 800 kbit/s upstream
ADSL2+	Asymmetric digital subscriber line 2+	G.992.5	up to 16 Mbit/s downstream up to 800 Mbit/s upstream
VDSL2	Very high-speed digital subscriber line 2	G.993.2	up to 100 Mbit/s downstream up to 100 Mbit/s upstream

Source: ITU

internet speeds of up to 1.2 Mbit/s theoretically. Cable modems account for around 30 per cent of the installed base of broadband users worldwide and they are the dominant technology for fixed broadband in North America.

However, as a means of providing broadband internet, cable modems have several shortcomings. First, cable networks are not widely available in most countries. Furthermore, the maximum speed claimed for cable is purely theoretical. In practice, cable modem services operate on the same principle as local area networks, i.e. the available capacity is shared between all connected users at any one time, to the cable head end. This means that performance is highly variable.

Fibre (FTTx)

The maximum upstream speeds delivered by DSL diminish as local loops gets longer. In view of the growing demand for bandwidth-hungry applications, some operators are now turning to very high-speed internet technologies, deploying fibre optics (already the technology of choice for the inter-urban network) in the access network. Fibre in the access network may either reach directly to the subscriber or to a nearby node (e.g. curb), with the last part of the link still over going twisted copper pair (see table 2.3).

FTTH (fibre to the home) was introduced in Japan in 1999, and by 2005 new FTTx subscribers outnumbered new DSL subscribers in that country. In the United States, 2.3 million households had access to FTTx at the end of 2005[7]. In Germany, Deutsche Telekom has announced plans to invest around USD 3.8 billion to deploy FTTN (fiber to the neighbourhood). One important regulatory issue is whether incumbent operators should be obliged to unbundle fibre in the access network and allow market entry by competitive service providers, as has happened in many countries with DSL unbundling. There is a fear, on the one hand, that unbundling fibre would deter fresh investment, and on the other hand, failing to oblige unbundling would create a new natural monopoly, in that it is hard to foresee residential applications that would require more than one fibre network supplier.

There are a number of other ways of providing broadband from fixed connections, including metro ethernet (also known as apartment LANs), broadband by satellite, fixed wireless access and so on. The most promising of these alternative technologies use wireless means, but without the use of cells to support roaming. They are neither strictly "fixed" nor "mobile" and can better be described as being "portable". These are discussed further below.

2.1.4 Portable internet

Wireless local area networks (WLAN)

In general terms, 3G cellular mobile services provide a high level of user mobility but a lower speed of connection, while fixed-line broadband services provide only limited mobility but a higher speed of connection. Between these two, "portable internet" technologies provide a better level of mobility than fixed services but a higher level of connectivity than cellular services. One of the first portable internet technologies was the wireless local area network (WLAN), based on the IEEE 802.11 family of standards (see table 2.4). The most popular is based on IEEE 802.11b and is known as Wi-Fi (wireless fidelity).

Wireless LANs use electromagnetic waves to transmit and receive data over short distances. In a typical WLAN configuration, mobile devices connect to a fixed broadband network via radio links with an "access point". However, as the technology develops, it is possible that some parts of the fixed network could be replaced with wireless technology. Also, in isolated regions, WLAN connectivity could be provided in tandem with a VSAT, a very small aperture terminal (box 2.2).

WLAN technology is particularly popular with home users, where it allows a broadband connection to be shared among several computers and devices scattered around the house. WLAN hotspots can also be found in airports, cafés and other public places. Although originally designed for short-range network connection, in developing countries WLANs are increasingly being used as backbone telecommunication infrastructure[8].

However, WLANs have a number of limitations, mainly related to their restricted geographical coverage. The growth of WLAN usage has also

made network security a problem. WEP (or wired equivalent privacy) was the original security scheme, but it could be cracked in less than a day of heavy traffic, using freely available programs such as AirSnort or WEPCrack. The Wi-Fi Alliance has since released an enhanced security scheme called Wi-Fi Protected Access (WPA), using much stronger encryption. Still, even this is not immune from hacking.

Wireless metropolitan area networks (WMAN)

Driven by the interest in WLAN hotspots, a number of more ambitious projects linking a metropolitan area with WLAN hotspots have been launched.

Wireless metropolitan area networks (WMANs) provide broadband internet access for fixed and mobile devices via base stations connected to a core network. They offer a low-cost, uncomplicated alternative to fixed-line infrastructure. To extend coverage, there are several approaches. One is to use numerous WLAN access points to cover a city. Another is to increase the signal power of the base stations greatly so as to reach mobile devices even at a considerable distance. This is the concept behind WiMAX and WiBro, which offer an interesting perspective for the future ubiquitous network.

IEEE 802.16 (WiMAX)

The initial specification for WiMAX (worldwide interoperability for microwave access or IEEE 802.16) was published in March 2002. WiMAX has been designed to transmit up to 70 Mbit/s over a maximum range of 50km. The service aims to offer users with laptops, PDAs or mobile handsets a high-speed internet link. It was in December 2005 that the IEEE ratified the 802.16e amendment to the 802.16 standard. Currently, there are more than 200 WiMAX trials underway around the world. WiMAX promises a cost-effective fixed wireless alternative to cable and DSL, allowing countries with limited fixed-line infrastructures to achieve broad connectivity with a high-speed network, without the need for large infrastructure investments. Although WiMAX is of particular interest to developing countries, as an alternative to fixed-line infrastructure, it can also be attractive in industrialized countries, particularly in densely populated areas like large urban centres (box 2.3).

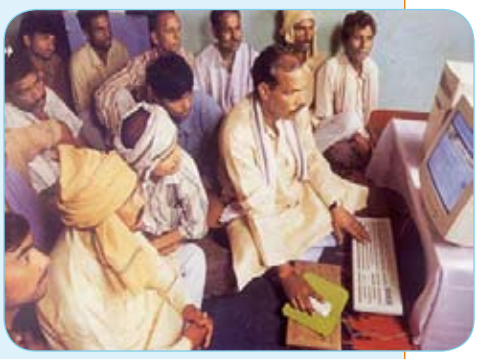
WiMAX is expected to be complementary to other wireless and wire-based technologies. For instance, it can complement WLAN networks, which are more suitable for high-volume indoor use, by providing wider coverage when outdoors. The specification has been enhanced to allow vendors to incorporate dual-mode chipsets in mobile devices, to support both technologies. In addition,

Table 2.3: The IEEE 802.11 family
A selection of different IEEE 802.11 technologies

Protocol	Release date	Frequency	Bandwidth
IEEE 802.11	1997	2.4 GHz	1, 2 Mbit/s
IEEE 802.11a	1999	5 GHz	6, 9, 12, 18, 24, 36, 48, 54 Mbit/s
IEEE 802.11b	1999	2.4 GHz	5.5, 11 Mbit/s
IEEE 802.11g	2003	2.4 GHz	6, 9, 12, 18, 24, 36, 48, 54 Mbit/s
IEEE 802.11n	expected mid-2007	2.4 GHz	540 Mbit/s

Source: Adapted from Sampalli Srinivas, October 2005

Box 2.2: Using satellites to bring connectivity to rural areas
ITC's eChoupal project uses VSAT technologies to get Indian farmers online



The International Business Division of ITC, one of India's largest exporters of agricultural commodities, has developed the eChoupal initiative to tackle the unique challenges facing Indian agriculture, with its fragmented farms, weak infrastructure and extensive chains of intermediaries.

Each village internet kiosk is managed by a farmer called *sanchalak*, who has a computer, typically in his or her own house, and an internet connection via a phone line or, increasingly, a VSAT connection. These kiosks serve an average of 600 farmers in 10 villages within a five kilometer radius. The *sanchalaks'* kiosks provide farmers with ready access to information, in their language, on weather, market prices, scientific farm practices and risk management. They facilitate the purchase of farm materials and the direct sale of farmers' produce.

The eChoupal projects allows farmers to take their own decisions, reacting to market demand and protecting quality and productivity. By pooling their requirements for farming materials and equipment, they are able to obtain more favourable conditions from vendors. In the future, a combination of VSAT and WLAN will further democratize internet access in the villages.

Image source: Digital Dividend Organisation

Source: eChoupal.com

WiMAX could eventually be combined with 3G mobile broadband to provide a customized high-speed environment whatever the location of the user.

2.2 Connected computing

In everyday life, there are always a number of routine, repetitive and mundane tasks to be carried out. Digital technologies have made some of these tasks easier and more efficient, e.g. paying bills. But a larger revolution may be at hand, one which will extend the power of digital technology beyond the mobile phone and the personal computer, to everyday items. In the future, all of the world's things may be connected to the global internet, through sensors, actuators and radio-frequency identification tags. Although the timescale of this revolution is yet unclear, the shape and scope of human activity is undergoing a radical transformation.

2.2.1 RFID (radio-frequency identification)

Radio-frequency identification (RFID) is a good example of an unobtrusive technology that has the potential to play a crucial role in creating a ubiquitously networked environment capable of transforming our daily lives. RFID uses electromagnetic radiation to identify a person or object[9]. The basic technological concept is a simple one, and its origins date back to the 1950s. An RFID system is made up of a transponder (tag) located on the person or object to be identified, and a reader (typically fitted with middleware) that forwards the data received to another system such as a desktop computer or database. When used in combination with sensor technologies, these systems can detect and control changes in their environment (see section 2.4.6). As such devices and tags become increasingly commonplace, a world of "ubiquitous computing" (as first described by Mark Weiser[10]) comes closer to realization, as does a global "internet of things", the subject of last year's ITU Internet Report[11].

RFID tags can be smaller than a square millimetre in size, and thinner than a sheet of paper[11]. Developments are ongoing to shrink their size further. Meanwhile, prices are also falling. In 2006, Hitachi announced that it had finally created the USD 5 cent tag[12], which is widely recognized as the magic price for mass deployment. At that price, RFID could compete with the traditional bar code, taking over many of its present day applications. In the past, comparatively higher tag costs largely restricted their use to high-value items. The cheapest and most widespread tags are passive tags, which are powered by energy they scavenge from the interrogating radio wave. By contrast, active tags have their own power source, and can generally transmit, as well as respond to data. Some tags are read-only, and others can be read-writable and even re-writable.

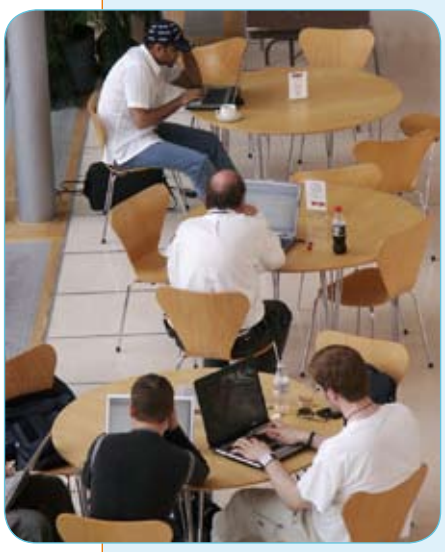
One of the early uses of RFID was in supply chain management. In supply chain management, tags can perform much more sophisticated functions than the traditional barcode. Since RFID does not require line-of-sight, it is much easier for manufacturers to identify and track stacked or piled items through the supply chain, and constantly monitor their status. Since each RFID tag is unique, each item can be tracked separately, in contrast to traditional barcodes, which cover only entire categories of items.

Retailers, too, have begun discovering the potential of RFID systems for front-end applications, e.g. to provide information about a product, such as washing instructions for an item of clothing, cooking or care instructions. A report from IDTechEx[13] estimates that, by 2008, retailers will account for over USD 1.3 billion of a global USD 7 billion RFID market (box 2.4).

Other sectors in which the potential of RFID has been recognized are transportation (RFID systems are already in operation for the collection of road tolls, for example), medicine and pharmaceuticals. Widespread tagging of medications through RFID can be used to fight drug counterfeiting - the tags help identify damaged, tampered, outdated medication for recalling. It can even be combined with sensor technology to monitor and maintain medical equipment and supplies, or to monitor the health of individual patients. RFID has been

Box 2.3: High-speed London

A WiMAX service for businesses in Westminster



A £4.4m (USD 8.8m) investment by Urban WiMAX is bringing wireless connectivity to businesses in central London, UK. Over 250 businesses volunteered to test-drive the high-speed wireless connection based on the WiMAX 802.16d-2004 standard. The first customers were connected in April 2006. Participants in include major corporations, media businesses and financial companies as well as members of the UK Parliament..

