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Technology developments in the digital economy

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Executive summary

This ACMA research report provides general information and analysis of technology developments related to communications services in Australia. The research aims to inform a wide audience of consumers and the community of more recent technological developments.

This report explores developments in information and communications technologies that underpin the digital economy. In broad terms, the digital economy is defined as the global network of economic and social activities that are enabled by information and communications technologies such as the internet, mobile and sensor networks.[1] There are three broad groups of technologies currently relevant to the development of the networks that support the digital economy and consumer applications and use of services—infrastructure, smart technologies and digital community. They are the focus of this report.

Infrastructure developments continue the ongoing trend of network upgrades to provide higher bandwidth and a transition to IP-enabled platforms, with innovation improving physical properties and performance quality across networks.

Optical fibre technology has become the preferred choice in greenfield access and core transmission networks, and a high level of activity has been maintained in the recent adverse economic environment. A current challenge for industry is to create all-optical networks that ultimately provide optical packet-switching in an IP environment, with development and standards activity focused on improving the physical performance of these networks.

Wireless technologies also continue to provide mobility and cost-effective infrastructure solutions for users to access the digital economy services. The current 3G technologies that support the demand for wireless mobile services in Australia are expected to follow the global evolution to faster and more efficient technologies such as Long-Term Evolution (LTE). Technologies such as WiMAX will also play a role in providing better access solutions, with development activity directed to allow interoperability and consumer use of multimedia and smart multifunctional devices. Femtocell technology may also emerge to play an important role in overcoming future wireless capacity issues.

Home network technologies are extending the improved fixed and wireless access network capability into the residential environment. Convergence of services onto unifying IP access networks has stimulated the development of similar converged technologies in the home network environment and is allowing home automation applications. A key challenge in this environment is transitioning from models of identity management developed for legacy telecommunications networks to internet-based multimedia communications services. The home network is where the convergence of multiple services and identities is occurring, and is the focal point for customer service management. These trends highlight the changing environment ahead for both service providers and consumers.

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[1] Australian Government, Department of Broadband, Communications and the Digital Economy, *Australia's Digital Economy: Future Directions*, 14 July2009, pp.2, viewed 6 December 2009, www.dbcde.gov.au/digital_economy/future_directions_of_the_digital_economy/australias_digital_economy_future_directions.

Growth in the take-up and use of smartphones has been one of the most important developments of the past two years, with smartphones expected to drive significant future growth in mobile traffic as well as create opportunities in the digital economy for content provision, service carriage and applications development.

Sustainability concerns are another important driver that is creating a new convergence between the telecommunications industry and utilities, and driving smart applications development. Smart technologies aim to address two competing drivers—the first from increasing energy consumption levels that are the result of the wider use of communications and the exponential increase in information and data storage requirements, and the second from energy and data storage efficiency techniques.

Smart technologies and systems are being used to control the growing energy demands of the communications and information sector, as well as manage the exponential increase in information resources made available through the internet.

Applications development is active in the areas of micropayments, location sensing and home networks, which all offer new forms of participation and connectivity in the digital economy. Device and delivery technologies have moved beyond the single-service model to a complex multifunction and multiservice environment not envisaged under existing regulation. The level of complexity associated with providing diverse digital media creates challenges also for service providers and users. Cloud computing, virtualisation and the power requirements associated with managing and distributing the exponential growth in data volumes are changing the structure of service provisioning in information and communications technologies.

Digital communications services and the online environment are integral to the Australian economy and society. The Australian community is now using the internet and digitally based services on a regular basis, with the boundaries between legacy services, digital applications and devices becoming increasingly blurred. Users are now interacting with the digital economy through the use of mobile payment, contactless smartcard and location-based technologies. The combining of location-based information with other information sources in the digital community has provided a range of rich commercial and social applications. This results in an augmented reality that provides added value beyond the original information sources. These activities have revealed a new willingness for social openness that has raised concern in the area of privacy and security.

In a world where information is abundant and attention is the new scarcity, the challenge for individuals is what to pay attention to. The challenge for business, government and other institutions is in how to attract attention. In a networked society, content creation and distribution channels are available to anyone with broadband internet connectivity. It has become so integrated in the media value-chain that the distinctions between ‘social media’ and ‘media’ are difficult to make.

The rapid pace of emerging technologies and their adoption will continue to shape and inform our lives at all levels of interaction. Understanding their current development will assist the ACMA, government, industry and community in ensuring that all Australians reap the benefits that these technologies offer to the digital economy.

Methodology

Technology developments in the digital economy provides an overview of infrastructure, applications, social and economic trends and developments, and anticipated developments.

The report focuses on developments and relevance to the emerging digital economy since the release of the ACMA's *Trends in communications and media technologies, applications and services* in March 2009.[2] This report contributes to work the ACMA is undertaking to inform its understanding of the operation of regulation in the communications and media markets, and as part of its statutory responsibilities to be informed and advise on technology developments and service trends. It offers an opportunity to identify and engage with change, and to anticipate the need for possible action by the ACMA.

Research was conducted using desktop research, information collection and analysis over the past year focusing on developments of significance reported over that period. The ACMA will continue to prepare reports of this nature and welcomes your feedback.

[2] Australian Communications and Media Authority, *Trends in communications and media technologies, applications and services*, March2009, www.acma.gov.au/WEB/STANDARD/pc=PC_311690.

Infrastructure

Overview

This section provides an overview of the major trends and developments in communications infrastructure technologies that underpin the digital economy. In broad terms, this includes ongoing upgrades in fixed and wireless transmission and access networks to deliver higher data rate capabilities. Developments in home networking technologies are another area of significant development activity that extend broadband capabilities and access to new automation applications in the residential environment.

Optical fibre networks and technologies

Optical fibre technology is increasingly used for network upgrades globally, as well as being an area of significant investment activity within Australia. Key improvements have occurred to the physical properties of optical fibre that transmit information and with connectors that bridge segments of optical fibre access networks, allowing optical fibre to be more widely used in long-haul transmission and access networks.

With growing demand for higher bandwidth in existing fixed and wireless networks, optical fibre technologies can provide high capacity using light signals through a silica-based glass fibre waveguide to transmit information. A single wavelength of light on a fibre can carry more than 100 times the information over greater distances than electrical DSL signals, and offers increasing capacity while aggregating disparate transmission network elements.[3]

Long-haul international submarine cables is an active area of optical fibre deployments. Telstra,[4] Pipe,[5] Southern Cross[6] and the AJC[7] optical fibre cables have either been deployed or had their capacity increased though technology upgrades and improvements and collaboration with other providers over the past 18 months.

Similarly, optical fibre is being deployed to a greater extent in national long-haul networks. With its 290km underwater cable to Tasmania, Basslink Telecom has deployed one of the world's longest unamplified optical fibre backhaul solutions.[8] Telstra has announced it will upgrade fibre capacity of its Next IP network between Melbourne and Sydney with a tenfold increase using wavelength division multiplexing (WDM) technology.[9] Nextgen Networks, owner and operator of Australia's third-largest

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[3] Ericsson, *Full Service Metro Broadband Architecture,* 284 23–3116 Uen Rev E, January 2009, viewed 9 December 2009, www.ericsson.com/technology/whitepapers/fsb_metro_rev_e.pdf.

[4] Telstra, *Telstra Endeavour Cable*, viewed 9 December 2009, http://telstrawholesale.com/products/international/international-data-transport/endeavour-cable.htm.

[5] Pipe, www.pipenetworks.com/docs/media/ASX%2009_10_08%20PIPE%20Tyco%20Telecom%20Completion%20Release.pdf.

[6] Southern Cross Cable Network, *Southern Cross Upgrade*, news release, 14 May 2009, viewed 9 December 2009, www.southerncrosscables.com/public/News/newsdetail.cfm?StoryID=169.

[7] Australia Japan Cable, *Australia Japan Cable collaborates to create a connectivity solution on AAG*, news and media, 1 April 2009, viewed 9 December 2009, www.ajcable.com/news-and-media/australia-japan-cable-collaborates-to-create-a-connectivity-solution-on-aag/.

[8] Basslink Telecom, www.basslink.com.au/home/fileadmin/templates/MediaArticles/Media_Release_Basslink_launch_160709.pdf.

[9] Telstra, *Telstra to upgrade capacity of Next IP network between Melbourne and Sydney*, media release reference number: 185/2009, 13 July 2009, viewed 10 December 2009, www.telstra.com.au/abouttelstra/media/announcements_article.cfm?ObjectID=45222.

fibre optic network, consisting of 8,500km of fibre optic cable from Brisbane to Perth, plans to extend its network by laying 6,000km of fibre optic backbone links that will pass 100 regional locations, a result of its successful bid for the Federal Government regional broadband tender.[10]

This investment activity has continued despite the constrained economic environment of 2009 arising from the Global Financial Crisis. The Asia–Pacific region has shown to be the most resilient, with optical network market growth up 33 per cent in the last twelve months.[11]

Access network upgrades using optical fibre are a noticeable development over the last 12 months. In the first six months of 2009, more than 5.5 million new fibre-to-the-home/basement (FTTH/B) subscribers were added worldwide, according to the latest update to the global ranking of FTTH/B economies, jointly issued by the three FTTH Councils of Asia–Pacific, Europe and North America.[12] This represented growth of 15 per cent in the first six months of the economic downturn.

In Australia, optical fibre is now preferred in greenfield access networks. Telstra,[13] Pivit,[14] OptiComm[15] and TransACT[16] have all deployed FTTH access networks. The Australian Government proposes to ensure that fibre-to-the-premises (FTTP) technology is installed in all new substantial greenfield property developments.[17] A new company has also been established by the government to build and operate a new super-fast National Broadband Network (NBN) that will use a FTTP access network to achieve greater than 90 per cent national coverage.[18]

While investment in transmission and access networks has been made, there will still be a lag to realise the full capacity of fibre networks where infrastructure still relies heavily on electronics for switching, aggregation and distribution, which all place speed, capacity and energy constraints on end-to-end performance. A current challenge for industry is to create all-optical networks that provide optical circuit or wavelength switching, and ultimately optical packet switching, for an all-IP environment.

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[10] Nextgen www.nextgennetworks.com.au/pdfs/www-businessspectator-com-au_Leighton-carrier-wins-NBN-t.pdf.

[11] OVUM, *Market Share 3Q09 optical networks, global and regional*, reference code: OVUM51837, 11 January 2010, viewed 20 January 2010.

[12] Fiber to the Home Council, *Global Fiber to the Home Expansion Defies the Economic Downturn*, media release, 30 September 2009, viewed 4 January 2010, www.ftthcouncil.org/en/newsroom/2009/09/30/global-fiber-to-the-home-expansion-defies-the-economic-downturn.

[13] Telstra, *Telstra to turbo-charge Velocity network speeds*, media release, 31 March 2009, viewed 4 January 2010, www.telstra.com.au/abouttelstra/media/announcements_article.cfm?ObjectID=44722.

[14] Pivit Capability Statement, www.pivit.com.au/images/files/pdf/pivit-capability-statement-v1.5.pdf.

[15] OptiComm, *NEC and OptiComm announce Australia's first live open-access FTTP site at University Hill, Victoria*, media release, 6 August 2009, viewed 4 January 2010, www.nec.com.au/F74056A2B409470098E1AA28C6D999A0.htm.

[16] TransACT, *TransACT releases fastest broadband plans in Australia*, media release, 7 August 2009, viewed 4 January 2010, www.transact.com.au/news/Article.aspx?id=1055.

[17] S Conroy (Minister for Broadband, Communications and the Digital Economy), *New property estates to lead fibre broadband revolution,* media release, 29 May 2009, viewed 4 January 2010, www.minister.dbcde.gov.au/media/media_releases/2009/048.

[18] Prime Minister, Treasurer, Minister for Finance, Minister for Broadband, *New National Broadband Network*, joint media release, 7 April 2009, viewed 4 January 2010, www.minister.dbcde.gov.au/media/media_releases/2009/022.

Optical fibre's performance is currently approaching the theoretical limits of silica-based glass materials, but there are ongoing developments to improve silica fibre performance through materials purity and fibre fabrication.[19]

Improvement in physical properties such as bend tolerance is another more recent area of focus.[20] Improved bend performance minimises signal loss and enables faster and more efficient optical cable pathways, routing and installation; this has led to the resolution of some of the technical and physical challenges faced by telecommunications carriers installing FTTH networks, particularly in multi-dwelling units, and also by data centres and enterprise networks, which face similar space constraints and installation challenges. Recent standardisation activity by the International Telecommunications Union (ITU) and the Institute of Electrical and Electronic Engineers (IEEE) has focused on the evolving requirements for bend loss in single-mode fibre in FTTH access networks. This class of fibre reduces costs through smaller internal and external plant space requirements for fibre management, relaxed deployment requirements, reduced installation re-work and improved service reliability for the high density network of distribution and drop-cables.

Fibre connectors have been used in internal networks such as exchanges and data centres but it is in the external plant environment where connectors are now making an impact.

Attenuation characteristics and the physical robustness of fibre connectors have been improved to a point where they are being integrated into external plant fibre network deployments such as FTTH. Hardened connectors and adapters now offer a copper-like installation by one deployment team; a cost saving over what was two deployment teams that required additional skilled fusion splicing.

Technological advances in index-matching gel and its use in fibre connections have also improved performance parameters.[21] Factory-configured, pre-assembled and pre-terminated external plant fibre connectivity products are now available as a solution in fibre access networks.

Service providers in Japan have a target of 30 million fibre-connected homes by 2010.[22] Mechanical splicing using connectors and matching gel are helping meet this target. In Australia, the trend in fibre-access networks is towards the deployment of factory-prepared connectivity products in the 'last mile'.[23] These products yield a cost-effective and consistent performance in the field without the requirement of matching gel.

As well as providing access to high bandwidth services across long-haul transmission and access networks, optical fibre deployments are also driving convergence in data and storage networks, and providing a transition path for digital transport networks that underpin new IP-based economic and social activities.

Data centres are currently undergoing a transformation that is driven by server virtualisation, power efficiency, enterprise cloud computing and the direct connection of fibre channel storage to IP-switching. Fibre channel over Ethernet enables the

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[19] Fiber-Optic Technology—Corning, *Web ProForum Tutorials*, viewed 9 December 2009, www.iec.org/online/tutorials/fiber_optic/index.asp.

[20] Fiber-Optic Technology—Corning, *Web ProForum Tutorials*, viewed 9 December 2009, www.iec.org/online/tutorials/fiber_optic/index.asp.

[21] Corning Evolant[R] Solutions, *Long-Term Reliability and Performance of Silicone-based Index Matching Gels in No-Epoxy, No Polish Connectors,* Corning Cable Systems LLC, October 2007, viewed 10 December 2009, http://catalog2.corning.com/CorningCableSystems/media/NAFTA/White_Papers/EVO-784-EN.pdf.

[22] Ibid.

[23] OptiComm, *Our Technology*, viewed 10 December 2009, www.opticomm.net.au/html/technology.htm.

convergence of data and storage networks over a 10GBit Ethernet fabric.[24] The transition to a shared fibre network and unified switching fabric can reduce the amount of fibre and ports required in the data centre and increase speeds and efficiencies required for low-cost operation of high-throughput services.

The evolution of optical technology, its standardisation activities and integration into fixed and wireless networks continues to cater for an environment of increasing traffic demands and dynamic IP-based multimedia applications and services. This is placing pressure on existing regulatory arrangements that are in their second decade of operation and were developed for a less complex communications business and service environment.

Wireless technologies

In wireless access networks, the global and Australian focus of technology activity is on upgrade paths to provide higher data rate capability and support for IP-enabled mobile applications. This is reflected in the ACMA's Five-year Spectrum Outlook process that assesses demand for spectrum by various stakeholders.[25]

Mobile network operators' network upgrades will likely follow a technology path to 4G LTE from 2G GSM and 3G High Speed Packet Access (HSPA)—Wide band Code Division Multiple Access (WCDMA) suite.

The number of GSM and WCDMA-HSPA family of systems has gained almost 90 per cent market share of all mobile technologies globally.[26] The other 10 per cent is predominantly the CDMA2000 family.

Long-Term Evolution

Long-Term Evolution[27] (LTE) is optimised purely for IP-based traffic[28] and has been designed to primarily enable higher peak data rates and provide improved system performance and spectrum efficiencies.

HSPA is an evolutionary protocol of 3G Universal Mobile Telecommunication System (UMTS) that uses Wide band CDMA.

On 16 December 2009, the Global Mobile Suppliers Association (GSA) published the latest GSM/3G market update.[29] In summary:

- the world's first LTE networks (TeliaSonera) are operating in Sweden and Norway
- the number of operators committed to LTE deployments has doubled in the last eight months, with up to 19 LTE networks expected to be launched by the end of 2010
- 66 operators have committed to HSPA Evolution (HSPA+), which includes 37 HSPA+ networks commercially launched in 24 countries. Of these networks, 34 support peak downlink data speeds of up to 21Mbits/s, while the other three networks support 28Mbits/s.

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[24] R. Layland, Network World US, TechWorld, *How clouds and fibre has remade the data centre*, 18 September 2009, viewed 4 January 2010, http://features.techworld.com/data-centre/3202247/how-cl.

[25] www.acma.gov.au/WEB/STANDARD/pc=PC_311686.

[26] www.gsmworld.com/newsroom/market-data/market_data_summary.htm.

[27] J Middleton, Informa.Com, Mobile Telecommunications International, *LTE edging closer to commercial reality*, October 2009.

[28] E Dahlman, S Parkvall, J Skold, P Beming, *3G Evolution: HSPA and LTE for Mobile Broadband*, 2nd Edition, Academic Press UK, 2007.

[29] GSA, *Latest GSM/3G Market Update from GSA Confirms Strong Mobile Broadband Gains in 2009 and a Positive Outlook*, news release, 16 December 2009, viewed 17 December 2009, www.gsacom.com/news/gsa_290.php4.

LTE capabilities are being tested by mobile operators and equipment vendors. US carrier Verizon Wireless completed its first successful LTE data calls in Boston and Seattle using the 3GPP Release 8 standard in the 700MHz spectrum. The data calls were streaming video, file uploads and downloads, web browsing and VoIP. Verizon, which is shifting its 4G strategy to LTE from a 3G rollout based on 1xEV-DO (Evolution-Data Optimised was developed from CDMA cellular technology), has 10 LTE sites up and running in the 700MHz spectrum, acting as a test bed to help them understand how to best prepare cell sites and how to add the technology to its network.

Nortel teamed with LG in Korea recently to demonstrate a 3GPP standards-compliant data handover between a LTE network and a CDMA network, showing video downloads, web surfing and VoIP calls, maintained when a mobile data user was moving between LTE and CDMA coverage zones. CDMA networks will co-exist with LTE networks as users migrate to 4G networks; the inter-technology handover will ensure the user experience without losing data connectivity.

Verizon expects to commercially launch LTE in up to 30 markets in 2010, covering 100 million people, with nationwide coverage in the USA planned for 2013. Japanese operator KDDI, partnered with Motorola and NEC to build its LTE network, plans to launch commercial LTE services in late 2012. KDDI is planning to deploy its LTE networks in the 1.5GHz and 800MHz bands, with future plans to provide 96.5 per cent national broadband mobile phone service coverage of Japan by the end of 2014.

In Australia, the short- and medium-term regulatory focus is on making available 2.5 GHz and 700 MHz bands for the deployment of next generation mobile access networks. Both these bands have been identified in the ACMA *Five-year Spectrum Outlook* as the main target bands for LTE.[30] The Australian Mobile Telecommunications Association (AMTA) has welcomed the release of spectrum for next generation mobile broadband such as LTE.[31]

While operators generally support the adoption of LTE, the economic downturn has led to the deployment of HSPA+ as an option requiring comparatively less investment. According to Informa, WCDMA/HSPA operators are focusing more on HSPA+ upgrades to offer improvements in capacity and data speeds at a lower cost than deploying LTE in the immediate future.

WiMAX

WiMAX is a standards-based wireless broadband access technology that enables the carriage of IP-based services. It is used for both mobile and fixed networks to provide the 'last mile'. WiMAX supports Quality of Service (QoS) to prioritise different types of traffic over its network.

Globally, wireless broadband internet deployments based on WiMAX have reached 519 networks in 146 countries, including 95 WiMAX networks deployed by 2G mobile operators, with 112 added in 2009, supported by ongoing global standardisation activity.[32] Development activity has been directed to improving interoperability and applications and device development in both mobile (802.16e) and fixed (802.16d) standards.

[30] www.acma.gov.au/webwr/_assets/main/lib311829/fyso_2010_2014.pdf.

[31] AMTA media release 5 January 2010, www.amta.org.au/articles/Mobile.telecommunications.industry.welcomes.release.of.Digital.Dividend.Green.Paper.

[32] WiMAX Forum news 2009, *WiMAX Deployments go global with 519 in 146 countries*, 17 December 2009, viewed 21 December 2009, www.wimaxforum.org/news/2030.