Initial sites were chosen with an eye to the application needs of the trial participants, so as to prove the technology's capabilities, including wireless 10 Mbit/s download and upload, closed-circuit television, voice and video.

Trial participants can use the pilot service free of charge. The full commercial launch of Urban WiMAX's service was planned for the third quarter of 2006. Urban WiMAX used advanced mapping software–the result of ten years of research and development–to solve the problem of non-line-of-sight delivery in urban areas.

Image source: flickr.com (Stuart Yeats)

Source: Digital Media Asia

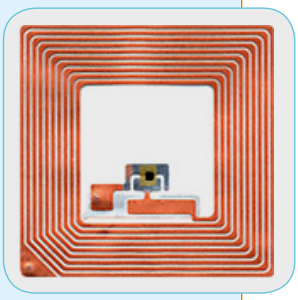
used to store individual patient information on wristbands. Precedents also exist for implanting RFID tags[14] in humans. As tags are typically the size of a grain of rice, they can be injected under human skin. Such implants are not dissimilar to identification chips used for pets or livestock.

The applications of RFID are already quite varied. RFID tags have been attached to the shoes of marathon runners to track their progress and used for monitoring the whereabouts of small children in theme parks. As it does not require contact, RFID is a key enabler of wireless contactless systems for payment: in Japan, users can pay for taxi fares using RFID-enabled mobile phones. The potential of RFID has been recognized outside the private sector, too. Governments are exploring the use of RFID for enhancing security, through tags in drivers' licenses, national passports, and even currency notes. The use of RFID is already cutting across many sectors, and the world market for this technology is likely to expand considerably over the coming years. The technology can be applied to existing processes, such as the supply chain, but can also open up entirely new markets. The combination of falling costs, shrinking size and computing power make RFID a technology to watch.

2.2.2 Sensors, actuators, and their networks

Sensors are devices that detect stimuli in a physical environment. They can detect changes in the environment and either indicate these directly (e.g. a stand-alone mercury thermometer) or pair with other indicators through an analogue to digital converter, to enable these results to be read and analyzed by humans. A sensor network is formed when there is more than one sensor feeding results back to a central server. Sensors in a network can also communicate with each other. When sensor networks operate without the use of cumbersome wires, information about environmental stimuli

Box 2.4: The RFID retail experience
Grocery shopping the RFID way



Both customers and retailers benefit from RFID technology. The journey starts in the factory, where RFID tags are employed throughout the supply chain to track items and manage supplies and deliveries.

Retailers can also analyse RFID tracking data to study consumer behaviour and purchasing patterns. They can use this information to streamline store layout and help shoppers find their way to the desired products (e.g. repeat purchases) faster and more efficiently. Additionally, RFID tracking can be used to better manage the movement of perishable goods and protect valuable items from theft.

For customers, shopping thus becomes easier and more convenient. At the checkout, RFID eliminates the need to unload and individually record each item purchased, by registering an entire basket or trolley full of RFID-tagged goods in an instant. Alternatively, the trolley itself could contain a reader, with a display showing the customer a running total of the items taken so far. The trolley can be personalized: after 'recognizing' the customer (from an RFID tag, mobile phone or key fob), the smart trolley would take known shopping preferences trolley into account and provide advice on special offers and promotions.

RFID in conjunction with contactless payment systems (see section 2.5.1) could greatly streamline and accelerate retail shopping. But it doesn't end there – on the way out the door, the customer's RFID-enabled phone exchanges codes with a reader on the car's dashboard, identifying the car's legitimate owner.

Image source: Barcode Solutions

Source: Adapted from ITU Internet Report 2005: "The Internet of Things", available at www.itu.int/internetofthings

can be transmitted over the air to a wide array of actuators and processing units. Sensors and their networks are already playing a vital role in medicine, industrial operation, environmental monitoring and robotics.

The constituent parts of a sensor network, namely the sensor nodes, are essentially tiny computers, very basic in terms of their interfaces and components. They are usually equipped with a processing unit with limited computational power and memory size, a sensor mechanism, a communication device and a battery as power source. A sensor network may have one or more base stations, possessing computational and communication power, thereby acting as gateway between sensor nodes and those responsible for the sensor monitoring.

Various applications have already been proposed for wireless sensor networks. In industry, for instance, they can be used to monitor hazardous, inaccessible environments. They can also be deployed in wilderness areas, monitoring the state of the environment autonomously without needing to be recharged or replaced. They can be used to form a dense security net around valuable objects, monitoring and tracking intrusions. In the digital world, wireless sensor network technology will be an important part of the coming "internet of things".

2.2.3 Robotics

The interaction between robots and humans has always inspired writers of science fiction. The dream that machines could help humankind with unpleasant, dangerous or simply tedious work is inherently appealing. The current renewal of interest in robotics outside the world of fiction is due mainly to the increasing maturity of robotic technology and falling costs. Today's wireless and sensor technologies also enable an unprecedented level of interaction between robots and the world around them.

Robots in the real world generally lack the glamour of their fictional paragons: they are machines designed to execute one or more tasks repeatedly, with speed and precision. There are as many (if not more) different types of robots as there are tasks for them to perform. A robot can be under the direct control of a human operator, or fully automated. The branch of engineering called robotics contains elements of electronics, mechanical engineering, computer science, artificial intelligence, nanotechnology and bioengineering.

Robots that are mobile can be classified as either androids or humanoids. Androids are usually fitted with wheels or tracks, robot legs being inherently unstable and difficult to engineer. They can be used for activities in extreme environments, rescues, or other onerous tasks. They can also serve as pets, such as the well-known Sony AIBO[15]. Humanoids, on the other hand, are designed to closely resemble human beings in form. Ideally, humanoids can walk and perform some basic human activities, such as carrying an object or recognizing speech (box 2.5). In order to make humanoids more accessible, a start-up company in France, for example, is planning to build an inexpensive, Wi-Fi-enabled humanoid robot, for the consumer market by early 2007[16].

Given the renewed interest in robotics, demonstrations of robots and robotic skills are multiplying across the globe. An exciting annual event for humanoids is the RoboCup soccer championship, held in 2006 in Bremen (Germany), at which teams of humanoids demonstrate how they master the complex skills needed for the sport, particularly as dexterity does not come easy to them.

2.2.4 Media convergence

As human work becomes ever more automated, and broadband technologies provide access anytime anywhere, people are beginning to consume an increasing amount of digital media. In particular, personal video recorders, MP3 players, and digital cameras combined with the wave of media convergence is changing the way we experience entertainment.

With the rapid growth of mobile phones, new technologies such as digital video broadcasting and digital multimedia broadcasting let viewers watch streamed content on mobile devices. Radio listeners have not been left out: digital audio broadcasting has led to tremendous quality improvements and transformed the listening experience, too. IPTV

technologies introduce an interactive dimension into television, giving viewers more control over what they watch, and when.

DAB (digital audio broadcasting)

Listeners to the BBC in the United Kingdom, and worldwide, can now record one BBC broadcast while listening to another live. Using a new digital radio system called DAB (or digital audio broadcasting), all national BBC radio stations are transmitted together using one carrier frequency, instead of many frequencies, as in the past. The audio data from different radio stations is transmitted in sequential slots, and the receiver filters them into different streams, corresponding to stations. This makes the system flexible enough for users to time-shift the programming. In addition, audio-on-demand is now possible on a number of radio stations and radio broadcasting websites: users can listen live to radio programming, or to archived material on the internet. This is also known as "internet radio".

DVB (digital video broadcasting)

In parallel to the changes re-shaping the radio world, there is also a global shift away from the analogue system that has dominated television during its first 45 years. An industry-led consortium called the Digital Video Broadcasting Project (DVB), formed by over 270 broadcasters, manufacturers, network operators, software developers and regulatory bodies in some 35 countries, is working on common standards for the global delivery of digital television and data services.

The DVB consortium has developed standards for cable, satellite and terrestrial digital TV. The terrestrial standard, DVB-T, was the subject of discussion at the Regional Radiocommunication Conference hosted by ITU in 2006 (RRC-06)[17], where participating countries from Europe, Africa and the Arab States agreed on a new frequency plan. As a result, DVB-T services will be offered in at least 114 countries, with a harmonised series of dates for the switchover from analogue to digital services.

DVB-T can be used to deliver multimedia programs to handheld devices, although power consumption remains an issue: currently, handheld battery-powered receivers do not have enough energy to receive a normal DVB-T signal for an extended period. Another standard in the same family, DVB-H, may be more appropriate for handheld devices and also lends itself to IP datacasting, thereby facilitating the interoperability of telecommunications and broadcasting networks (box 2.6).

DVB-H faces competition from 3G networks operators, however, who are also capable of providing mobile television services, such as MBMS (multimedia broadcast multicast service) offered by 3G networks. But in their present state (without the HSDPA upgrade), 3G networks may have difficulty in providing affordable real-time broadcast TV services. For this reason, it is more likely that 3G handsets will be offered with multimodal capabilities.

Box 2.5: Musical robot

Japanese car maker Toyota builds a trumpet-playing robot

"He" stands 120 cm (four feet) tall and still doesn't have a name. So far he knows only one song on his trumpet, "When You Wish Upon A Star". But he is learning…

This talented robot is the latest in a series developed by Japanese companies to showcase humanoid robotics. Sony, too (like Toyota) has created Aibo, a robot dog with engagingly authentic canine habits, and the all-singing, all-dancing Qrio, which can jog along at a top speed of 14 m/min. Another car maker, Honda, has developed a walking humanoid called Asimo, which has been a travelling sensation all over the world. Robot development is a highly competitive business in Japan—the market is estimated to be worth around USD 4.5 billion. Japanese companies find the humanoid models to be excellent ambassadors and status symbols.

Image source: Toyota

Source: Various company websites, including sony.com and toyota.com

DMB (digital multimedia broadcasting)

As its name suggests, DMB is a digital transmission system for sending data, radio and TV to mobile devices. Users can enjoy TV programmes as well as audio and data services on DMB mobile phones, portable DMB receivers, or in DMB-enabled vehicles. However, the primary target market is the mobile phone user. DMB comes in two forms: satellite-based (S-DMB) or terrestrial (T-DMB). The main difference between the two in practical terms is that S-DMB provides broader geographical coverage.

The Republic of Korea inaugurated the world's first S-DMB service. TU Media, founded by the leading mobile carrier SK Telecom, received a license from the Korean Broadcasting Commission (KBC) in December 2004. In March 2005, T-DMB was launched in the Seoul metropolitan area. Japan is also at the forefront of the introduction of DMB technologies. Taxi passengers already watch television using S-DMB services (box 2.7). The S- DMB business model is based on subscription. By contrast, T-DMB relies solely on advertising, and provides popular television programming free of charge. Receivers of T-DMB can be integrated in car navigation systems, mobile phones, personal video players, laptops and even cameras. This flexibility is likely to give T-DMB the edge over S-DMB[18].

Although DMB technology promises mobility for television viewers, there are inherent limitations associated with screen size. Both its satellite and terrestrial versions provide video quality suitable for screens of 18 cm, adequate for taxi use, but nonetheless deemed small by some users. Projection onto a larger screen, however, results in unacceptable quality loss and would not substitute for existing technologies indoors.

IPTV (internet protocol television)

IPTV is set to radically change the entertainment landscape. The delivery of programming over a versatile IP network will mean that users can benefit from interactive services, while the market will be exposed to increased competition. IPTV describes a system capable of receiving and displaying a video stream encoded as a series of IP packets. An IPTV service is one where users can watch many different high-resolution programmes through a secure managed network. For residential users, IPTV is now being provided together with video on demand, or bundled with web access and VoIP telephony ("triple-play" or "multiple play" services)[19] using a single infrastructure. With the spread of IPTV, cable and telecommunication operators are increasingly turning to this new market for diversifying their revenues.

Box 2.6: 3 Italia kicks off!

First mobile TV service using DVB-H technology launched in Italy

The world's first commercial mobile TV service using DVB-H technology was launched in Italy on 5th June, 2006, just ahead of the FIFA World Cup. 3 Italia, the mobile network operator, claimed to have signed up 111'000 users in the first six weeks of operation. The operator is aiming to have 500'000 clients by the end of 2006. The rapidly-growing service is already available in over 2'000 Italian towns and cities.