The Russian Yota WiMAX network continues to expand with 250,000 active commercial users. In 2010, Yota plans to add a new GSM plus Mobile WiMAX phone supporting VoIP over WiMAX. Clearwire in the US has more than 555,000 subscribers; its WiMAX network covers more than 30 million consumers in 34 markets. Malaysia's Packet One Networks has 130,000 subscribers; KT covers more than half the Korean population; UQ Communications now covers more than half of Japan's population; Imagine launched its Mobile WiMAX network to cover Ireland; Freedom4 is set to offer full mobile WiMAX services in the UK with its nationwide 3.6GHz spectrum after being granted a licence variation.[33]

In Australia, Internode through its Airspan Network offers 802.16d at 3.5GHz in Adelaide; SPAusNet plans to use 802.16e at 2.3GHz in Melbourne; Energy Australia plans to deploy 802.16e at 2.3GHz in Sydney; BigAir Group through its Airspan Network offers 802.16d at 5.8GHz in Sydney; Unwired with Cisco has deployed 802.16d at 2.3GHz and 3.5GHz in Sydney; and Allegro Networks with Alvarion is planning to deploy 802.16d at 3.6GHz in Brisbane.[34]

The 2.3 GHz band is a WiMAX profile band and is also identified for the ITU global standard for international mobile telecommunications (IMT-2000).[35] Under the ACMA's Five-year Spectrum Outlook, the current arrangements in this band provide sufficient flexibility to allow for the use of all technologies covered by IMT-2000 standards.[36] More recently, Vividwireless deployed an 802.16e network in Perth covering approximately 150 base stations using 2.3 GHz spectrum licence, with other Australian capital cities expected to follow.

WiMAX equipment vendors have seen growth worldwide in 2009. Motorola recently shipped its ten thousandth WiMAX Access Point; Alvarion now supplies more than 260 commercial network deployments in more than 100 countries; and Intel launched notebooks with its embedded WiFi/WiMAX minicard in the US, Russia and Japan.[37] A range of notebook and USB modem/PC card makers have started adding WiMAX chips to their products since the chips were made available from Intel and others. Dell has also started offering embedded products to enable roaming over different WiMAX networks globally, as it believes that full interoperability has now been achieved at the equipment level; it is expecting demand to increase from other operators outside the US early in 2010.[38] Mformation® Technologies Inc.(a provider of advanced mobile device management solutions) in an interoperability partnership with Sequans Communications (a WiMAX semiconductor product manufacturer) will provide a wide range of support programs to service providers for managing and controlling devices over a WiMAX network. This partnership will allow WiMAX services and devices to be manufactured compliant with standards and therefore be able to work for any WiMAX service provider.[39]

In 2010, it is anticipated that Mobile WiMAX 2.3GHz products will be certified, providing the necessary terminal equipment to connect data, voice and video services.

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[33] Ibid.

[34] WiMAX Forum *WiMAX Deployments*, 12 August 2009, viewed 21 December 2009, www.wimaxmaps.org/.

[34] www.itu.int/ITU-R/index.asp?category=information&rlink=imt-advanced&lang=en.

[35] www.itu.int/ITU-R/index.asp?category=information&rlink=imt-advanced&lang=en.

[36] www.acma.gov.au/webwr/_assets/main/lib311829/fyso_2010_2014.pdf.

[37] WiMAX Forum news 2009, *WiMAX Deployments go global with 519 in 146 countries*, 17 December 2009, viewed 21 December 2009, www.wimaxforum.org/news/2030.

[38] C Gabriel, Rethink Wireless, *Dell offers WiMAX laptop upgrade, initially for Clearwire*, 7 May 2009, viewed 2 February 2010, www.rethink-wireless.com/2009/05/07/dell-offers-wimax-laptop-upgrade-initially-clearwire.htm.

[39] WiMAX Industry Broadband Wireless News and Marketplace, *Sequans Communications and Mformation Announce Interoperability Partnership in Support of WiMAX Device Management*, Mformation® Technologies Inc., 20 October 2009, viewed 2 February 2010, www.wimax-industry.com/ar/27p.htm.

WiFi

WiFi[40] generally refers to wireless local area network technology that provides short-range, high data rate connectivity between portable data devices and access points connected to a common wireless network.

WiFi access points are becoming increasingly dense in both outdoor and indoor environments. According to In-Stat, the number of WiFi-enabled devices such as cameras, gaming devices (handheld and consoles), and personal media players is forecast to increase from 108.8 million in 2009 to 177.3 million in 2013.[41] Nearly all smartphones today support WiFi and the technology can also be used to establish a user's location (positioning), using comprehensive databases of access point locations.

In many locations, multiple WiFi signals are present, which presents opportunities for triangulation or pattern-matching algorithms to be used to enhance location-determination performance—to the point that indoor navigation applications in environments such as shopping malls are now possible. In the right environments, position fixes, accurate to 10–20 metres, are possible in a couple of seconds. The primary downside of this technology is that while WiFi access points may be dense in urban areas they are far less numerous in suburban or rural areas, limiting coverage and performance in these areas.[42]

A further development of the WiFi standard IEEE 802.11u will enable interworking of several WiFi networks. In the future, WiFi networks will advertise their services and the terms under which users can link to them; based on a user's identity with a network service provider, they might be able to access a narrowly defined set of essential connections and functions. Final approval for 802.11u is scheduled for June 2010.[43]

Another WiFi standard development, IEEE 802.11v, which is likely to be finalised in July 2010, enables improved WiFi management protocols such as power management and support for location data. The broad aim of this standard is to enable wireless networks to negotiate and manage streaming media sessions so that one user's request for high-definition video does not 'choke' WiFi voice users on the same access point.[44]

In yet another development, IEEE 802.11z is geared towards enabling peer-to-peer connections. Through the WiFi Direct Project from the WiFi Alliance, a WiFi card in a laptop is able to bypass an access point and link directly with wireless printers, cameras, projectors, sensors or plasma screens. Even though the access point is bypassed, the WiFi device remains associated with it, benefiting from the security and management services offered by the access point.[45]

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[40] IEEE P802.11—Task Group p—Meeting Update, *Status of Project IEEE 802.11 Task Group p—Wireless Access in Vehicular Environments (WAVE)*, viewed 18 December 2009, http://grouper.ieee.org/groups/802/11/Reports/tgp_update.htm.

[41] E Potter, Marketing Coordinator, Reed Business, *Wi-Fi becomes the Multimedia Interface of Choice for Consumer Entertainment Devices*, In-Stat, 15 December 2009, viewed 7 January 2010, www.in-stat.com/press.asp?ID=2688&sku=IN0904628WS.

[42] B Butler, Spirent Communications, CommsDesign, *Playing Nice—LBS and Hybrid location technologies*, 8 December 2009, viewed 21 December 2009, www.commsdesign.com/design_corner/showArticle.jhtml;jsessionid=CHD0JEEEXQMONQE1GHOSKHWATMY32JVN?articleID=222002766&pgno=2 h.

[43] Ibid.

[44] Ibid.

[45] J Cox, NetworkWorld, *What's next for Wi-Fi?*, 12 November 2009, viewed 21 December 2009, www.networkworld.com/news/2009/111209-wifi-change.html?fsrc=netflash-rss.

In the past, WiFi-based home networks were able to support voice and data, with limited local capacity sharing and streaming HD video. In September 2009, the IEEE 802.11n WiFi standard was ratified; it offers up to 160Mbits/s throughput over short distances as well as QoS. Such tagging of packets enables priority data like audio and video to be delivered continuously, permitting HD television over WiFi—something not possible previously. Industry is touting the 802.11n standard as the Ethernet-replacement.[46] Planned future advances in 802.11n will support spatial data streams and meshing nodes via the 802.11s standard (due in September 2010); it is predicted to enable high-speed, wireless backbones, paving the way for internet-like WiFi networks.[47]

The combination of these standards development initiatives offers additional internet access options for participation in the digital economy.

Femtocells

Providing high-speed connectivity and portability over the last few metres in the home is an area of considerable activity. A femtocell is a short-range cellular mobile network cell that could be installed in a home or office. Physically, a femtocell base station is not unlike a DSL modem; with WiFi antennae added. A femtocell base station enables users to connect to their cellular service using cellular frequencies and protocols, with the backhaul provided by a broadband access service or other such wide-band connection to the home or office.

While not making a publicised appearance in Australian networks, internationally, femtocell operators have been active. Femtocells have been launched by Vodafone in the UK and Verizon in the US. According to the Femto Forum, as of January 2010, there are nine commercial deployments by major carriers worldwide, with numerous advanced trials expected to lead to further deployments later in the year.[48] The success of these launches was recently supported by the results of a market survey from ABI Research that showed more than 50 per cent of consumers in the US are interested in locating a femtocell within their home. Femtocells will not only resolve 3G coverage, capacity and cost issues; they are expected to dramatically improve the indoor mobile experience.[49]

For the mobile network operator, femtocells offer a method of de-loading the cells designed for use in public places and providing indoor access. With improved indoor access, the percentage of calls made at home could increase and the substitution from fixed to mobile services could accelerate.[50] As mobile networks add increased broadband data to their service offerings, the drive towards locating the cell infrastructure as close as possible to the point of demand is expected to gather strength.

As with so many innovations that cut across established business structures, femtocells will create a number of commercial conundrums such as payment models across networks. For a developing digital economy, the main benefits from these

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[46] W Rash, eWeek.com Mobile and Wireless, *802.11n: The Wi-Fi revolution nobody noticed*, 19 November 2009, viewed 21 December 2009, www.eweek.com/c/a/Mobile-and-Wireless/80211n-The-WiFi-Revolution-Nobody-Noticed-517334/.

[47] J Cox, NetworkWorld, *What's next for Wi-Fi?*, 12 November 2009, viewed 21 December 2009, www.networkworld.com/news/2009/111209-wifi-change.html?fsrc=netflash-rss.

[48] The Femto Forum website, viewed 9 February 2010, www.femtoforum.org.

[49] Femto Forum, *Femtocells Deployed on Three Continents as Major Survey Charts 50% Consumer Interest in US*, press release, 7 January 2010, viewed 9 February 2010, www.femtoforum.org/femto/pressreleases.php?id=127.

[50] JR Luening, Wireless Economics Signals Research Group, *Femtocell Economics*, GSMA Mobile World Conference, Barcelona, Spain, February 2009, viewed 10 December 2009, www.femtoforum.org/femto/Files/File/Femto%20Forum%20Business%20case%20presentation.pdf.

developments are improved indoor mobile coverage, the potential for more efficient data application and the ability to operate within the home networked environment.

The main regulatory impact of these developments is expected to be continued demand for mobile wireless spectrum to enhance network capacity.

Home network technologies

The home network potentially has large significance for the digital economy. It can be described as a local residential network used to interconnect a wide variety of digital devices predominantly designed for use in home entertainment, telecommunications and home automation systems, and also to provide connectivity between these devices and associated external services.

Home networking is moving from disparate vertically integrated networks and services provided by multiple service providers to multiple converged services over a single high-speed unified IP network. Individual networks in isolation may not be able to realise the full capabilities of multimedia services and devices, and currently act as a barrier to wider participation in digital economy activities.

Technologies have evolved to facilitate a home network solution with a focus on exploiting existing legacy home cabling to support digital IP networking. The HomePNA (formally the Home Phone Networking Alliance) is an association of companies that develops and standardises technology for home networking and the HomeGrid Forum, a similar global body, has agreed to promote the new ITU-T G.hn global wired home networking standard.

G.hn provides gigabit per second data rates and operates over legacy cabling systems such as mains powerlines, phone lines and coaxial cables.[51] G.hn is the most widely accepted standard for home networks in the United States where the majority of homes are fitted with coaxial cabling. G.hn is able to provide data across existing wiring in homes where new cabling may be difficult to install.

The ITU-T group working on home networking specifications under the G.hn banner recently agreed on specifications for smart grid products, which include a 'low complexity' profile targeted at smart grid applications.[52] Some of the smart grid products that will benefit from this agreement include smart meters; in-home displays and smart thermostats; plug-in electrical vehicles and electrical vehicle supply equipment; smart appliances such as washing machines, dryers, dishwashers, heating, ventilating and air-conditioning systems; and energy system interface devices. These specifications will allow equipment manufacturers to develop products that deliver the low power consumption, low cost, performance, reliability and security that is required for smart grid and other lower bit rate applications.

Other home network technologies such as High Definition Multimedia Interface (HDMI) and Broadband over Power Line (BPL) tend to be used as hybrid network solutions in the home rather than as a complete home network solution. HDMI requires wiring to interconnect multimedia devices while BPL provides Ethernet connectivity with quality dependent on the existing internal electrical mains network. The IEEE P1901 standardisation of BPL is expected to help this technology receive a wider acceptance. In greenfields installations, fixed Ethernet backbone wiring may be more easily installed at lower costs at the building stage. A hybrid network solution, including a wireless component, could be used to complete the interconnection of devices.

[51] DS2 Blog, *Top 10 things you need to known about the G.hn standard*, 12 May 2009, viewed 5 September 2009, http://blog.ds2.es/ds2blog/2009/05/top-ten-things-about-ghn-standard.html.

[52] ITU-T Newslog, *Home Networking Standard given Smart Grid specs*, 20 January 2010, viewed 3 February 2010, www.itu.int/ITU-T/newslog/Home+Networking+Standard+Given+Smart+Grid+Specs.aspx.

A number of industry bodies has identified the 60GHz radiofrequency spectrum as suitable for short-range, high-speed data transfers. The WiGig Alliance released a specification in December 2009 for a short-range, high-bandwidth wireless access technology similar to WiFi, using 60GHz radiofrequency spectrum to cater for high-data transfers required for multimedia applications within the home.[53] The aim of WiGig is to unify the next generation of wireless products by encouraging the adoption and widespread use of 60GHz wireless technology worldwide. WiGig claims device speeds more than 10 times faster than today's wireless LANs.

The WirelessHD consortium is another industry-led effort to define a worldwide standard for the next generation wireless digital network interface for consumer electronics and personal computing products.[54] For consumers, elimination of cables for audio and video dramatically simplifies home theatre system installation and eliminates the need to place source devices near the display. The WirelessHD specification 1.0 is optimised for wireless display connectivity, achieving high-speed data rates of up to 4Gbits/s at 10 metres, where its core technology is based in the 60GHz frequency band. Future theoretical data rates could be as high as 25Gbits/s, with the ability to scale to enable the provision of higher resolution, colour, depth and range.

In February 2009, NICTA, Australia's Information and Communications Technology (ICT) Research Centre of Excellence, held the first public demonstration of a prototype system using its world-first 60GHz Gigabit wireless (GiFi) chip technology.[55] This is the world's first transceiver integrated on a single chip that operates at 60GHz on the CMOS (complementary metal–oxide–semiconductor) process, the most common semiconductor technology. As the integrated transceiver is extremely small, it can be embedded into devices; allowing the networking of office and home equipment without wires.

The ZigBee Alliance, which promotes a set of low-power wireless home networking technologies based on the IEEE 802.15.4 physical radio standard, is positioning its platform as an industry standard for services related to home automation, remote control and home energy management.[56] At the end of May 2009, the Alliance's Smart Energy public application profile was endorsed by the European Smart Metering Industry Group (ESMIG).[57]

Consumer electronics based on ZigBee RF4CE, released in July 2009, is expected to increase the presence of ZigBee in homes.[58] At present, a range of devices now incorporate this Zigbee standard in the energy, home automation and healthcare markets, including consumer electronic device control, energy management and efficiency, home and commercial building automation, and industrial plant management. The ZigBee Smart Energy, Home Automation and Health Care public

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[53] The Wireless Gigabit Alliance, *Ecosystem*, viewed 21 December 2009, http://wirelessgigabitalliance.org/ecosystem/#home-networking.

[54] WirelessHD®, *Introduction to WirelessHD® Technology*, viewed 18 December 2009, www.wirelesshd.org/technology.html.

[55] NICTA, Ultra-high speed wireless networks, viewed 18 January 2010, www.nicta.com.au/research/projects/60ghz_wireless.

[56] T Chan, Greentelecomlive.com, *ZigBee Alliance views to become smart meter standard*, 8 June 2009, viewed 16 June 2009, www.greentelecomlive.com/2009/06/08/zigbee-alliance-vies-to-become-smart-meter-standard/.

[57] ZigBee *Smart Energy Public Profile*, 2009, viewed 7 January 2010, www.zigbee.org/Markets/ZigBeeSmartEnergy/ZigBeeSmartEnergyOverview/tabid/431/Default.aspx.

[58] 2009 ZigBee Alliance, ZigBee—Control Your World ™, *Understanding ZigBee RF4CE*, July 2009, viewed 4 January 2009, www.zigbee.org/LearnMore/WhitePapers/tabid/257/Default.aspx.

profiles already provide improvements in these markets.[59] RF4CE provides another public application profile that can be used to create multivendor interoperable solutions for use within the home, particularly by defining commands and procedures to enable consumer electronic devices such as TVs, DVD or CD players to be controlled by remote control devices.[60]

Without standardisation, however, providers may offer bundled network and service solutions of a proprietary 'sticky' nature. The challenge for Home Networks will be developing interoperable delivery systems that are flexible enough to allow new services to be adopted from a variety of suppliers.

Digital identity management

Digital identity management is at the core of information and processes that support communications in the digital economy. Digital IdM is generally referred to as the management of a user's digital identity and is the secure management of identity information such as credentials, identifiers, attributes and reputations.[61] In practice, this covers a wide range of processes that include establishing, modifying, suspending, archiving or terminating identity information; recognising partial identities that represent individuals in a specific context or role; establishing and assessing trust between individuals and the entity[62] with which they have a relationship (whether business or personal); and discovering the (location) of an individual's identity information.[63]

Identity Management (IdM) is an integral infrastructure component that underpins many aspects of modern communications and interactions such as network authentication for the establishment of connectivity and validation of data transfer through certification. IdM enables access to places and services, and is used by a growing number and range of transactions between individuals and governments and commercial enterprises. In particular, the home network environment is where the convergence of multiple services and identities is occurring, and is also the focal point for customer service management. Home network users are under pressure to manage a growing number of disparate communication and application related identities coupled with their specific security requirements.

One of the key challenges in the development of a digital economy is transitioning from models of identity management developed for circuit-switched telecommunications networks to internet-based communications. Telecommunications systems developed a proxy for individual identities by assigning a unique integer-based phone number to every household, business and end user, allowing interoperability and facilitating global communications. This single identifier has been extended to mobile device users and provides a basis of support for a range of other national interest and consumer safeguard obligations. The internet, as an IP-based communications platform, has enabled users to access multiple networks and devices and, consequently, multiple identifiers are required by users. In addition, there is a growing diversity of identity management models under development by private and public sector organisations. The ACMA's numbering work program is examining the

[59] ZigBee *Health Care Public Profile*, 2009, viewed 7 January 2010, www.zigbee.org/Markets/ZigBeeHealthCare/ZigBeeHealthCareOverview/tabid/426/Default.aspx.

[60] ZigBee *Remote Control Public Profile*, 2009, viewed 7 January 2010, www.zigbee.org/Markets/ZigBeeRemoteControl/ZigBeeRemoteControlOverview/tabid/475/Default.aspx.

[61] International Telecommunication Union, *Identity Management Global Standards Initiative* (IdM-GSI), 4 May 2009, viewed October 2009, www.itu.int/ITU-T/gsi/idm/.

[62] An entity is a human being, an organisation, a hardware component or a piece of software. An entity is something that exists as a particular or discrete unit, such as a corporation.

[63] International Telecommunication Union, *Joint Coordination Activity for Identity Management* (JCA-IdM), 11 February 2010, viewed February 2010, www.itu.int/ITU-T/jca/idm/.

various uses made of phone numbers, including as a source of individual identity, and how these uses may be relevant in the transition to an IP-based communications environment.

Currently, there are three main models or approaches to IdM under development: user-centric, service provider/organisation-centric and network-centric/federated.

Developments in IdM have been concentrated at the enterprise (organisation) level, where the identity data is controlled and managed by an organisation. But there is a growing trend towards the development of user-centric IdM, which gives users control of their identity and identity data, and is consistent with the participative nature of many internet-based applications and services. As new information and communications technologies continue to emerge, IdM will be required as the unifying component. If IdM is to be the underlying, unifying component of seamless interaction across a global digital economy, IdM frameworks require a standardised approach to ensure interoperability.

The lack of a unified approach in standards development is a potential barrier to broader participation in the digital economy, where the capacity to interconnect globally may inhibit the flow of transactions and communications. IdM is a complex issue that will continue to generate activities within standards development organisations. IdM requirements will continue to challenge standards-based activities as the online or web-based opportunities for consumers will continue to grow and become more complex and pervasive.

Smart technology

Overview

This section provides an overview of the major trends and developments in smart devices and systems that enable engagement with the digital economy, as well as the smart technologies that allow more efficient use of physical as well as information resources. Smart technologies aim to address two competing drivers—the first from increasing energy consumption levels that are the result of the wider use of communications and the exponential increase in information and data storage requirements, and the second from energy and data storage efficiency techniques. This section explores both themes.