Pay-as-you-go users can access the mobile TV service at EUR 3 (USD 4) per day, EUR 12 (USD 15) per week or EUR 29 (USD 37) per month. Alternatively, subscribers can pay EUR 49 (USD 63) per month for unlimited mobile TV services, one hour of calls per day and one gigabit worth of downloads per month.

Image source: DVB Project Office

Source: DVB Project Office at www.dvb-h.org

Box 2.7: Tokyo unveils satellite multimedia service for taxis

Japan launches MobaHO!, the world's first satellite multimedia broadcasting service for taxis

Two Japanese companies, Mobile Broadcasting and the taxi operator Daikoku Kotsu, have introduced MobaHO!, a satellite digital multimedia broadcasting service intended specifically for taxi passengers. Taxis are equipped with LCD monitors, which come with an internal speaker and are placed on the headrest of the passenger seat.

The S-DMB service provides taxi customers with 30 audio channels, and 8 video channels offering news, music, overseas FM radio, sports and entertainment, interspersed with taxi commercials.

Image source: MoBaHO!

Source: JCN Network, "World's first satallite digital multimedia service for taxis", 20 July 2006

IPTV provides two-way transmission capabilities that are absent from traditional TV distribution technologies. This allows viewers to take advantage of interactive services, e.g. selecting camera angles or commentary streams when watching a sports event, or by voting for contestants in a reality TV show. The interactivity can even include user-generated content, whereby individuals or organizations can produce and distribute their own content, either publicly or to selected groups. IPTV can therefore create the potential for point-to-point content distribution and full video on demand (time-shifting). It also gives subscribers video stream control (e.g. pause, fast-forward, rewind etc.), emulating hard-drive based digital video recorders (DVR) such as TiVo.

As broadband becomes more popular and affordable, convergence will only gather pace. Major telecommunications providers are exploring IPTV as a way of generating new revenue from their existing networks, and to defend against encroachment from cable operators. In Hong Kong, China, the incumbent telecommunication operator, PCCW, was the first to launch IPTV commercially and already has a large portion of its subscriber base signed up to IPTV. It is expected to overtake the local cable television service provider in 2006, in terms of number of subscribers (box 2.8).

IPTV demonstrates how conventional entertainment services (TV is 75 years old) are being transformed by the internet, thereby increasing consumer choice with *à la carte* programming and personalisation options. Being IP-based, IPTV is an obvious choice also for viewing away from home using devices like Slingbox[20]. Thus, this wave of media convergence is seeing traditional media, like radio, music, video and TV broadcasting, moving to other platforms, giving the consumer better quality and more variety.

2.2.5 User devices

The desire for increasingly personalized devices is central to maintaining the sales of consumer electronics devices such as digital music players and laptop computers. The mobile phone market is no exception. Users now choose their own ring tones and screen wallpapers. They are also becoming more discriminating about the design and physical appearance of their handsets, so much so that the rate of replacement of such devices is no longer merely dependent on functionality. The mobile phone has moved from being a practical accessory to becoming a reflection of a user's personality or social status.

A study from the Mobile Content Forum found that 70 per cent of Japanese mobile users keep their mobile within one metre of their body during the day time, and 40 per cent during the night as well. The mobile phone can thus be considered as an extension to the user's physical self, and the rate of replacement in Japan is accordingly very high. Anyone contemplating replacement is faced with an almost overwhelming choice of handset, and manufacturers have been quick to create niche markets, including the luxury, female, sporty and

Box 2.8: NOW, it's IPTV!

IPTV in Hong Kong, China

IPTV, or "Internet Protocol Television", is on the verge of conquering the Hong Kong television market. The city's fixed-line telephone incumbent, Pacific Century CyberWorks Limited (PCCW) is leading the charge with its NOW Broadband TV service, which has been growing vigorously ever since its inception in 2003.

By 2005, NOW TV subscribers numbered more than half a million, up 52 per cent over the previous year. The company predicts a further 36 per cent growth in 2006, as the number of subscribers rises to 750'000. NOW TV is thus likely to overtake the current television market leader, iCable Communications, which had a customer base of 738'000 in 2005 but nowhere near NOW TV's meteoric growth rate.

At the time of its launch, NOW TV operated only 23 channels; that number now exceeds 100. Channels are categorized into sports, entertainment, movies and news and infotainment groups respectively, along with on-demand adult programming. Certain channels are free to non-subscribers, being carried by advertising. PCCW provides customers with an "*à la carte*" subscription, allowing them to purchase individual channels, unlike the traditional bundled channels on cable. The company's success is partly due to the fact that Hong Kong is one of the most densely populated cities in the world, and has a high broadband penetration rate, bringing down the cost of the network infrastructure.

Image source: flickr.com (fatcontroller)

Sources: NOW Broadband TV, at www.nowbroadbandtv.com; and Daily IPTV, "PCCW's now broadband TU poised to beat cable", available at www.dailyiptv.com

'tweenager' markets (box 2.9). The luxury market, too, has spawned a whole variety of devices competing on materials, workmanship and extras. The female market, in particular, was characterized by Intel's resident anthropologist as the "canary bird of the technological mineshaft": if a product doesn't work for the female market, it is unlikely to make the grade in the mass market[21].

The personal computer (PC) has also evolved considerably since IBM first showcased its PC to the world in August 1981[22]. It came in three versions, the cheapest of which was a USD 1'565 home computer (about USD 3'500 at 2006 prices)—monitor and disk drives not included. The computer had a 4.7 MHz processor and 16 K of memory, and came with Microsoft's BASIC programming language. It was capable of displaying just four different colours for graphics and 24 for text, and ran only basic games and tools, such as a music tuition program. Today, there are over a billion personal computers worldwide. A typical hard drive, at 160 GB, has the capacity of over one million of the floppy disks used by the original IBM machine.[23] The last 25 years have also seen the personal computer become increasingly personal, as many people now own one or more computers, whereas in the past a "home computer" was typically just that: one that was shared between the members of a household. This change in ownership has precipitated changes in the way we use PCs—Wi-Fi coverage is increasingly becoming available on trains, in coffee shops and in tourist hotspots. A recent report from the UK ICT regulator, Ofcom, found that 16 to 24 year-olds in the United Kingdom are spurning television, radio and newspapers in favour of online services, fuelling a radical media shift.[24] Such shifts demonstrate just how dynamic the personal computer market is, and the demand for continued improvement and innovation in this field does not seem to wane. And some argue that the true personal computer of today is the mobile phone, with its mass penetration, individual nature and increased functionality. Will the mobile phone be the starting point for tomorrow's personal computer?

Portable music players are also subject to rapid innovation. As functionality is fairly basic, other factors, such as design, ease of use and branding, become more important for consumers. Apple's iPod is an example of such innovation (box 2.10).

Box 2.9: Kiddy cool meets parent power

Disney makes its move from films to phones

Walt Disney has a huge legacy of films, theme parks and fluffy toys, but the company may soon be able to claim a successful new addition to its business empire. It recently announced its decision to enter the mobile phone market, with Disney Mobile, a service designed for 10 to 15 year-olds.

The service gives parents the power to monitor and control their child's phone usage. A choice of two camera phone handsets is available, from LG Electronics and Pantech. Parental facilities include the setting of monthly limits for voice and text minutes, ring tones and other downloads, and the selection of times and days of the week when the child is permitted to use the phone. If any preset allowances are exhausted, the phone will still allow calls to designated numbers, such as to the child's parents or to the emergency services. GPS technology allows the parents to track the location of their child's handset from their phone or PC. To maintain the Disney theme, subscribers can download free and paid ring tones, wallpaper and graphics from a Disney "vault", either free.

Image source: flickr.com (pshan)

Source: USA Today, "Disney's phone lets kids talk at parents' discretion", 4 may 2006, at www.usatoday.com

A 'mere' MP3 player, it has become a phenomenal worldwide sales success, involving into an ever-growing family of products from calf leather accessories to sleek and sturdy speakers. The new release of the iPod presents users with the possibility of watching videos, too. But the iPod has started to face competition from mobile phones that have integrated MP3 players and mobile TV programme.

The future direction for user devices is important to ascertain: will users prefer a single device with multiple functions, or many different devices? It does seem that users are heading towards the all-in-one multi-functional device. Already, mobile phones are displacing other more mundane items. A 2006 Nokia study[25] of young people aged 18-35 found that 72 per cent had discarded their alarm clock in favour of the mobile phone, and 73 per cent no longer wore a wristwatch. A further 44 per cent of those questioned used their phone as their main camera, and 67 per cent expected their phone to eventually replace their MP3 player. However, the results did show some regional differences. Whilst 68 per cent of respondents in India used their mobile as their main camera, 89 per cent of Americans questioned preferred to keep two separate devices, and the global average of people expecting to use just one device was less than half, at 42 per cent.

This suggests that the answer to the question above is not quite as clear cut as one might expect, and may be subject to many different variables—for instance, it has been suggested that there is a 'gadget threshold' that needs to be overcome before users will accept multi-functional devices. Thus, for an internet-enabled mobile phone, ease of browsing might be a crucial factor. Manufacturers also have to contend with issues such as screen size and battery life limitations. Nonetheless, mobile phones have an undoubted importance in modern life, with a third of the respondents in the Nokia study claiming they would rather lose their wallet or purse than their mobile phone, and a fifth claiming they would sooner lose their wedding ring than their mobile phone. Manufacturers are pushing ahead with multi-functional devices, suggesting that their confidence in consumer acceptance is high. An example of such a device is Sony's 'Mylo Personal Communicator' (box 2.11), a portable wireless entertainment device combining instant messaging, voice over IP, e-mail and music.[26]

The evolution of user devices is both exciting and bewildering for the consumer, who faces an ever increasing variety to choose from. Ease of access and use will become increasingly decisive criteria, given the relentless pace of innovation and the attendant burden of choice for consumers. Vendors and operators will find themselves

Box 2.10: iPod therefore I am
A status symbol and corporate goldmine

Since its 2003 launch Apple's iPod has sold millions of devices (around 22.5 million in the 2004-05 financial year) and is credited with redefining the MP3 player market in a manner similar to the way IBM's PC redefined the personal computer market. The 60GB model is capable of storing 15'000 songs. The success of the iPod has encouraged Apple to further diversify the product portfolio. The company recently paired up with the mobile phone manufacturer Motorola to produce the 'ROKR' iTunes device—one of the first dedicated music phones to hit the market. Apple is also working on a widescreen video iPod that will let users download and read novels. There are rumours that Apple has approached some of the world's largest publishing houses, to convince them to commit their full libraries of books to electronic archives.

The strong sales of iPod players are supported by the success of the iTunes portal, which allows users to download music, videos, television and audiobooks, with prices starting from USD 0.99. Apple recently completed a deal with Warner Brothers to sell episodes of the popular TV series 'Friends' via the iTunes website. The iPod and iTunes generated almost half Apple's profits in 2006.

Image source: flickr.com (notic)

Source: BBC News, "Apple pulls in profits from iPods", 19 July 2006, available at http://news.bbc.co.uk; Daily Mail, "Now you can read books on your iPod", 3 August 2006, available at www.dailymail.co.uk

facing challenges of ensuring interoperability and compatibility, to keep pace with the evolution of their products and services.

2.3 Digital communications

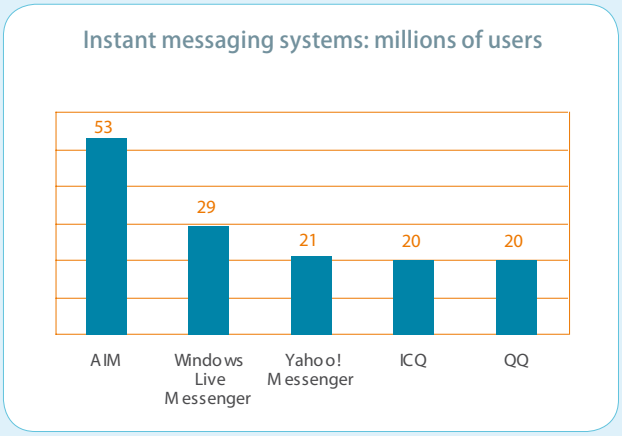
2.3.1 The evolution of voice

Voice communication has changed dramatically in the last two decades[27]. In the early 1990s, mobile phones were still a luxury reserved to business users, but the combined impact of handset subsidization, lower tariffs and the introduction of prepaid schemes all helped to create today's mass market, with over two billion mobile phone users worldwide (figure 2.2)[28]. The mobile phone has become such an integral part of many peoples' lives that in many cases it has supplanted the fixed phone entirely.