Smart devices and systems

Smartphones

Growth in the take-up and use of smartphones has been one of the important developments over the past two years, with smartphones expected to drive significant future growth in mobile traffic and applications development activity. Smartphones provide a faster, integrated and more efficient exchange of converged information compared to disparate legacy devices and networks. However, the growth in numbers of devices and their use has increased energy requirements in supporting transmission and data handling networks.

A smartphone is generally recognised as a mobile phone based on software platforms such as Symbian, Windows Mobile, Android, OS X iPhone, Palm OS, Blackberry OS or LiMo.[64] This list is not exhaustive; Samsung recently announced its open mobile platform, Bada,[65] and Nokia, usually associated with Symbian, has announced it will release a handset based on the Linux-based Maemo 5 platform[66] in 2010.

Smartphones employ 3G radio access technologies or WiFi to allow access to internet applications and services. They also offer data processing power and data storage capability for handheld computing.

Sales of smartphones are growing compared to a global decline in sales of other mobile phones. Ovum expects smartphone shipments to grow at a compound annual growth rate of 20.5 per cent by 2014, when they will account for 30 per cent of the wider market.[67] Cisco has predicted that mobile data traffic will roughly double each year from 2010 to 2013, and that almost 64 per cent of this will be video-enabled by smartphone applications. During 2009, YouTube has experienced a 2000 per cent growth in the number of videos uploaded from mobiles.[68]

Twitter also has a number of third-party applications where users can upload photos and video, so it is expected that much more video will be uploaded on the go.

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[64] LiMo Foundation, viewed 10 December 2009, www.limofoundation.org/.

[65] Samsung Electronics, bada, viewed 10 December 2009, www.bada.com/.

[66] Forum.Nokia.com, *Technology Topics, The Maemo Platform*, 2009, viewed 10 December 2009, www.forum.nokia.com/Technology_Topics/Device_Platforms/Maemo.xhtml.

[67] A Leach, Ovum, Telecoms and Software News, Smartphones: the silver lining of the declining handset market, 2009, viewed 10 December 2009, www.ovum.com/news/euronews.asp?id=7923.

[68] KM Cutler, VentureBeat, *YouTube to support 1080p high-definition video; mobile video uploads up 2,000% this year*, 12 November 2009, viewed 10 December 2009, http://venturebeat.com/2009/11/12/youtube-to-support-1080p-high-definition-video-mobile-video-uploads-up-2000-this-year/.

Smartphones also allow for advertising to be tailored to the user and could be both location- and time-based.

In the context of this growth in usage, a key trend is tethering or managing the platform. The aim is to tie specific devices together with a network-based service hub for content and device management, controlling access in both directions for users, developers and content providers. Only those applications that are vetted by the manufacturer are able to be downloaded from a controlled environment such as the 'apps' store or hub; Apple requires that developers digitally sign their applications to enable tracking if needed later.

Control by manufacturers over their products may even extend to remote re-configuration or deletion of files. Firmware updates could be initiated by the manufacturer or by the user via a website.

Apple offers the most complete managed device platform, yet other manufacturers are following. This approach is often justified as a way of stopping the proliferation of malware.

Restrictions imposed by managed device platforms have led to a practice, when applied to the iPhone, known as 'jailbreaking'. After installation of unofficial software patches (which usually voids any warranty), users can bypass the official application distribution mechanism and install unapproved grey-market applications such as iPhoneModem9, which allows the phone to share its internet connection with a computer.

Smartphone users are also changing the social rules for mobile phone usage. Smartphones have allowed 'social reporting', or posting to social network sites or blogs in real time as events unfold; in natural disasters such as the Haiti Earthquake, this allowed real-time reporting and coordination of relief efforts.

Gartner also predicts the rise of location-based services (LBS) or, rather, 'context-aware' services, in which applications can make use of the phone's GPS capability. For example, Google Latitude is a LBS that monitors an individual's location and that of friends, and can share these locations. Extending this further is the concept of 'augmented reality'; applications such as wikitude use the phone's display to present the user with information and points of interest about their surroundings.[69] GPS information is used to conduct online queries and the results are then overlaid on the camera display.

Managed Device Platforms (MDPs) are expected to define the new high-end devices for the next five years, where the complete end-to-end user experience of the handset will be managed by one vendor. This new category of managed devices is being delivered by a small number of vendors, limiting compatibility and deployment by carriers. For example, the total Apple iPhone environment and Google's Android application platform compete directly with other high-end smartphones.

These developments in access capability and availability have led to a range of new services and applications. This has created significant opportunities in the digital economy segments for content provision, service carriage, application development and provision. From a regulatory perspective, demand for spectrum is also expected to grow, as mobile network operators need to increase network capacity for data and video applications, driven by the take-up and use of smartphones.

[69] Wikitude World Browser, *Mobilzy*, 2009, viewed 10 December 2009, www.wikitude.org/.

Smart energy systems

Sustainability concerns are creating a new convergence between the telecommunications industry and the power utilities, with new communications challenges emerging. A key component of the effort required to use energy more efficiently is control. Communications networks are increasingly playing a key role in managing overall power load and usage, and as these initiatives become more widely deployed there will be implications for network design in allowing the flow of information between energy users and suppliers.

Two examples of this convergence are smart metering applications and smart grid systems.

Smart meters are capable of capturing energy usage information over short intervals, typically 30 minutes or less. They then transmit this usage information to the service provider as well as receive control instructions in real time.[70] Consumers are able to compare the amount of electricity, water or gas they use at any given time of day and adjust their activities. Suppliers are able to monitor use and adjust supplies accordingly, thereby enabling more efficient provision, distribution and use of energy.

During 2009, smart metering has been implemented through a range of state-based initiatives. Victoria is the first state in Australia to implement an extensive rollout of smart meters to 2.2 million homes and 300,000 businesses to better manage their energy needs, cut carbon emissions and help increase retail competition, with a view towards future smart electricity grids. Installation of the smart meters began in September 2009 and is scheduled to be complete by 2013.[71]

Lochiel Park, in Campbelltown, South Australia, is trialling an electricity load management device (LMD) where, unlike traditional use of smart metering that manages demand by using a time-of-day price model, the trial employs in-home zoned load management with circuit breakers that can cut power to areas when demand exceeds the threshold, as determined by the resident. Lochiel Park was opened on 11 October 2009.[72]

A trial of smart meters for water efficiency began in New South Wales in April 2009 to drive water conservation efforts in Sydney homes.[73] As part of the 16 month efficiency trial, 468 smart meters were installed in Sydney homes, including 160 with digital touch-screen displays. The meters were designed to provide real-time data on water use by monitoring water usage and detecting water leaks.

Under the Water Smart Australia projects, funded by the Australian Government's *Water for the Future* framework,[74] Wide Bay Water Corporation's 'Innovative Smart

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[70] Your Development—Creating Sustainable Neighbourhoods, *Smart Metering fact sheet*, 5 August 2008, viewed 21 December 2009, http://yourdevelopment.org/factsheet/view/id/56.

[71] Department of Primary Industries, Energy: Smart Meters, *Advanced Metering Infrastructure in Victoria*, 23 December 2009, viewed 11 January 2010, www.dpi.vic.gov.au/dpi/dpinenergy.nsf/LinkView/4EC2E4EA42B821FCCA2572B10079A930A8BAF6E4E66C900FCA2572B20004C403.

[72] M Rann (Premier of South Australia), *The future of sustainable living on show*, media release, Government of South Australia, 12 October 2009, viewed 11 January 2010, www.lmc.sa.gov.au/home/news.asp?nid=94.

[73] P Costa (Minister for Water, Minister for Regional Development), *Trial of smart meters puts water efficiency at a fingertip*, media release, State Government of NSW, 30 April 2009, viewed 11 January 2010, www.sydneywater.com.au/WhoWeAre/MediaCentre/documents/ministerial/Costa_Smart%20metering_300409.pdf.

[74] Water in Australia: Water for the Future, 14 December 2009, viewed 11 January 2010, www.environment.gov.au/water/australia/index.html.

Metering Program for Hervey Bay'[75] had completed installation of all meters and data loggers as of November 2009. This project allowed for the installation of a system that allows water meters to be read remotely from the residential water network, enabling a time-use billing system to encourage customers to use water in off-peak times and also allowing for the diagnosis of different types of water leaks.

Home networks enable greater control of electricity within the home, wide area networks provide two-way connection between the consumer's premises and the distributor substation, and backhaul networks link the substations to the utility back office.

Smart grid technology enables the interaction between power supplies and appliance consumption in order to manage and reduce base load. Smart grid communications requirements are demanding and include the ability to support thousands of devices, high reliability, traffic priority and high security settings.[76] Ensuring that smart grid requirements are incorporated into communications network planning and development is a key challenge but, for the digital economy, the benefits from the smart grid initiatives come in the form of direct financial savings through deferred or delayed capital or other expenditure, improved reliability and an overall reduction in greenhouse gas emissions.[77]

Intelligent housing systems[78]

Other examples of smart applications are being tested in the home environment. In the Living Tomorrow (LT) complex in Brussels, is a highly interconnected house where smartphones, mirrors, carpets, multimedia systems, lighting and heating, banking and bill-paying systems all communicate wirelessly and seamlessly with each other. The mirrors in the bathroom display blood pressure, temperature and weight from sensors in a toothbrush and in the floor; a smart mirror can provide reminders and display the weather. Some 80 per cent of the applications on display are at or near market while the remaining 20 per cent are visions for the future, possibly a decade away.

Working in partnership with prominent global enterprises, architects have created this future house, along with additional sections to provide insight into the bank, workplace and supermarket of tomorrow. With a smartphone at the centre, speed, simplicity and integration will be the key to these applications' market acceptance, driving ecommerce in the future.

Intelligent transport systems

Intelligent Transport Systems (ITS) encompass a range of wireless and wired technologies, commonly known as dedicated short-range communications (DSRC), which transfer data over short distances between in-vehicle mobile radio units and roadside units. This facilitates the transmission of real-time information between vehicles, or between vehicles and road network operators.[79]

ITS use decentralised information and communications technologies (ICTs), in both infrastructure and vehicles, in an effort to manage factors and elements that are

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[75] Wide Bay Water Corporation, *Innovative Smart Metering Program for Hervey Bay*, fact sheet, www.widebaywater.qld.gov.au/downloads/smartmeters_mono.pdf.

[76] C Pavlovski, Chief Architect, Technology and Innovation, *Smart Grids and the Telecommunications Network*, 13–14 October 2009, CommsDay Melbourne Congress 2009, p.7, viewed 15 December 2009, www.greentelecomlive.com/wp-content/uploads/2009/10/IBM_ChrisPavlovski.pdf.

[77] Ibid, p.35.

[78] L Murray, Engineering and Technology, *Engineering Innovation—tomorrow's world*, 21 November 2009 – 4 December 2009.