While mobile phones have tended to augment the total revenue derived from voice sources, another service, voice over internet protocol (VoIP), threatens to diminish it. VoIP involves routing telephone calls via IP-based networks, such as the internet.[29] VoIP owes its increasing popularity to a number of advantages that, together, constitute a highly appealing method of communication for many categories of users, from household to corporate. VoIP calls are often free, or at any rate far cheaper than similar conventional services. Users can take or make calls from any place where they are connected to the internet, and benefit from extras such as call forwarding and integration with other services (e.g. video conversation, conference calls and file exchange). Analysys, a telecoms consultancy, predicts that 32 million European workers will be using VoIP by 2010, and that spending in the sector will surge to USD 12 billion.[30]

VoIP services have existed since the 1990s, and were the subject of the third edition of the *ITU Internet Reports* series[31]. However, mass-market VoIP services have only become popular quite recently. Among the better-known services targeted at consumers users are Vonage and Skype. Skype was launched in 2003, and acquired by eBay in 2005. That acquisition has pushed several other internet giants to start experimenting with internet telephony. Thus, Microsoft recently acquired a VoIP company called Teleo, Yahoo! bought DialPad, and Google has launched "Google Talk", a service which lets users of its instant messaging program chat over the internet. Phone providers are also taking an interest in VoIP: BT and Nokia

Box 2.11: Instant messaging – the next big thing to hit the air?
IM boost from new wireless devices



Until recently, instant messaging (IM) was perceived as being tied to the desktop computer. Now, wireless operators and service providers are beginning to see its lucrative potential, and a host of new devices have been launched. For example, in mid-2006 Sony launched a personal wireless communicator device called 'Mylo' ('my life online'), targeting two categories of heavy text users: socializers and music fans. Mylo gives users access to instant messaging, HTML web pages, and e-mail, in addition to playing music and displaying photos. It comes with pre-installed IM software for Skype, Yahoo! Messenger and Google Talk. Despite the inhibiting effects of competing standards and platforms, forecasts for the worldwide growth of wireless IM are sanguine.

A recent Gartner study estimates that the corporate IM market will grow globally at an annual rate of around 20 per cent at least until 2009. Research from In-Stat found that in 2005 there were around 2.5 million wireless IM users worldwide, generating revenue of USD 54.5 million, and In-Stat forecast that revenues would reach USD 3.6 billion by 2009.

Note: Figure for QQ refers to peak online users and all other figures refer to active users.

Data source: Adapted from Wikipedia

Source: America's Network, "Wireless Instant Messaging Rises", 1 June 2006, available at www.americasnetwork.com. See also www.learningcenter.sony.us

are experimenting with intelligent handsets that switch seamlessly between cellular and VoIP calling, obviating the need for duplicate accounts and handsets, and resulting in cheaper calls for the consumer.

The market for VoIP is now being further expanded as manufacturers begin to offer wireless communications and entertainment devices that are equipped ready for wireless instant messaging (IM) and VoIP use. Thus, in February 2005, Skype announced a deal in which it would add its software to Motorola handsets. Later that year, the German mobile subsidiary E-Plus began to offer Skype calls on its network, responding to the growing demand for such services.[32] Unlike VoIP calls made using their home computers, for example, there is a small cost to the consumer - they pay EUR 39.95 (USD 50) for a package which allows unlimited VoIP calls over 3G data cards. But not all mobile operators welcome such developments, and Vodafone in Germany felt sufficiently threatened by the increasingly popularity of VoIP that it has taken measures to block VoIP calls over its mobile data networks, starting from July 2007.[33] However, even moves such as this are unlikely to significantly delay the rapid take up of VoIP on mobiles, in a similar way to fixed-line networks.

What might the future of voice services hold? Some observers believe that voice will soon be only an extra application, bundled in with more sophisticated data and video services, for no additional fee. The idea would be to develop a fully IP-based "next-generation network" (NGN) that accommodates, coexists with and eventually replaces current fixed and wireless networks, carrying voice streams as data packets. NGN standardization activities are being undertaken in the ITU Telecommunication Standardization Sector under the banner of the NGN Global Standards Initiative (NGN-GSI).[34]

2.3.2 Messaging mania

The transformation in voice communications in recent years has hardly, of course, led to the

demise of the written word. On the contrary , short messages, wireless e-mail and instant messaging clients are more popular than ever.[35] The boom in messaging has created enticing business opportunities the world over, as illustrated by the United Kingdom market (box 2.12).

Other countries have also seen a rise in the numbers of those using MMS services. Research from M: Metrics[36] found that the use of MMS in the USA rose by 32 per cent between February and July 2006, while France and Germany saw increases of 16-20 per cent. One of the factors driving this growth could be the improved resolution (and hence better picture quality) now available with mobile phone cameras. The study authors also found that there was a direct correlation between camera resolution and propensity to use MMS. For those whose camera resolution was higher than one mega pixel, 44.3 per cent had used the service (compared to the global average of 30.5 per cent). The number of people owning camera phones is also increasing. Across the UK, US, France and Germany, the number of camera phone owners increased by 22 per cent from February 2006 to July 2006, with the percentage of subscribers owning camera phones across the four countries standing at just over fifty per cent.

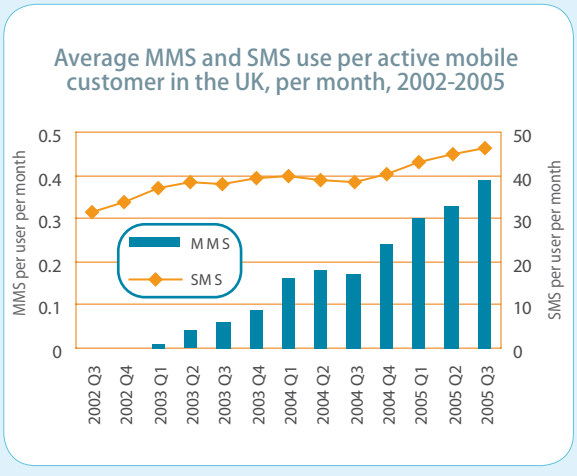
Box 2.12: Texting short and multimedia

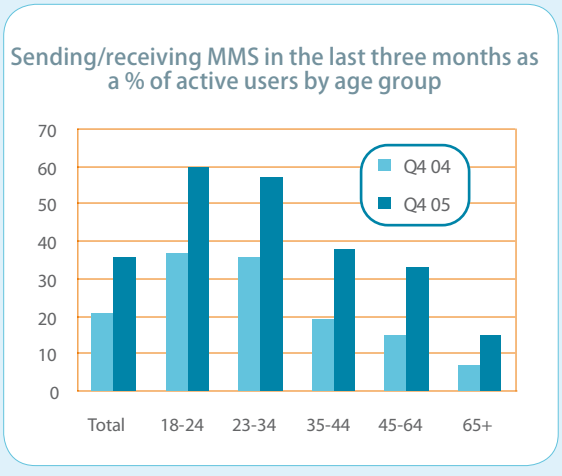
The popularity of messaging in the United Kingdom

The United Kingdom ranks in the world's top 15 countries for both mobile teledensity and total mobile subscribers (see data table 2)[37], and thus makes an interesting case study for the take-up of newer multimedia messaging services (MMS) which can also deliver pictures, sound clips and video. The popularity of the multimedia message is growing, particularly with the provision of new and innovative services, such as the MMS postcard (a postcard featuring a photo taken by a user, ordered by MMS). A recent report from Forrester Research[38] estimates that MMS will bring operators revenue of EUR 5 billion by 2010.

Figures from Ofcom in the UK show that MMS is set to become a mass-market (see left chart). Whilst the average number of SMS messages sent per user per month still dwarfs that of the number of MMS, there has been a significant increase in usage, and 36 per cent of consumers either sent or received a multimedia message in the last 3 months of 2005 – up from 22 per cent in the first three months of the same year. The breakdown of MMS usage by age group is particularly interesting: more than half the mobile users in the 18-34 age bracket use MMS. But it is the older age groups that have seen the highest increase in usage patterns: the percentage of users 45 years old and over using MMS more than doubled in a single year (see right chart).

SMS and MMS use in the United Kingdom





Source: Adapted from Ofcom

Despite the growing popularity of MMS, the SMS market is not short of innovation. Although a short phone call may still be cheaper than a volley of SMS messages, SMS remains popular because it is less obtrusive than a phone call, allowing the person to send and receive messages without regard for time and place. In the Philippines, where the cost of sending an SMS is substantially lower than making a voice call, an average of 250 million text messages are sent per day.[39] Computer and internet penetration remain low in the Philippines, so text messages serve as the equivalent of e-mail and instant messaging, and are used for everything from day-to day communications, to organizing political demonstrations, and reporting crimes. Recently, Geneva Software Technologies, based in Bangalore, announced that it has developed software to translate English text messages into other languages and send a translation to any mobile device in the world, regardless of the character set it is programmed to use[40]. There are hopes that this kind of service can be used to deliver disaster alerts, e.g. warning of impending tsunamis. And in China, which boasts the largest mobile phone market in the world, with almost 400 million users at the end of 2005, SMS has even created an entirely new form of employment: SMS stenography (box 2.13).

The popularity of e-mail and texting on the move has fuelled strong sales of devices such as the "BlackBerry" from the Canadian company Research in Motion (RIM). The company has seen spectacular growth recently, with final-quarter results 92 per cent higher in 2005 than in the previous year. This is largely attributable to handheld device sales (66 per cent). The total number of BlackBerry subscribers increased in that same quarter by nearly half a million, passing the 2.5 million mark – a 135 per cent increase over the previous year.[41]

2.3.3 The rise of social networking

The proliferation of methods of communication in the digital world inevitably has an impact on social interaction and networking. Digital communication channels do not just provide new means to support traditional social networks — they also stimulate new kinds of social interaction that may involve both real and virtual personalities. Digital technology and online environments enable participants to exercise their freedom and creativity anonymously by setting up synthetic personae complete with attributes such as age, race or religion. Digital social networking has given rise to some of the web's most active websites, such as MySpace (box 2.14), Bebo and Facebook[42], where users post profiles and share details of social events. The success of such sites does come at a price, however. The same anonymity that makes digital social networking so attractive makes it possible for users to engage in malicious impersonation, which fuels concerns about the protection of minors.

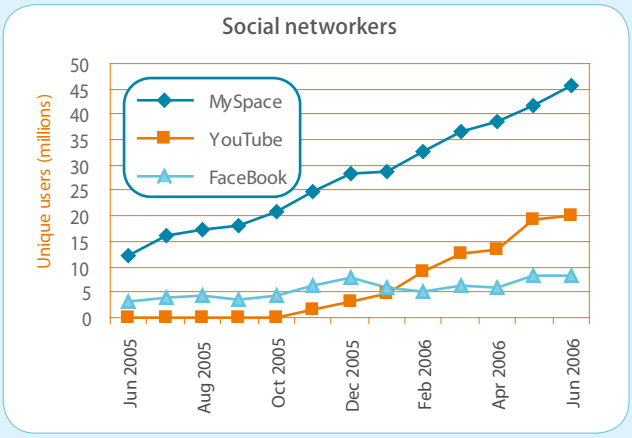
In the Republic of Korea, more than 90 per cent of young people in their late teens and early 20s are members of CyWorld, another popular social networking service.[43] Members design personalized rooms and decorate them with their favourite furniture and other goods. Digital wares, purchased using the CyWorld currency of *dotori* (acorns), are the main source of income for CyWorld. The items range from stacks of paper to couches and TVs, and typically cost less than one US dollar. CyWorld members can even send digital gifts to their cybuddies. While many social networking sites are struggling to make profits, the parent company of CyWorld, SK Communications, expects revenues of USD 140 million, the bulk of which (70 per cent) is in rental fees for digital items.[44] Other revenue sources include fees for sending instant messages, a recent addition to the service. The fact that CyWorld's instant messaging service is incompatible with MSN Messenger, once the dominant messaging service in Korea, seems inconsequential given the overwhelming popularity of CyWorld.

2.4 Digital content

Services are the lifeblood of telecommunication networks. Consumers use networks to interact through voice, text messages, instant messaging, personal websites and so on. However, telecommunication networks, in particular broadband networks, are also utilized by operators and media companies to bring information and audiovisual services to consumers, and, where permitted, gambling and gaming services. The traffic flow

Box 2.13: Famous for 15 minutes on MySpace

The phenomenon of social networking sites



MySpace (www.myspace.com) is an immensely popular social networking website in the United States with over 100 million members, a heavy proportion of whom are in their teens or twenties. The acquisition of MySpace by News Corp., in July 2005 for USD 580 million[45] was widely seen as the "coming of age" of social networking. Part of the MySpace phenomenon is the emergence of MySpace celebrities. To illustrate the novel approach to reaching celebrity status, the Wall Street Journal reported the case of a cosmetologist called Christine Dolce, one of the earliest adopters. Having achieved online fame after setting up a company to sell her jeans, Dolce found her life completely transformed by her status as a MySpace celebrity, to the extent that she stopped her work in order to concentrate on this new activity.

Concerns over emulators, and in particular the danger posed by adult 'predators', has led to the US legislature taking measures to limit or ban access to MySpace-like websites, especially from publicly funded educational facilities such as schools and libraries.

Data source: Adapted from the Financial Times using Nielsen/Net Ratings figures, 23 August 2006

Sources: Wall Street Journal, "Moguls of New Media", 29 July 2006; CNET News.com, "Chat Rooms Could Face Expulsion", 27 July 2006, available at http://news.com.com

is increasingly bi-directional, with consumers disseminating home-spun digital content via the same networks, asserting their identity and claiming their piece of cyberspace. Digital content has become such an indispensable part of life, that it is easy to forget that it has only been a mass phenomenon for slightly more than a decade.

2.4.1 The global knowledge web

Nobody really knows how big the web is today. Yahoo! estimates the size of the public web to be about 40 billion pages. But the "deep web", which includes documents and company intranets behind firewalls, is estimated to be many hundred times larger.[46]

News and information services

The world wide web has brought about a colossal change to the way we access news and information, and might be better perceived as a global knowledge web. With the spread of the internet and other network systems, traditional news media have found a new niche market. Via their websites, the very latest news content can be immediately posted online or sent to subscribers' e-mail accounts. Written news articles and also audio and video streaming services can be provided from websites, adding to the choice available to users. Daily newsletters can be customized to meet personal preferences for certain categories of news. Similar bulletins can also be received in SMS form on mobile devices. Readers are invited to post reactions and their own views.

The distribution of information has been central to the utility of the web from the outset, and web content has become immeasurably richer since the early days. Public transport schedules, local information, cooking recipes, author biographies and so on, have migrated from paper to the web. People can check the opening times of the Louvre in Paris or the Forbidden City in Beijing,

and even browse the online picture galleries. Many consumers search for the lowest airfares or hotel packages on the web. Children use Google images to find illustrations for school projects, and high school students download application forms for universities. Even the venerable Old Farmer's Almanac, first published in 1792, has now made the transition to the web and even offers podcasts. Even though it is only 15 years old, the web is now taken for granted as an indispensable and universal information resource.

Dictionary, encyclopaedias and libraries go online

It was not long ago that we had to flip through prestigious bound volumes to look up meanings of unfamiliar words. Albeit bulky, dictionaries by their very nature, reflect a long-term view of language and etymology. Still, they are unlikely to include the most recent street talk. Consisting essentially of unadorned text, they are not always easy for readers to comprehend. Encyclopaedias, while they contain more visual content, tend to be even more cumbersome, not to mention expensive for the average user.

In the digital world, the definition of an unknown word is generally only as far away as the nearest web browser. Online resources, often free, provide a wealth of information in addition to word definitions, such as synonyms, sample sentences, conjugation, pronunciation, word origins, and so on. Some sites even deliver educational daily newsletters. The Merriam-Webster Online Dictionary[47], for instance, provides podcasting services, including a "Word of the day on your iPod". Moreover, online dictionaries can be continuously updated, and made as specialized as necessary. Recently, search engines like Google and Yahoo! have incorporated dictionary and translation functions in their search pages, allowing users to look up words and even translate entire web pages, thereby increasing the usefulness of the results. Although many of these services provide crude translations, instantly knowing the approximate meaning of a foreign word or sentence still holds great value.

Traditionalists point to the fact that libraries are made up not only of dictionaries, thesauri and encyclopaedias, and that the contents of most library books are not accessible online. This is about to change, however, with projects such as the Google Library Project, intended to digitize books in major libraries, making them available through Google Search (box 2.15). Though this ambitious initiative still faces challenges, including copyright issues, it responds to an ever-growing demand for finding information quickly, accurately and cheaply.

Box 2.14: Occupation—full-time SMSer

Making a living from short messages in China

It may be a Singaporean who holds the World Record for "fastest SMS thumbs", but it is in China that the art of SMS writing has turned professional. The SMS stenographers are paid according to how many times their short messages, or 'Duan Zi' as they are known, are sent. The messages range from political satire to adult humour. SMS also provides Chinese users with a portal through which they can access information not normally available in the public media.

Image source: flickr.com (bennylin0724)

Sources: Singtel, "SingTel SMS Shootout 2005 unveils Singapore's fastest thumbs", 20 November 2005; ITU, "The Regulatory Environment for Future Mobile Multimedia Services: The Case of Hong Kong SAR and China", June 2006 (at www.itu.int/multimobile)

Engines for searching the digital world

Search engines have become the key starting point for finding information on the internet, but also on computers and private corporate networks. There are numerous web search engines in existence, and in many different languages. Some of the more popular ones are Google, Altavista and Yahoo! For convenience, consumers sometimes set the search page to be the default page of their web browser, as they tend to start many online activities with a search. To attract users, search engines often offer complementary web services, such as e-mail, instant messaging or VoIP phone calls. For all their power,

search engines are confronted with a number of challenges. The fundamental problem is that the web is growing at a tremendous rate and it is difficult to map it rapidly and accurately. As a result, search engines have to continuously revise their indexes to ensure that their map of the web is up-to-date. Theoretically, there are no limits to the growth of the web, but there are limits to the amount of indexing information search engines can store. Thus, recently added, less-connected, pages may be less visible than older ones. Moreover, even the most ingenious search algorithm can be manipulated so as to give more prominence a website than it may deserve.

As the number of mobile subscribers soars worldwide and the mobile internet becomes available to more people, search engines will become increasingly popular on mobile devices, too. Mobile search portals are made simpler and shrunk to work with mobile browsers and small screens. Consumers can use their mobile devices to perform searches just as they would from a desktop computer, whether it be to read the news, look up prices for a product, settle a trivia question, or verify their knowledge of history.

Global geographical knowledge

For the traveller, maps and guide books have always been a trusted aid. But they did have their limitations. They can very easily be out of date. It is not always convenient to carry around a world atlas. And moreover, most publications could not provide a global overview and detailed local information at the same time.

Seizing the opportunity that the internet provides, map publishers have put their geographical information online. Internet map services can be regularly updated, and made accessible to large numbers of users who retrieve information specific to the area they are interested in. Users can search directly for the district, street or shop name they want, and use the zoom to obtain the best map scale for viewing. Banks, post offices, parking lots, schools etc. can be located easily. Among the numerous map services available on the web are MapQuest, Google Maps and Yahoo! Maps, all of which are supported by web search engines. In addition to traditional two-dimensional maps, search engines are also opening up access to the huge databases of geographical data, transforming the map user's experience. In 2005, Google launched Google Earth, combining geographical depictions with satellite pictures of the earth (box 2.16). With its innovative and functional approach to displaying global information geographically, Google Earth was an instant hit.

As the number of mobile handheld devices grows, the demand for map services on the move is also growing. Map service providers offer essentially two kinds of service: users can either install a program onto their mobile device and then periodically purchase map updates, or they can use mobile web-capable devices to access map-based websites. The former option can function in standalone mode, whereas the latter requires an internet connection, typically in the form of a Wi-Fi hotspot or through the mobile service provider. This can be a handicap when travelling in remote areas where coverage is poor. Some mobile devices also have GPS functionality that makes them effective navigation aids when used in conjunction with maps.

The vast global knowledge web enables users find the information they need more easily and efficiently. While the web continues to grow at a staggering pace, it still represents only a small fraction of the content offered in the wider digital world. Entertainment content—for instance in the form of music, video, adult-only content, gaming, user-generated and context-aware content—is beginning to play a powerful role in shaping our new digital lifestyle.

2.4.2 Sights and sounds

The music industry was considered to be in decline in the late 1990s: users downloaded songs free of charge from the web (using semi-legal file-sharing systems) while sales of pre-recorded tapes and CDs fell. But now, the music industry is bouncing back as it finally embraces MP3 compression technology and creates legal ways to download music.

The future of music is certainly digital. Music can now be downloaded to a fixed device, or can be streamed directly from the internet. For mobile use, audio files can be copied to a compatible music player or phone. Because of the low transfer speeds on 2G mobile networks, music downloads have been

Box 2.15: Digital Knowledge
The Google Library project

The end may be in sight for the outdated search engines still used in many university and public libraries. Librarians can look forward to more targeted inter-library loan requests.

On 14 December 2004, Google announced the launch of Google Library Project. The company is scanning books from the libraries of Harvard, Stanford and Oxford University, the University of Michigan, the New York Public Library and elsewhere. As the digitized material is indexed by Google's search engine, it becomes searchable online. For books under copyright, users will see only a few sentences around the search term, to avoid copyright infringement.

Google Scholar is a closely related service for academic journals. Since 2005, it provides links to university libraries, online databases and subscription services, for the use of students and researchers.

Nonetheless, publishers are worried with many claiming that the industry will be harmed. Other analysts suggest that, on the contrary, the project will be good for book sales, and cite the case of Amazon.com, which found that sales increased when selected pages and content were made available online. Although some issues remain unresolved, Google is undoubtedly helping users find the most relevant information, as quickly as possible. In the next few years, as the Google Library Project enters full operation, we will experience a new stage in the evolution of search technology.

Image source: Google

Sources: Jonathan Band, "The Google Library Project: Both Sides of the Story", Information Outlook, Vol.10, Issue 9, June 2006; Google Press Center, "Google Checks Out Library Books", 14 December 2004 (at www.google.com/press)

prohibitively expensive. With song files taking up 3 to 4 MB each, music lovers needed to be patient, and relatively wealthy, to download them. The advent of 3G networks and mobile phones with a hard drive, is changing all this. Users can now purchase and play their favourite music when on the move, or swap it between devices. A leader in this field, as discussed above, has been Apple's iPod (box 2.10).

As music technology is finding its digital way, the video and TV broadcasting industry is also looking to develop a digital strategy. It may be difficult to imagine mobile devices ever replacing the plasma TV in living rooms; nonetheless, wireless carriers, broadcasters, handset manufacturers and content producers are all betting on the future of mobile TV and video. According to research firm IDC, by 2010 around 24 million US consumers, representing 9.2 per cent of cellular subscribers, will watch TV or video on mobile handsets, up from about 7 million. Revenue is set to quadruple to over USD 1.5 billion in 2006.[48]

As 3G networks enable mobile operators to bolster the quality of video provided to handsets, DVB-H technology (discussed above), which operates like broadcast TV without straining the capacity of the cellular network, is beginning to reach maturity. This is strong motivation for the media providers to make their content mobile, and to adjust it for different formats (e.g. live or on demand, full-length or abridged, streamed or downloaded, broadcast or one or to one). A new word, *mobisodes*, has entered the dictionary to refer to short mobile TV episodes. Last year, Fox launched its mobisodes "24: Conspiracy", each about a minute long and carrying parallel story lines to the TV series "24" starring Kiefer Sutherland. Another mobisode released by Fox is "Prison Break: Proof of Innocence" in April 2006[49]. Fox claims that it had more than 2 million downloads of its various mobisode series.

Still, the smooth delivery of video content, whether through 3G or DVB-H, remains technologically

Box 2.16: A mapping revolution
A map you can drive

It is probably safe to say that map sites have redefined the way we use maps. Like other online map services, Google Earth is designed to present geographical information on request. What makes Google Earth special is the way it presents that information.