[79] The Australian Communications and Media Authority, IFC 27/2009*, Planning for intelligent transport systems—Proposals for the introduction of intelligent transport systems in the 5.9GHz band in Australia*, October 2009, viewed 6 January 2010, www.acma.gov.au/WEB/STANDARD/pc=PC_311940.

usually at odds with each other, such as vehicles, loads and routes to improve traffic flow. ITS has the potential to increase the efficiency of freight and public transportation, and reduce vehicle wear, pollution and fuel consumption. It will also prove vital in road safety through emergency vehicle notification systems, collision avoidance systems, driver assistance systems and automatic road law enforcement.[80]

A key development in ITS has been standardisation activities to allow multiple services to operate over disparate platforms and work across national borders, while maintaining a simple user interface that requires minimal intervention from the driver. The ITU-T Focus Group CarCom (FG CarCom) sessions at the Infrastructure, Telematics and Navigation (ITN)-hosted event, held in October 2009, discussed the evolution of speech-based Human-Machine-Interfaces (HMI) in cars, the main focus of which was hands-free communication in cars.[81] As more and more information systems, such as navigation systems, restaurant guides and telephone systems—otherwise known as infotainment (information and entertainment) systems—are being used by the driver, the need for new HMI that do not require the driver's attention is increasing.

In February 2009, all EU member states were directed to implement the harmonised use of the radio spectrum in the 5875MHz–5905MHz band for safety-related applications of ITS.[82] The US and Canada have allocated spectrum for ITS in the 5.9GHz band.

In other developments, the Wireless Access in Vehicular Environments (WAVE) IEEE P802.11p is a draft amendment to the 802.11 standard, an enhancement required to support Intelligent Transport Systems. In order to provide the DSRC for future vehicle-to-vehicle (V2V) or inter-vehicular communications, the IEEE is developing 802.11p to be used in future Vehicular Ad Hoc Networks (VANETs).[83] 802.11p will employ 5.85–5.925GHz spectrum and provides a minimum set of specifications to enable vehicle-to-vehicle and vehicle-to-roadside communications, ensuring interoperability between wireless devices attempting to communicate in potentially rapidly changing communications environments and in situations where communications transactions must be completed in time frames much shorter than the minimum specified in infrastructure or ad hoc 802.11 networks.[84] The Task Group is currently working to resolve comments associated with the recent draft of 802.11p.[85]

In the Australian context, the ACMA outlined proposals to release spectrum in the 5850–5925MHz band (the 5.9GHz band) to permit the introduction of ITS for road users in Australia in 2009. Australia currently has a number of services already allocated to this band, including fixed-satellite services and mobile services; to enable the introduction of ITS into this band would require development of sharing

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[80] ITU-T Telecommunication Standardization Policy Division, ITU Telecommunication Standardization Sector, *Standardization Activities for Intelligent Transport Systems,* ITU-T Technology Watch Report 8, October 2008.

[81] www.itu.int/ITU-T/studygroups/com12/fgcarcom/itn/200910/index.html.

[82] JP Conti, Engineering and Technology, *Comms Convergence—high speeds at high speeds, Intelligent Transport System—will it work next year?*, 12–25 September 2009.

[83] S Eichler, Institute of Communication Networks, Technische Universitat Munchen, Performance Evaluation of the IEEE 802.11p WAVE Communication Standard, 2007, viewed 2 February 2010, www.lkn.ei.tum.de/forschung/publikationen/dateien/Eichler2007PerformanceEvaluationofthe.pdf.

[84] Dr M Weigle, Old Dominion University, Standards: WAVE/DSRC/802.11p CS 795/895 Vehicular Networks, Spring 2008, viewed 2 February 2010, www.cs.odu.edu/~mweigle/courses/cs795-s08/lectures/5c-DSRC.pdf.

[85] L Armstrong, W Fisher, IEEE P802.11—Task Group p, *Status of Project IEEE 802.11 Task Group p — Wireless Access in Vehicular Environments (WAVE)*, viewed 9 February 2010, www.ieee802.org/11/Reports/tgp_update.htm.

arrangements to manage the interactions between these systems and existing services.

These international harmonisation activities are intended to allow the Australian car manufacturing industry and users to realise economic and social benefits from adopting standardised ITS applications.

ICT energy efficiency

Achieving improvements in ICT energy efficiency is subject to two countervailing pressures: efficiencies in technology and exponential growth in consumption. This has been an area of ongoing incremental changes, particularly in communications transport and information storage.

ICT power

Power in the ICT sector contributes to its significant carbon footprint, estimated to be between two and three per cent of the global total footprint.[86] One source of pressure is the considerable growth of the ICT sector and, in particular, data and storage demands, driven in part by wider adoption of ICT technologies and increased demand for communications-based services. This has led to a requirement for higher capacity transmission, switching and terminal components that all require power to perform their role in an end-to-end communications network.

The first countervailing pressure is incremental efficiencies achieved in communications transport. Transmission systems have migrated to fast, efficient optical technologies and away from the slower, less efficient electrically-based technologies. In Australia, this trend is likely to continue with the fibre access network to be built by the National Broadband Network.

While optical transmission technology has contributed to power efficiencies in long-distance and metropolitan carriage capacity, the increased volume of data in core and access networks is still switched and processed by electrically-based semiconductor technology. Moore's Law continues to govern advances in semiconductor processing capacities through miniaturisation and integration.[87] This has led to a downward trend in energy required in switching devices, resulting in a 40 per cent efficiency gain per annum.[88] So, while the energy required to transport a bit of information is decreasing in a macro sense, the sheer volume and speed at which bits are switched—the second countervailing pressure—increases the overall power requirements. Smaller integrated devices continue to have cooling requirements that affect the equipment's power efficiency. Power and heat management can consume up to 35 per cent of the required power for a commercial router. This presents a potential energy bottleneck in routers as data volumes and speeds continue to increase. Optical switching, buffering and processing technologies are still challenges on the horizon but offer the promise of lower energy alternatives in the future.

Data centres are a vital part of the service delivery chain. The volume of information stored by them is doubling every 18 months.[89] In order to cope with such rapid expansion and reduce associated power costs, more efficient storage practices, server

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[86] C Pettey, Gartner, *Gartner Estimates ICT Industry Accounts for Two Percent of Global CO2 Emissions*, 26 April 2007, viewed 9 January 2010, www.gartner.com/it/page.jsp?id=503867.

[87] G Moore, Intel, *Moore's Law: Raising the Bar*, February 2003, viewed 9 January 2010, http://download.intel.com/museum/Moores_Law/Printed_Materials/Moores_Law_Backgrounder.pdf.

[88] R Tucker, ARC Special Research Centre for Ultra-Broadband Information Networks (Cubin), *A Green Internet, Information Logistics and Energy*, 5 November 2009, viewed 9 January 2010, www.ee.unimelb.edu.au/staff/rst/talks/files/Tucker_Big_Picture.pdf.

[89] EChannelLine, *Report: Digital Universe Doubling Every 18 Months*, IDC, 19 May 2009, viewed 9 January 2010, www.channelinsider.com/c/a/Storage/Report-Digital-Universe-Doubing-Every-18-Months-516604/.

consolidation and virtualisation are being adopted. While individual server power efficiencies are improving, the effect is eclipsed by the growth of data centre services that currently represent approximately one per cent of the global power consumption.[90] Power management and cooling can comprise up to 50 per cent of energy consumption for a data centre.[91] This has led to an upward trend in emissions from power consumption in data centres that has doubled worldwide between 2000 and 2006, and is predicted to quadruple by 2020.[92]

Wireless mobile networks are well established as a communications medium and are challenging the traditional dominance of fixed-access networks. Over four billion people in the world now have access to a mobile phone that has become prominent in their business, social and domestic environments. Cellular communications are estimated to consume 0.5 per cent of worldwide electrical energy, with the networks' component accounting for 99 per cent and handsets one per cent.[93] More than 50 per cent of energy consumption can be attributed to base station equipment and a further 30 per cent to mobile switching equipment. Power management software upgrades are now being adopted to increase 2G base station efficiency by 33 per cent.[94] The move to new energy-efficient 3G technologies and architectures has also seen reductions in base station power requirements of up to 50 per cent over traditional designs.[95] In mobile core networks, the use of flat all-IP-based architecture has also contributed to power consumption efficiency.

Efficiency improvements in cellular network base stations can compensate for growing demand. This is in contrast to fixed networks, where the transition from legacy to optical technologies is required to achieve efficiencies despite growing demand. Fixed networks are also dominated by the growing energy consumption in the user segment, with the proliferation of multimedia devices. This growth has been mirrored in the centralised information storage and management requirements that are growing at a rate far beyond segment efficiency solutions. While improved ICT services carry the promise of improved operational efficiencies in other industry sectors, ICT power requirements overall are accelerating.

Desktops and storage virtualisation[96]

Server virtualisation has had a profound impact on storage infrastructure but the advent of desktop virtualisation is expected to place new and greater demands on storage environments.

Virtualisation is the creation of a virtual (rather than actual) version of something, such as an operating system, a server, a storage device, or a network resource.

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[90] J Koomey, Lawrence Berkeley National Laboratory and Stanford University, *Whole System Redesign for Electricity Efficiency: Some lessons from the world of computing*, 12 June 2009, viewed 9 January 2010, www.citris-uc.org/files/Jonathan%20KoomeyonITefficiency-v4.pdf.

[91] R Tucker, ARC Special Research Centre for Ultra-Broadband Information Networks (Cubin), *A Green Internet, Information Logistics and Energy*, 5 November 2009, viewed 9 January 2010, www.ee.unimelb.edu.au/staff/rst/talks/files/Tucker_Big_Picture.pdf.

[92] J Kaplan, W Forest, N Kindler, McKinsey and Company, *Revolutionizing Data Center Energy Efficiency*, July 2008, viewed 9 January 2010, www.mckinsey.com/clientservice/bto/pointofview/pdf/Revolutionizing_Data_Center_Efficiency.pdf.

[93] G Fettweis, Vodafone Chair, TU Dresden, *ICT Energy Consumption—Trends and Challenges*, 1 April 2009, viewed 9 January 2010, http://ec.europa.eu/information_society/events/cf/ee09/document.cfm?doc_id=10510.

[94] Cellular News, *Nortel Software Upgrade Reduces GSM Base Station Power Consumption*, 2 April 2009, viewed 9 January 2010, www.cellular-news.com/story/36822.php.

[95] S Vadgama, Fujitsu Sci J, Vol. 45, No. 4, pp. 404–408 Tech, *Trends in Green Wireless Access*, October 2009, viewed 9 January 2010, www.fujitsu.com/downloads/MAG/vol45-4/paper22.pdf.