Google has mapped virtually the entire earth by pasting images obtained from satellite imagery, aerial photography and global information systems onto a three-dimensional globe. Upon launching the program, the user sees a virtual globe from the perspective of a spaceship approaching the Earth. One can go directly to a destination at any level, by typing in a country name or a street name, or simply by double-clicking on a point, and zooming in. Google Earth also has digital terrain model data collected by NASA's Shuttle Radar Topography Mission. This means that the Grand Canyon or Mount Everest can be viewed in three dimensions. For some major cities, Google has provided a layer allowing one to see even buildings in three dimensions.

Epidemiologists, meteorologists and urban planners are discovering the magic of an aerial view of the globe. For them, one of the most attractive features is the ability to graphically depict many different types of data on the digital planet. They can set position markers for volcanic events, cases of bird flu, the locations of crimes, for example. A mouse click on a volcano marker opens a window containing images and explanatory text, or even a web camera shot of the smoking crater. Maps of ocean temperatures, for example, can be layered over the globe.

Google Earth also played an unexpectedly valuable role in the summer of 2005, following the disastrous flooding in New Orleans caused by Hurricane Katrina. After the hurricane struck, Google Earth rapidly added 8'000 post-disaster aerial photographs of flooded areas obtained from the US National Oceanic and Atmospheric Agency (NOAA). The images allowed disaster relief workers to scan areas on the computer to find passable roads, for example.

Image source: Google Earth

Source: Google Earth and Der Spiegel International

challenging. The ability of consumers to flip channels quickly is an important hurdle. There are also tradeoffs to consider between screen and device size, image resolution and battery life. Since the higher resolution screens consume more power, content providers have to make do with the small screen of most mobile devices. ESPN customizes sports highlights for mobile devices by showing close-up reactions of players and fans and tight shots of the action, making the best use of the small screen. Not surprisingly, sports is being seen as an important driver for mobile TV (box 2.17).

Yet, although almost everyone carries a phone, consumers ultimately may decide to use other portable devices for TV-type programming, such as a video iPod, a device for TV place-shifting such as a Slingbox, or a gaming device like a Sony PlayStation Portable (PSP). But despite the limitations of today's technology, it seems that as they go digital, audio and video service offerings are set to converge.

2.4.3 Adult content and gambling

One of the telecommunication industry's worst-kept secrets is that the early adoption of media-driven technologies can often be credited to the demand for adult content[50]. The list of technologies that were given an early boost by the sex industry is impressive: VHS, CD-ROM, DVD, pay-per-view TV, PC games, BBSs, premium-rate telephone lines and, even the World Wide Web. Mobile phone technology should be no exception, especially given its wide reach. As mobile providers try to

Box 2.17: Sports go digital

Living it large and seeing it small at the FIFA World Cup 2006 in Germany

Major global sporting events, such as the football World Cup or the Olympics, tend to act as triggers for the development of the ICT sector. For consumers, the urgency of following the event can justify a purchase while for manufacturers and service providers, it acts as appropriate timing for the release of an new product or service and a focus for marketing efforts.

For instance, many countries timed the introduction of colour television with the 1970 World Cup in Mexico, where Brazil beat Italy in what many consider to be the greatest ever final. Somewhat later, as Brazil and Italy met again in the final of the 1994 World Cup in the United States, fans had the chance to follow what was arguably the most tedious ever final on the World Wide Web, perhaps while browsing elsewhere for more exciting fare. In 1998, when the event was hosted and won by France, SMS was used both for score flashes and for French fans to coordinate their celebrations on the *Champs Elyssée*. By 2002, when Japan and the Republic of Korea jointly hosted another highly memorable tournament, 3G mobile services were formally launched in Korea during the Opening Ceremony. Thus landmarks in sporting history coincide with milestones in technological progress.

And so to Germany ⋯. Like all of the World Cups in the post-war period, the event provided a boost for the consumer electronics industry, especially for sales of HDTV-ready television sets and plasma screens. But it was what was happening outside the home, and at opposite ends of the spectrum of screen sizes, which marked the more significant innovations this time. Germany 2006 saw the launch of mobile TV services in a number of countries, including Italy (box 2.6) and the host country itself. Fans had been able to download and watch clips of games on their mobile phones for a couple of years, but now it was possible to watch near-live action delivered using DVB-H technology, at least in certain cities.

Available to far more fans was the experience of watching crystal-clear pictures on huge screens in cinemas and so-called fan-fests in host cities.

Using a technology developed under the auspices of ITU[52], called Large Scale Digital Imagery (LSDI), screens of up to 144 m2 broadcast live action to thousands of fans. Several screens were set up along *Strasse des 17 juni* in Berlin, close to the Brandenburg Gate, and two were constructed in the middle of the Rhine in Frankfurt. For those fans unable to get tickets for the sold-out games, here was a chance to participate in an event with family and friends and to enjoy the action which was almost as good as being at the game (and certainly cheaper). As a result, the number of fans attracted to Germany was far higher than could be accommodated in just the stadiums, to the delight of shopkeepers and tournament sponsors alike.

It was not only in Germany that the phenomenon of fan fests was experienced. In Hong Kong, shopping centres stayed open all night for the games. In Italy, the national team's victory on penalties in the final game was watched by around 180 000 people on the *Circo Massimo*, extending the live experience to far more than could afford to follow the team to Germany. And what was the lasting memory of the game? Zinedine Zidane's infamous headbutt on Italian defender Marco Materazzi in the closing minutes of extra time shocked and mystified those who saw it live. But within a few hours, it was being analysed on blogs, and posted on social networking sites and video-clip sites like YouTube. Indeed, within a few days, the short video clip had been animated by amateurs in many amusing and bizarre ways to bring humour and social comment to help demystify Zidane's actions. Such clips were sent around the world in forwarded e-mails and now probably fill more capacity on computer hard drives than existed in the whole world at the time of the 1954 World Cup, the first to be broadcast live on television. Technology and sport make a perfect marriage with sport, providing a commercial drive for technological development while ICTs help football to become the beautiful game once more.

Image source: sxc.hu

Source: ITU

reduce their dependence on voice and grow their data revenues, sexual content has invaded SMS, ring-tones, logos, wallpapers and games. For instance, a strip poker game can be played via mobile phone against both real and virtual opponents, with the real players paying in credit to gamble, while their glamorous opponents provide a sequence of ever-more revealing downloads[51]. The longer the game lasts, the higher the revenues for the service provider.

Now that colour screens are the norm on mobile phones and video streaming has advanced sufficiently to run comfortably (if not always smoothly) even on 2.5G systems, mobile adult content appears to be ready for takeoff. Big-name media brands like Playboy, Penthouse, Hustler and Private Media have set up their own mobile content divisions. Content has evolved from wallpapers and SMS to more sophisticated forms such as interactive applications, Java downloads and video clips. The arrival of 3G and feature-rich handsets is creating even more possibilities, leading to some analysts referring to the 3G of "Girls, Gambling and Games"[53]. Strategy Analytics reported USD 400 million in sales for mobile adult content in 2004, with global market projections of USD 2.1 billion by 2009.

While technology becomes less of a challenge for video distribution, social taboos and, in many cases, legal issues, impede the distribution of adult video content. In Ireland, for instance, 3G mobile phones must be registered under the names of adult owners, in an effort to protect children from inappropriate content.

For service providers, age verification is one of the key concerns. This can be done through credit card verification, and bans on selling services to underage subscribers. Mobile operators are taking initiatives in this area, with European operators adopting a code of practice and the CTIA in the USA developing similar guidelines. However, as with the internet, adult content on mobile phones can come from many sources. Blocking young people from all adult content will be an uphill battle. A focus on digital identity management, as discussed in chapter four, may be the way forward.

Once the technology became available, gambling, too, went digital. Users can choose from a large variety of online gambling services today, ranging from online casinos and sports betting, to bingo and poker. In Europe, credit or debit cards can be used to top up gambling accounts and receive the winnings. In the United States, these cards cannot be used for online gambling. But offshore electronic money services such as Firepay, Neteller, and Moneybookers provide accounts for avid gamblers. In July 2006, the Chief Executive Officer (CEO) of BetOnSports, a London-listed betting company, was arrested by US authorities. Along with 10 associates, he was charged with criminal racketeering and wire fraud. The indictment targets some USD 4.5 billion in holdings of the company. Stock prices of other big online gambling companies plummeted. Prosecutors are now getting tougher in response to recent draft US legislation forbidding internet gambling sites knowingly accepting payment from US citizens. The bill also called for criminalizing the processing of payments for online gambling by financial institutions.[54]

As the legality of online gambling varies between jurisdictions, there is often cause for dispute in a borderless digital world. For instance, the government of the island nation of Antigua and Barbuda, which licenses internet gambling entities, filed a complaint with the World Trade Organization (WTO) about the US government's efforts to impede online gaming. The Caribbean country won the preliminary ruling, but WTO's appeals body partly reversed the ruling in April 2005 – in particular, it ruled that the United States may be violating global trade rules because its laws regulating horse-racing bets were not applied equitably to foreign and domestic online betting companies.

Despite the legal hurdles, online gambling holds great potential for revenue generation, even more so than online adult content. It already represents a USD 12 billion industry that is expected to double in size by 2010, in part thanks to mobile technology. In addition to attracting customers from the United States and Europe, operators are turning to Asia and its sizable customer base. However, Asian governments may follow the United States in strictly regulating online gambling to reduce the social impact of this highly lucrative business, or at least for the purposes of taxation.

2.4.4 Online gaming

Broadband internet access has been a boon to fans of computer games. Early computer games were typically single-player activities involving a virtual opponent, or multi-player activities with opponents or partners who had to be in the same room. Today, multiplayer online games can take place over digital networks, across the world, and can involve flexible and complex configurations of players.

An important type of online game is the "massively multiplayer online role-paying game" (MMORPG), which can support hundreds or thousands of players simultaneously. The MMORPG takes place in a giant, always-on virtual world, with players competing or cooperating on a grand scale. The type of dedication that MMORPGs demand from players is very intense, and often requires some degree of withdrawal from the real world (box 2.19).

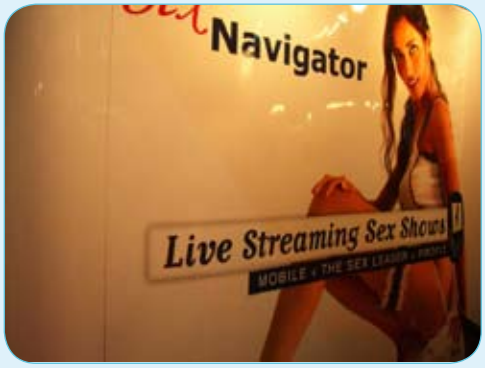
To support a very large number of players, MMORPGs need large-scale game worlds. In some games, large areas of the map are interconnected, so that a player can traverse vast distances without having to switch servers manually. For example, the *Tribes* game requires a number of large maps, and to enable a smooth gaming experience, each server plays in rotation. In PlanetSide, on the other hand, all map-like areas of the game are accessible (by flying, driving, or teleporting). MMORPGs typically charge players a monthly fee for access to the servers, and players are able to progressively build up their level, or to "buy" ready-made characters, with attractive skill-levels or other assets, from other players. Indeed, a new career is emerging for teenage gamers, particularly in China, who spend hours building digital characters before selling them on.

Recently, games consoles, such as PlayStation 2, have also begun to support internet and LAN gaming. Console gamers can use their television as the display unit. Many mobile phones also support wireless gaming through Bluetooth or similar technologies; however, their popularity is limited, due to speed restrictions, the small display screen and limited battery life. Instead, other types of gaming are being developed for mobile phones that exploit the potential of moving around in the

Box 2.18: No sex please, we're third generation

An Asian government expresses concern over 3G

Concerns about the social impact of adult content are not new. But in an unusual twist, the government of Cambodia has decided to ban 3G services completely, on the grounds that they can be used to send and receive pornographic pictures and video. The decision represents the successful culmination of a campaign led by the wives of prominent government officials. The Cambodian prime minister argued that 3G technology is too advanced for the Cambodian people, and explained that voice and SMS should be enough for the time being.