[96] J Gsoedl Techtarget, *Virtual desktops and storage*, August 2009, http://searchstorage.techtarget.com/magazineFeature/0,296894,sid5_gci1363267_mem1,00.html.

Virtualisation is software technology that uses a physical resource such as a server and divides it up into virtual resources called virtual machines (VMs). Virtualisation allows users to consolidate physical resources, simplify deployment and administration, and reduce power and cooling requirements.[97]

Current developments in offline virtual desktop infrastructure (VDI) technology have enabled users to take virtualised desktops on the road while remaining secure and compliant with centrally managed policies. Offline capabilities have the potential to catapult virtual desktop infrastructure from a niche application to mainstream deployment.

The desktop hypervisor is touted to make an impact in 2010 and beyond. Considering that the model for the deployment of desktops within an organisation probably hasn't changed in 20 years—where each user has a box, with a mishmash of management tools layered across the top to protect the users from themselves and protect the network from users—the advent of desktop virtualisation technologies will most likely improve application interoperability across organisations, thereby enhancing the user experience and minimising IT infrastructure and management issues.[98]

To support expected user experience, virtual desktops will need to have the look, feel and flexibility of traditional desktops. Unless audio, video and graphics capabilities, and peripheral support, are comparable to, or at least close to, traditional desktops and laptops, VDI is likely to continue its niche existence. A Remote Desktop Protocol (RDP) to close the user experience gap is being developed by Citrix Systems' Independent Computing Architecture (ICA) protocol and High Definition Experience (HDX) extensions. VMware, partnered with Teradici Corp. is developing a software-only version of PC-over-IP to deliver multimedia to VDI clients beyond the current capabilities of the standard RDP.

The next two years is considered important in resolving protocol limitations, performance and offline support to allow desktop virtualisation to become more widespread.[99]

Cloud computing systems

Shared computing services accessible over the internet that can expand and contract on demand topped Gartner's list of the 10 top technologies for 2010.[100]

Cloud computing can be thought of as a means of deploying applications that abstract computing, storage, network and application resources in order to provide uniform, on-demand scalability and reliability of application delivery. The National Institute of Standards and Technology (NIST) definition of cloud computing states that ...'it is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (for example, networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.'[101] It encompasses any

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[97] SearchServerVirtualization.com Definitions, *virtualization*, viewed 28 January 2010, http://searchservervirtualization.techtarget.com/sDefinition/0,,sid94_gci499539,00.html#.

[98] P Venezia, *InfoWorld's Top 10 emerging enterprise technologies—2009's up-and-coming technologies for business that will have the greatest impact in years to come*, InfoWorld Staff, 16 November 2009, viewed 4 December 2009, www.networkworld.com/news/2009/111609-infoworlds-top-10-emerging-enterprise.html.

[99] B Gammage, Vice President/Gartner fellow, covering client computing in Techtarget and J Gsoedl, *Virtual desktops and storage*, August 2009.

[100] S Shankland, CNET News, *Gartner: Brace yourself for cloud computing*, 20 October 09, viewed 10 December 2009, http://news.cnet.com/8301-30685_3-10378782-264.html.

[101] P Mell, T Grance, National Institute of Standards and Technology, Information Technology Laboratory, *The NIST Definition of Cloud Computing*, Version 15, 10 July 2009, viewed 28 January 2010, http://csrc.nist.gov/groups/SNS/cloud-computing/cloud-def-v15.doc.

subscription-based or pay-per-use service that, in real time over the internet, extends IT's existing capabilities.[102]

At present, cloud computing takes several forms, from Amazon's Web Services and the Google App Engine[103] to the full-on application of Salesforce.com.[104]

Large online storage capacity is now being commonly referred to as 'the cloud' and the data contained within it as 'cloud-based data'. Cloud computing, as opposed to online storage, is considered to be of more use in the business and academic sectors, where information and data is shared in the cloud and can be used to run parallel computing techniques; millions of computational tasks are broken down into hundreds or thousands of smaller tasks, which then run across many servers simultaneously. This allows for faster processing time for applications such as searching, social networking and mobile commerce that underpin commercial and social communications in the digital economy.

[102] E Knorr, G Gruman, InfoWorld Home, *Cloud Computing, What cloud computing really means*, viewed 28 January 2010, www.infoworld.com/d/cloud-computing/what-cloud-computing-really-means-031.

[103] Google Code, *What is Google App Engine?,* 2009, viewed 10 December 2009, http://code.google.com/appengine/docs/whatisgoogleappengine.html.

[104] Salesforce.com Australia, *What is Cloud Computing?*, 2009, viewed 10 December 2009, www.salesforce.com/au/cloudcomputing/.

Digital community

Overview

In an increasingly converged communications environment, in which a mobile phone can be used to access the internet and send instant messages, an internet connection used to make voice calls, or a fixed-line service used solely for internet access, it is becoming difficult to isolate consumer trends by communication service types alone.

This section provides an overview of some developments in the use and application of communications and digital media, with a focus on recent developments in mobile commerce, the social web, location sensing and information abundance.

Mobile payment technologies

Near Field Communications (NFC) enables a form of micro-payment that uses two devices to communicate peer-to-peer, providing contactless transactions, authentication and high-speed processes that provides an interface for people to the digital environment. Communications between devices and readers are based on secure encryption systems that use common protocols to provide a NFC base for a variety of end applications.[105]

One example of NFC is Sony's FeliCa, which is compliant with the global standard NFC: ISO/IEC 18092, a short-range wireless communications protocol. It was developed by Sony with NXP Semiconductors. FeliCa was first used in the Octopus Card, a rechargeable and contactless stored-value smart card used to transfer electronic payments in both online and offline systems in Hong Kong. It was originally designed to collect fares for the Hong Kong transit system but has since grown to be a widely used payment system for virtually all public transport in Hong Kong. Additionally, it is used for payment at convenience stores, supermarkets, fast-food restaurants, parking meters, car parks, and other point of sale applications such as service stations and vending machines.

Many countries have adopted FeliCa, mostly in the transport and entertainment sectors. Hong Kong, Japan, China, Thailand and Taiwan are using it for travel and transportation; Italy has used FeliCa for tickets to basketball games, enabling smooth entry into the stadium; Finland and the US have adopted FeliCa-based student identification cards. Other examples of the uses of FeliCa technology are e-Money, airline check in and ticketing, cash cards, access control and online credit card payments.[106]

FeliCa-compatible mobile phones have been marketed as mobile phone wallets. These mobile phone wallets have ID and payment functions; can be used as credit cards, membership cards, e-money cards, e-tickets, and airline tickets.[107] This type of mobile micro-payments application has yet to take off in Australia.

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[105] Sony, *FeliCa—Contactless IC Card Technology*, March 2009, viewed 20 January 2010, www.sony.net/Products/felica/pdf/data/FeliCa_E.pdf.

[106] Sony Corporation 2010, *FeliCa*, viewed 20 January 2010, www.sony.net/Products/felica/index.html/index.html.

[107] Sony Corporation 2010, *FeliCa: Overview of FeliCa*, updated March 2009, viewed 20 January 2010, www.sony.net/Products/felica/abt/index.html.

Another application is Square, developed by Twitter co-founder Jack Dorsey.[108] Square allows anybody with a mobile phone or laptop that has a headphone jack to accept credit card payments using a small plug-in dongle, rather than having to purchase costly credit-card processing equipment.[109] Square is currently working on the iPhone and iPod Touch applications. The objective is to provide a cheap way for small businesses to charge by credit card.

Mobile coupon technology[110]

Mobile coupons and mobile ticketing are closely related, using the same technology, and can be integrated to improve commercial offers to customers.

Currently, almost all mobile coupon systems are based on delivering a code, usually a barcode to a mobile phone (either stored in an SMS or MMS inbox) or to a mobile coupon application that is downloaded to the phone. Downloadable applications allow for end-to-end coupon transactions to be managed from a single point; this allows for other mobile advertising applications to work in parallel with the coupon function. The growth in smartphones has seen coupon-specific applications become very common, often linked to location-based services.

At present, the major mobile coupon technologies include barcoding, both one-dimensional and two-dimensional; SMS; mobile web and downloadable smartphone applications; Bluetooth; and contactless Radio Frequency Identification (RFID). However, these mobile coupon technologies are yet to mature, as is the support mechanism at the retail end.

Currently, mobile/web coupons average 20 per cent redemption rates. According to a member of the Mobile Marketing Forum, mobile coupons are convenient compared to paper coupons because consumers are less likely to forget their mobile phone and are keen to spend less time at a cash register.

Coupons.com, leveraging the iPhone platform, has a new application where consumers can browse local businesses for savings. Coupons are browsed based on the consumer's GPS location and the application displays a map, leading the customer directly to the merchant offering the savings.[111]

Another example is a major US department store that is enabling customers to access savings at the registers using their mobile phones with a 2D bar code coupon program. Customers are able to download and carry coupons on their phones that can then be directly scanned from the phone's display screen at the point of sale. In conjunction with Cellfire and Motorola, new imaging scanners are capable of reading the 2D barcodes. Assisted by mobile communications, coupons are available in multiple venues, including newspaper circulars, postcard mailers and email communication. Cellfire supports more than 800 phone models in the US market including iPhone, Blackberry, Windows Mobile and Java.[112]

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[108] T Duryee, *Twitter Co-Founder Jack Dorsey Launches New Mobile Payment Company*, 1 December 2009, viewed 4 December 2009, http://moconews.net/article/419-twitter-co-founder-jack-dorsey-launches-new-mobile-payment-company-/.

[109] SquareUp Inc. website, viewed 10 December 2009, http://squareup.com/.

[110] H Wilcox, Juniper Research Whitepaper, Mobile Coupons and NFC Smart Posters Strategies, Applications and Forecasts 2009–2014, *Wave and Save with mobile coupons*, November 2009.

[111] C Harnick, Mobile Marketer, Mobile Commerce Daily, *Money Mailer, Coupons.com launch location-based iPhone app*, 20 October 2009, viewed 20 January 2010, www.mobilecommercedaily.com/money-mailer-couponscom-launch-location-based-iphone-app/.

[112] 2010 Cellfire Inc, viewed 21 January 2010, www.cellfire.com/index.php.