In Singapore, there are already over 360'000 3G subscribers and the high-speed phones are ideal for youngsters who want to browse and download information—including questionable content. With this in mind, the National Internet Advisory Committee (NIAC) of Singapore recently proposed measures allowing parents to monitor their children's online behaviour. NIAC recommends that telecom operators allow parents to screen what their increasingly tech-savvy children are viewing with their mobile phones and examine their browsing history. SingTel, the operator with the largest share of the 3G mobile market, welcomed initiatives to protect children from obscene online content and promised to study the recommendations.

Image source: flickr.com (Héctor Milla)

Source: "No 3G, please", Wireless Asia, 28 June 2006.

Box 2.19: Start your next life online

Second Life is an online game that gives you a new life in a virtual world

Bored with your life? Start a new one, on the internet! Design your new appearance, home, friends. This virtual utopia can be as detailed as you like, and you are the sovereign – down to details of currency, economy and government.

This is all possible in games such as Second Life, launched in 2003 by San Francisco-based Linden Lab. The Second Life "world" resides in a large array of Linden Lab servers. Subscribers ("residents") run the Second Life client program which allows them, via the internet, to view and modify the Second Life world and participate in its economy. Most of the content is resident-created; indeed, residents retain the intellectual property rights.

Second Life residents are represented by an avatar (see box 4.1), which may be customized in a variety of ways. The basic avatar is a humanoid in shape and, through a series of graphical user interface (GUI) controls, can be modified by adjusting parameters such as size, build, colours and hair style. Residents can also create or buy clothing, and fit out their avatars with accessories.

Second Life has its own economy, and a currency called Linden dollars (LUSD). Residents receive an initial amount of LUSD when they open an account, and a weekly stipend thereafter, the amount depending on the type of account. Additional currency can be acquired by selling objects or services within the environment. Residents can purchase LUSD directly, or convert between Linden currency and US currency through Linden Lab's currency brokerage, the LindX Currency Exchange, with a rate that fluctuates daily. Interest groups can be created for a fee of LUSD 100. After three days an additional two members must have been recruited, otherwise the investment is lost and the group is deleted.

Second Life has become very popular. Many real-world celebrities have confessed to "living" their second lives in the virtual world. Problems also exist in this utopia. Some residents are malevolent; thus, groups of residents are actively trying to damage the world, by creating self-replicating objects that may eventually paralyse the server. Second Life speculators buy land at low costs in hopes of earning quick profits when it appreciates in value. There have even been real-life lawsuits against Linden Labs for loss of virtual property. A virtual second life may not be such a utopia after all.

Image source: secondlife.com

Source: secondlife.com

real world while playing a game. These generate revenues through transactions (e.g. sending and receiving SMS) in addition to subscriptions[55].

As a form of entertainment, online gaming is here to stay, though it seems that overindulgence may be hazardous. Every hour spent gaming is an hour away from the 'real' world, and too many hours at play have been seen to lead to physical and psychological health risks. An exaggerated example is the gamer in South Korea who died after playing an online game for 50 hours with hardly a break[56]. A minority of gamers do develop a dependency, spending as many hours as possible online or with video games each day. With no social life to speak of, and no friends outside the cyberworld, these young refugees from the non-virtual world may raise social problems that go beyond their own physical health.

2.4.5 User-generated content

Recent years have seen a large increase in user-generated content, spurred not only by growing numbers of users but also by the increasingly

active and diverse nature of user involvement in the digital sphere. There has been a natural evolution of the user's role, from passive observer to active contributor. Many forms of user-generated content can be seen as a natural extension of individual expression, e.g. the blog can be seen as a continuation of the conventional diary. Two of the most successful examples of user-generated content are the video sharing website YouTube (box 2.20), and Wikipedia, the online encyclopaedia.

A blog is essentially a web-accessible journal that is intended to be shared with friends, family or the general public. It can include text, images, video and audio, all assembled with standard, easy to use blog creation software. The usual superlatives apply: it is estimated that new blogs are being created at the rate of one per second[58]. Their importance in the realm of public discourse has led to the coining of the word 'blogosphere'. Blogs are a relatively persistent form of user-generated content, with 55 per cent of all new bloggers still posting three months after they started.[59] Many blogs are created with the purpose of tracking or chronicling particular events, or as an attempt to attract a wider audience. Blogs have been created to comment on the war in Iraq[60], terrorist bombings in Mumbai and London[61], and natural disasters such as Hurricane Katrina in 2005[62]. Blogs allow users to keep track of rapidly evolving situations, as part of the wider concept of "citizen journalism", or to coordinate campaigns (such as the 'Free Our Data' blog run by the Guardian newspaper[63] in the United Kingdom). Institutional blogs have also sprung up, as governments and businesses search for a more informal voice in which to communicate with the general public[64]. Still other blogs are created in hopes of generating income through advertising packages tied to websites such as Google.

Podcasting is an audio variant on blogging: the term is a combination of iPod (the name of Apple's popular portable audio device) and broadcasting. Podcasting consists of making regularly produced audio shows available on the web. It frees listeners from the constraints of a broadcasting schedule by allowing them to listen to programming when and where they like. Podcasts can cater to highly specialized listening markets, unlike traditional radio, which is subject to the discipline of listener ratings[65]. Podcast website iPodder.org lists categories such as food, games, beer, business and automotive. Even the Vatican has its own podcast—the "Catholic Insider" podcast show[66]. Most podcasting is free of charge for the listener, and comes without any commercial advertising. The highly individual character of podcasts makes them an ideal medium for targeted advertising. This is being exploited in a commercial spin-off of podcasting known as nanocasting.

Another prominent example of user-generated content are wikis, made popular by websites such as wikipedia.org. Wikis are collaborative websites in which users (not necessarily registered) are able to read, but also create, modify and even remove public content (a subset is the corporate wiki, which is beginning to replace the static corporate intranet). Wikipedia, launched in 2001, is an online encyclopedia that is entirely user-generated. Nonetheless, a much-discussed survey by Nature found that the accuracy of Wikipedia's science entries compares favourably with those in traditional peer-reviewed publications, such as the *Encyclopaedia Britannica*[67]. Most wikis have a system that records changes, so that at any time, a page can be restored to any of its previous states. This feature is useful in guarding against vandalism, to which wikis are particularly susceptible due to their open philosophy. Generally speaking, though, the community aspect of wikis seems to encourage user responsibility, and studies by IBM have found that most vandalism to Wikipedia is removed in five minutes or less.[68] There are times, however, when pranks are welcome in the digital world: a large proportion of user-generated content on the internet has to do with homegrown humour, like the Asian phenomenon of kuso (box 2.21).

2.4.6 Towards context-aware services

Imagine walking through a shopping district when the mobile phone rings. It's your favourite shop, which has registered that you are in the vicinity and automatically called to promote a new item that you might be interested in (according to their data on your previous purchases). Suppose you enter the shop, and find a shirt you like, but size 10 is out of stock. A quick scan with your mobile phone over the shirt's label tells you which other branches have a size 10 in stock, and provides you with directions on

Box 2.20: Broadcast yourself

User-posted videos fuel debate

YouTube, a video sharing website, has become part of the mainstream in a very short time. The website attracts more than 100 million visitors per day, accounting for 60 per cent of videos watched online, far ahead of competing sites on MySpace, Google, Yahoo!, AOL, and MSN. Although many of the video clips are pirated, the site has become a mainstream fixture. So much so, in fact, that Google announced it would purchase the video-sharing site in October 2006.[57]

Video images posted on YouTube are complementing traditional news coverage. Thus, media organizations such as BBC and *The New York Times* ran background links to online video postings from people affected by the July 2006 fighting in southern Lebanon. Similarly, a five-second video posted on YouTube, showing the US president massaging the German chancellor's neck during the G8 Summit, sparked a lively debate in the German and US press as to whether this was appropriate behaviour. In the words of a political science professor quoted in the *China Daily*, "Today, public figures have to be more careful in 'a thousand ways'".

The sheer volume of video postings, and the user-oriented nature of websites such as YouTube, makes the issue of control problematic. Users are encouraged to flag harmful content, and the host may then take steps to remove it; the volume and pace of posting outstrips efforts to control it. At any rate, what is harmful is often a matter of opinion. For example, military authorities have been embarrassed by clearly news-worthy material posted by soldiers from the front lines. Video posters also create a problem when they ignore intellectual property rights. In Japan, where the number of YouTube users is very high, JSRAC, a pro-intellectual property rights agency, has been asking YouTube to remove protected content.

Websites such as YouTube, for all their rough-and-ready nature, are an important social and business phenomenon. Mainstream media closely scour them for newsworthy postings; public personalities are painfully aware of their vulnerability to the all-seeing video eye; and those who have a stake in protecting intellectual property are just waking up to the implicit challenge of video sharing. The debate is just beginning.

Image source: YouTube

Source: Various, including *Daily Telegraph*, "Pentagon declares war in internet combat videos, troops told to stop oploading films which make the US look anti-Arab", 26 July 2006.; *Guardian Unlimited*, "Bush rubs Merkel up the Wrong Way", 26 July 2006; The *New York Times*, "Anne Frank 2006: War diaries online", 24 July 2006; *China Daily*, "Bush back rubs magnified on internet", 22 July 2006; BBC News, "YouTube hits 100m videos per day", 17 July 2006.

how to reach them. After finishing your shopping, you get in the car to drive back home. You're low on fuel, so the car's satellite navigation system discreetly suggests a fuel station around the corner. The next morning, as you leave for work, your umbrella and raincoat prompt you with a whistle: the forecast is for rain. At work, sensors in your computer mouse and your telephone handset detect an abnormally high body temperature; you're coming down with the flu, and your monitor flashes up a warning, along with healthcare advice and information. Though these ideas might sound futuristic, they are merely examples of the kind of context-aware services that will become routinely available in a ubiquitously networked world.

Marc Weiser's vision of ubiquitous computing is one in which people and their environments are augmented with computational resources to

provide information when and where it is needed.[69] Context-aware computing can be defined as applications that have the ability to detect and react to environmental variables[70]. It can be seen as the analogue to a human assistant, making our interactions with everyday services and things even smoother. It is certainly a powerful concept, but is it really what people want? In a truly ubiquitous networked system, users themselves are not outside the system - they are part of it. Thus, the level of user control is of considerable importance, as are the number and type of interactions between users and enabled devices.

Analysts have identified three different levels of interactivity between a mobile device and a user: personalization, passive context-awareness and active context-awareness.[71] Each successive level takes from the user some of the customary control over the services. A pull-oriented framework is one in which the user defines the services they wish to use, while a push-oriented framework has unsolicited services 'pushed' at the user. Location-tracking provides a good example. A personalized service might allow the user to manually keep location data for a list of friends; a passive context-aware service would track their location automatically; and an active context-aware system would automatically alert the user when friends are detected nearby. Not surprisingly, users lose more control when using passive and active context-aware applications, than when personalizing their own applications. Despite this, users may prefer context-aware applications over personalized systems, due to the potential for added convenience.

Mobile telephones are the most widely used ICT device today, so RFID–enabled and sensor-enabled mobile networking will be a significant step towards the ubiquitous networked environment, and increased context awareness. As discussed earlier, sensors are particularly useful in situations where human involvement would be dangerous, impractical, or prohibitively expensive, such as monitoring an accident-prone zone or inspecting the physical condition of a bridge or a railway line. Camera phones already have built-in sound and visual sensors. But developments are ongoing to provide additional sensor capabilities for mobile phones, from blood glucose testing to a sense of smell[72]. Biometric sensors can enhance the security of a phone and prevent unauthorized use. Mobile phones could also alert their owners to a change of status in their environment, for instance with a built-in smoke alarm.[73]

Despite their great potential, context-aware services will have some unintended repercussions, such as the invasion of privacy. A balance must be struck between convenience and public interest. The implications of new technologies need to be explored early in the design phase, so that steps can be taken in good time to protect sensitive data and consumer privacy (see discussion in chapter four).

Box 2.21: KUSO!

Japanese word takes on a new digital meaning

'Kuso' (based on a scatological interjection in Japanese) is a word that has come to refer to internet parodies of pop songs, movies, comics etc. The term—like the phenomenon—has spread around Asia. A lively kuso community is now busy exchanging these digital parodies.

One of the best-known examples of kuso is the "Back Dorm Boys". This Chinese male duo became famous for their lip sync music videos to songs by the group Backstreet Boys. Their many other productions, captured on a low-quality web camera in their college dormitory room, were distributed rapidly on the internet within mainland China and eventually overseas. The two boys, Wei Wei and Huang Yi Xin, were signed up by *Sina.com*, one of the largest internet portal websites in China, after graduating from Guangzhou Arts Institute in June 2006.

Image source: YouTube

Source: Richlyi.com

2.4.7 Digital homes

Increased convergence—for instance between fixed and mobile telecommunications, technology and media, internet and television, and so on—has finally brought the digital home within grasp. Convergence allows devices and technologies to communicate seamlessly, enabling consumers to combine devices from different manufacturers. In the past, consumers were "locked in", compelled to stick with one manufacturer, in order to avoid compatibility problems. Moreover, the cost of installing and maintaining digital homes was high, making consumers reluctant to build or buy them. In recent years, however, compatibility problems have been greatly reduced as communication technology advances and manufacturers increasingly focus on collaboration (e.g. the Digital Living Network Alliance[74]).

There are, however, a number of technical and social concerns associated with digital homes. A major hurdle is the conversion of conventionally designed houses. Adoption of digital home technologies is likely to take place in an incremental and disjointed fashion[75], at least in the initial stages. In digital homes, owners will most likely have to act as system administrators, working to ensure that all domestic appliances run smoothly. Experience suggests that installing and managing a single appliance may be feasible, but making several devices interoperate will be a challenge for most people. Moreover, the impact of new technologies tends to be hard to predict, and the social dynamics and relationships within the home may make it a more sensitive environment, than for instance, a place of business. The question that remains is how intelligent a home should be, and how can innovation and convenience, on the one hand, and domestic comfort and stability, on the other, be properly balanced?

2.5 Digital transactions

With the growth of the internet and always-on access, the number of transactions conducted digitally has grown significantly over the last decade. As such, the field of electronic commerce has been the subject of much study and speculation. One of the main stumbling blocks to electronic commerce has been the lack of an effective and secure payment system. Today, most people use the traditional credit card for digital transactions, with security being provided by firms such as PayPal. But digital transactions is now an area ripe for change. Credit cards may remain the norm for some time to come, but micropayments, too, may be making a comeback. And the rapid take-up of mobile phones, together with the use of RFID, has created great anticipation about possibilities for mobile transactions on the go.

2.5.1 Contactless payment systems

A contactless payment system allows the user to pay for goods and services using a smart card that may either contain a pre-loaded cash balance, or is linked to a bank or credit account to which the payments are charged. Smart cards, based on RFID technology, look and feel exactly like a regular bank card, but offer both the end-users and retailers a number of additional advantages. The primary benefit is that transactions can be carried out more swiftly, reducing congestion in the stores and obviating the need for consumers to carry around large quantities of cash. Contactless payment systems are in use across Asia, Europe and North America. According to IDTechEx, contactless payment systems represent the single largest market by value for RFID, although this is likely to be eclipsed in 2007 by the market for item-level tagging.[76]

There are a number of different technologies for contactless payment, but the RFID standard ISO 14443 is the most common for business to consumer transactions, accounting for more than 80 per cent of contactless credit card transactions worldwide. Data transmitted by ISO 14443 chips is encrypted, and the transmission range is designed to be very short, at around 100 mm or less.[77]

Contactless systems are certainly a step beyond traditional bank cards, or paper tickets on public transport systems (box 2.22). But if the user has to carry a different contactless card for each application—one linked to their bank account for store purchases, another for use on one city's public transport network, and yet another for a different city—then any gain in convenience is reduced. Manufacturers are therefore looking at ways to use the technology in a form that can be more easily combined and transferred.

2.5.2 Mobile payments

Examples of mobile payment systems include the SMS-based pre-payment metering schemes for electricity and gas that have been developed by LogicaCMG and Iskraemeco ECL in the United Kingdom[78]. One of the most advanced and cutting-edge economies in terms of e-commerce development is Japan. A Eurotechnology study[79] estimates that the Japanese mobile commerce market is already worth some USD 10 billion per year. Japanese mobile commerce revenue exceeded that of mobile content in 2004, and Eurotechnology predicts that it will hit the USD 100 million mark in the not-too-distant future.

A study by Royal Philips Electronics and Visa International[80] found that retail purchases with a mobile phone were well received by consumers, who praised the ease, convenience and speed of the contactless payment system. In Japan, customers of NTT DoCoMo have been able to take advantage of a "digital wallet service" since early 2005[81]. The service operates using RFID technology, enabled by the integration of a SONY FeliCa contactless smart chip into the customer's mobile phone. Just five months after the introduction of the service, over a million individuals had already signed up. The main services on offer are:

a) withdrawing cash at ATMs;

b) shopping at kiosks and vending machines;

c) buying train or air tickets;

d) buying tickets for concerts, cinemas and theatres;

e) doubling as a member card for sports clubs and shops;

f) key/ID for security doors (both corporate and residential);

g) shopping online.

Most mobile phone payment systems operate using the Near Field Communications (NFC) standard, a short-range wireless technology operating at 13.56 MHz[82]. A study from ABI Research[83] predicts that, of the estimated 830 million new phones that will be constructed worldwide in 2009, 30 per cent will be NFC compliant. Consultants Booz Allen Hamilton[84] reported in August 2006 that mobile payment solutions have realistic prospects of successful market penetration worldwide. The authors identified the drivers underlying the interest in mobile payment systems:

a) Device manufacturers are looking to position the mobile phone even more firmly in the heart of everyday life, by looking at additional sales drivers, like mobile payment;

b) Credit card associations are looking to contactless payments, due to an increasing marginalization by the card issuers;

c) Banks would like to promote cashless payment transactions, in order to cut costs;

d) Retailers are attracted by the prospect of reducing per-payment transaction costs through mobile payment systems.

2.5.3 The revival of micropayments?

Micropayments are financial transactions involving such small amounts of money that collection with conventional payment systems is impractical, essentially because of the disproportionate cost[85]. A micropayment system will usually accumulate a number of different micropayments, and then collect the cumulative amount as a single payment.

First-generation micropayments systems were introduced around 1994, but failed to thrive and disappeared when the *dot.com* bubble collapsed. A second generation is now emerging, and appears to be benefiting from lessons learned first time around. Micropayments have been used for purchasing music and video downloads, and for online games, where the basic game is provided for free, but the user pays for enhancements. Among online individual content payments, the share of micropayments increased from 7.4 per cent in 2003, to 17.9 per cent in 2004, with almost USD 50 million paid using micropayment systems in 2004. This increase in the use of micropayment systems has been mirrored by the share of content subscriptions dropping from 89 per cent to 84.6 per cent over the same period.[86]

First-generation systems, which included systems such as DigiCash, eCash, MilliCent and CyberCoin,

Box 2.22: Buy faster, board faster

RFID ticketing for the world's major transport systems

Some of the world's busiest transport systems have turned to contactless payment systems. In London, Hong Kong and Japan, where many millions of people use the public transport systems every day, contactless tickets significantly speed up ticketing and boarding.

Japan's JR East railway operator introduced "Suica" in 2001. The Super Urban Intelligent Card uses a Sony FeliCa RFID chip, and is pre-loaded with a balance against which travel costs can be debited. Some Suica cards double as credit cards, and can be used even in shops where the Suica system is not supported. The cards also recharge themselves from the credit card account automatically when the balance runs low.

Hong Kong's Octopus is one of the most successful electronic cash systems in the world; the number of cards in circulation is nearly twice the Hong Kong population, and over nine million transactions are processed per day. Launched in 1997 as a fare collection system, it proved so successful that it is now used for virtually all public transport in Hong Kong, as well as payments at supermarkets, fast food stores, car parks and service stations. It even has a feature for donating money to charity. Like the Japanese Suica card, Octopus uses a Sony FeliCa RFID chip, and data is transmitted at up to 212 kbit/s. The range is between 3 and 10 cm. Payment is made by holding the card in close proximity to a card reader, which beeps to acknowledge payment, and displays the card's remaining balance. The Octopus card is anonymous, with no personal information, bank card or credit card details stored on the card. An automatic add value service (AAVS) allows the owner to specify a bank account or credit card from which to automatically add funds to the card if the balance should fall below zero.

The Oyster card is London's solution for contactless payment. First issued in 2003, the cards are now used by over 5 million people. The card is based on Philips' MIFARE chips, and likewise has a range of about 10 cm. Owners can load the card up with a pay-as-you-go balance, or use it in a restricted mode as a dedicated transport pass. Travellers 'touch in' and 'touch out' at the start and end of each journey. Like the Suica and Octopus, the Oyster card can be set up to automatically top-up when the balance runs low.

Image source: Oyster

Source: Smart Card Alliance, "Contactless Payment at the Retail Point of Sale: Applications, Technologies and Transaction Models", March 2003, available at www.smartcardalliance.org; CIO Insight, "How Safe Are the New Contactless Payment Systems?", 20 June 2005, available at www.cioinsight.com

had a number of disadvantages. These systems were mostly token-based rather than account-based, meaning that users purchased tokens or "e-coins" which they could then use to buy items. Token-based systems are less readily scalable than account-based systems, given the need for a central administration to issue and redeem tokens or e-coins. First-generation systems also had very cumbersome interfaces that were anything but user-friendly, requiring a solid grounding in encryption, digital signatures and transport protocols on the part of the users. In some cases, special hardware was also needed. Payments took a long time to complete, and because most systems required customers to install wallet software, payments had to be made from the same computer each time, meaning that systems were not portable.

Second-generation micropayment systems are almost uniquely account-based systems, so they are more readily scalable. They have also achieved greater coverage than first generation systems, partly because customers are more used to working on the internet, and to the concept of paid content. Second-generation systems are also for the most part free of charge for the user, unlike some first-generation systems that charged a set-up fee,

monthly maintenance costs, and a further fee for each individual transaction.

Over the last few years, the number of merchants using second-generation payment systems has significantly increased. Click&Buy has over three million customers and 2'500 merchants; PaySafeCard has over 2'000 merchants, and in early 2005, Bitpass had registered over 1'900 content merchants. Online music retailers, such as Apple's iTunes and Yahoo! Music and Amazon, are good examples of successful second-generation micropayment websites. Apple's website consolidates multiple micropayments into a single credit card transaction, thus avoiding one of the primary drawbacks associated with micropayments: the disproportionate size of the credit card transaction fee for a single transaction.

Although second-generation systems appear to be more enduring than their first-generation counterparts, neither first nor second-generation micropayment systems have successfully addressed the issue of interoperability. The World Wide Web Consortium (W3C) set up a Micropayment Markup Working Group which went on to develop a Micropayment Transfer Protocol (MPTP 1995), as well as the common mark-up for micropayment per-fee-links language. However, neither the protocol nor the language became full standards, and the group was terminated around 1999. The issue of interoperability therefore remains unresolved, but the success of second-generation systems should encourage the industry to return to the issue.[87]

All digital transactions, whilst offering end-users convenience and in many cases the ability to more easily and closely track their payments than for non-digital transactions, also raise the issue of security and privacy. As the number of digital transactions increases, criminals will search for vulnerabilities in the system which they can exploit. Because of this, digital transaction systems need to be developed in tandem with digital security and identity schemes.

2.6 It's all about convergence

The long-anticipated wave of digital convergence is likely to be driven by consumers as much as suppliers[88]. Mobile and fixed-line networks had appeared to be drifting apart as they developed different features and targeted different markets, but today they are increasingly targeting the same applications. Similarly, convergence between the telecommunication sector, the broadcasting sector and the internet means that both competition and collaboration are crucial.

Connected computing technologies are giving shape to a future internet of things. Multi-functional and personalized user devices are becoming an inseparable part of our lives, as the transition from analogue to digital continues apace.

Telecommunications networks, especially broad-band ones, are opening our lives to digital content to an unprecedented extent. Information, entertainment, gambling and gaming services are more easily available than ever before. Users themselves are able to publish self-generated content and compete directly with the media giants.

Given the extent to which digital technologies have invaded our real world lives, it is hard to remember that the world wide web and the digital mobile phone are only 15 years old, and the PC only slightly older at 25 years. What does the next 25 years hold in store?

Endnotes for Chapter two

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