Smart posters with embedded NFC tags will bring static billboards to life, creating immediate interaction between potential customers and their prospective purchases. Technologies such as NFC, RFID, visual markers or Bluetooth make it possible to tag everyday objects in order to advertise associated information and services, facilitate their discovery and enable interaction with them. Established Physical Mobile Interaction technology uses mobile devices to interact with tagged objects in order to facilitate the interaction with associated information and services.[113] As everyday objects are augmented with multiple contactless tags, they seamlessly pass information, complement mobile interfaces and adopt some of their features. A prototype, based on these techniques, has been developed to implement a dynamic NFC-display advertisement billboard.[114] Users are able to interact with the advertisements by touching the tags on the NFC grid with their NFC-enabled mobile phones, downloading and storing ads, creating their own ads and uploading them onto the display; the use of mobile devices adds more features to these interactions by storing billboard information for later use, contacting the creator of the ad or opening an associated website. The inherent separation between the mobile display and the billboard is such that privacy-sensitive information, such as contact details or payment information, is protected and not shown on the public display (that is, the billboard itself) but rather on the private screen of the mobile.

According to Juniper, by 2014, consumer usage of mobile coupons will generate a redemption value close to $6 billion globally.[115]

While these mobile applications are not expected to become available in Australia in the short term, mobile payment applications represent a convergence point between content, carriage and e-commence, and raise issues about developing community interest in and ease of use of mobile micro-payments.

Location-aware community

The combining of location-based information with other sources of information in the digital community has provided a range of rich commercial and social applications. Through the use of digital wireless infrastructure and mobile devices, location information can be harvested. To provide a specific location, a fixed wireless beacon, a mobile device and a process of quantifiable reception of a signal from the beacon is required. The location of a device can now be estimated using:

- WiFi transmitters that are rarely moved, as beacons
- cellular base stations used as beacons
- WiMax transmitters as beacons as receivers become more widespread.

Such systems may initialise their databases with a drive through and then build on this from signal and location information gleaned from the statistics of multiple end-users.

The growing penetration of GPS and other services whereby location can be estimated could create a new range of activities centred on location information. GPS is an easily identifiable location identification process but a WiFi-enabled device's proximity to WiFi access points or a mobile handset's adjacency to base stations can also be used to estimate the location of a device. One such system is Skyhook

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[113] G Broll, S Siorpaes, E Rukzio, M Paolucci, J Hamard, M Wagner and A Schmidt, *Supporting Mobile Service Usage through Physical Mobile Interaction*, In Proc. Of PERCOM'07, IEEE Computer Society, pp. 262–271, 2007.

[114] A Messna, J Buttgen, E Rademacher, G Broll and A De Luca, *Mobile Interaction with an NFC-based BillBoard*, MobileHCI '09, 15–18 September 2009, viewed 28 January 2010, www.medien.ifi.lmu.de/pubdb/publications/pub/messner2009mobilehci/messner2009mobilehci.pdf.

[115] H Wilcox, Juniper Research Whitepaper, Mobile Coupons and NFC Smart Posters Strategies, Applications and Forecasts 2009–2014, *Wave and Save with mobile coupons*, November 2009.

Wireless.[116] The security of Skyhook's WiFi Positioning System (WPS) is studied by researchers from ETH-Zurich.[117] Unlike GPS systems that rely on dedicated infrastructure, the WPS and equivalent systems do not maintain their own access point infrastructure; instead, they rely on the existing commercial, public and private access points.[118] The article by the ETH-Zurich researchers describes how such systems may default to using the cellular networks, which are more reliable beacons if WiFi beacons are spoofed. The Skyhook Wireless website advises of a XPS system that uses the relative strengths of several location technologies including WPS, GPS and cellular tower triangulation.[119] The use of Skyhooks and Google services may be of more value indoors compared to the use of GPS systems.

The World Wide Web Conference is the global event that brings together key researchers, innovators, decision-makers, technologists, businesses and standards bodies working to shape the web. In articles presented at WWW2008[120] and WWW2009,[121] authors from Microsoft Research Asia describe how location information can be used to identify the modes of transport used by travellers and where they stop—which in turn, could indicate places of interest. With processes that are conceptually simple but computationally complex, positional data is mined using path, speed and acceleration, and stops to identify how and where people are moving in an area. This information can then be used in a form that can identify optimal routes for specific modes of transport and locations of interest for users.

Location-based services that use WiFi or cellular base stations as the beacons to identify a location need the equivalent of Google-Maps or other maps to add some richness to the experience. The company Micello[122,123,124] is developing indoor mapping applications; for example, to provide up-to-date information on places of interest on campuses and shopping malls.

Location information developments are of regulatory interest, particularly in the context of developing capabilities for national emergency warning systems.

Web applications

Augmented reality

Augmented reality (AR) refers to computer-generated imagery that is superimposed onto real time environments. Advanced AR adds computer vision and object recognition, providing information about the surrounding real world.

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[116] Skyhook Wireless, Company Overview, 2009, viewed 10 December 2009, www.skyhookwireless.com/whoweare/.

[117] NO Tippenhauer, KB Rasmussen, C Popper & S Capkun, Department of Computer Science; ETH Zurich *iPhone and iPod Location Spoofing: Attacks on Public WLAN-based Positioning Systems*,; 8092 Zurich, Switzerland.

[118] Ibid.

[119] Skyhook Wireless, Company Overview, 2009, viewed 10 December 2009, www.skyhookwireless.com/whoweare/.

[120] Yu Zheng, Y. et al., Microsoft Research Asia, China, *Learning Transportation Mode from Raw GPS Data for Geographic Applications on the Web*, WWW 2008, viewed 10 December 2009, www2008.org/papers/pdf/p247-zhengA.pdf.

[121] Zheng Y. et al., Microsoft Research Asia, China, *Mining Interesting Locations and Travel Sequences from GPS Trajectories,* WWW 2009, Madrid, viewed 10 December 2009, www2009.org/proceedings/pdf/p791.pdf.

[122] www.micello.com/.

[123] Price Waterhouse Coopers, CommunicationsDirect, *Exploring the Great Indoors with Micello*, 25 November 2009, viewed 10 December 2009, https://communicationsdirectnews.com/do.php/150/38058.

[124] Ubergizmo, *Micello: Mobile Indoors Maps*, 22 September 2009, viewed 10 December 2009, www.ubergizmo.com/15/archives/2009/09/micello_mobile_indoors_maps.html.

The deployment of AR applications over 2009 has been enabled through computing intensive smartphones (such as Android and iPhone devices) equipped with a GPS, magnetometer, digital compass and camera.[125] Facial recognition technologies could soon be added to the mix.

Together with mobile broadband growth and a flourishing applications development community, AR has moved rapidly on from concept to practical application. These technologies combined may operate to know where the user is and in what direction a user is looking. While in operation, the user views potentially useful information about points of interest nearby (contacts, buildings, shops and associated directions) that is overlaid on the real view as observed through the camera; the actual information available depends on the particular application in use. US-based web analytics service Social Radar reported that '… 87 per cent of social media posts, comments and chatter around augmented reality has been positive'.[126]

However, some concern has been expressed about potentially unintended civil society consequences. AR systems might be used for unwanted information and messages (spam). Spam filters could be configured 'to block any kind of unpalatable visual information' determined by personal preferences.[127] Conversely, with the broadening 'information shadow' about people and organisations available online, AR systems might be used to identify—or hide—the political or personal preferences of people. There currently exists a capability to preserve, mine and index online communications and data on the web. When a user Tweets, uploads videos and pictures, posts and makes comments on blogs or updates status on social networks, they cast a digital or information shadow that can parallel an individual's activities or mimic convictions in real life.[128]

Citizen expectations about accepted use and privacy norms are developing as individuals gain experience in the use of these tools.

The evolving web

In addressing the term 'Semantic Web', the Price Waterhouse Coopers Technology Forecast, Spring 2009, used the term 'linked data' to describe accessing and sharing data on the web. Linked data is a useful term in that it captures one of the underpinnings of the semantic web: 'a Web where not only documents but also individual data elements are linked'.[129] Linked data means that users—and semantic web applications—can find data sets of relevance in different places in the web, and aggregate them or parts of them in other locations to create a more personalised web experience.

In practice, this means that users no longer have to go to a 'home page' or specific website for information. Data sets, in the form of applications or widgets found on a particular website at any one time, are linked data that may be from any number of web locations (and geographical locations in terms of the location of servers and service providers).

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[125] Boostzone Institute, *From Augmented Reality to Augmented Business*, 6 November 2009, viewed 4 December 2009, www.boostzone.fr/from-augmented-reality-to-augmented-business/.

[126] Buzzstudy, *How do you feel about Augmented Reality?* posted 5 October 2009, viewed 16 November 2009, http://infegy.com/buzzstudy/how-do-you-feel-about-augmented-reality/.

[127] J Cascio, The Atlantic, *Filtering Reality*, November 2009 , viewed 20 November 2009, www.theatlantic.com/doc/200911/augmented-reality.

[128] BrianSolis.com, Geekadam, Casting a Digital Shadow; Your reputation precedes you, 17 July 2009, viewed 28 January 2010, www.briansolis.com/2009/07/casting-a-digital-shadow-your-reputation-precedes-you/.

[129] Price Waterhouse Coopers, *Technology Forecast*, Spring 2009.

At the inaugural Web 2.0 Summit in 2004, participants saw that, while value was facilitated by software, value was also being co-created by and for the connected community of users. The buzz around Web 2.0 was about harnessing this 'collective intelligence'.[130]

Six years on, what's changed is the web has gone mobile. With smartphones complete with proximity, location and motion sensors, collective intelligence is now being driven by interconnected sensors as well as by people. Add to the mix, voice, face and object recognition software, and interconnected data sub-systems, the emerging 'information shadow'—created by people and sensor networks—has now joined the lexicon along with the 'internet of things'. For example, people have information shadows in emails, messages, tweets or other social network status updates, blog postings and comments, and photographs and videos online. The internet of things and information shadows can be used by semantic web applications to provide socially and contextually relevant data.

With the rise of microblogging and social network updates, a new data source has been added to the web. According to O'Reilly Media Inc., with information about shared events and developments, it is possible now to have 'real-time indications of what is on our collective mind'.[131] For collective intelligence to be at its most effective, the challenge is to manage, understand and respond to massive amounts of data in real time. This is a challenge for individual participation in the digital economy, as well as for companies and government engaging with its citizens.

Developments in social media

The term 'social media' describes media or content that is authored by the user and it can take many different forms. Some types of social media are forums, message boards, blogs, wikis and podcasts. Social media applications such as Google, Facebook, Twitter and YouTube provide a social networking environment that enables interaction between individuals and groups.[132]

Social media drivers

'Self-expression and sharing expertise continue to be primary motivations', according to the 2009 Technorati (US-based) survey, with respondents rating personal satisfaction as their primary measure of success.[133] The survey also found that the majority of bloggers (72 per cent) are hobbyists.[134] The boundary between social media producers and professional media producers in the production and consumption of mediated experiences has blurred and social media has evolved into an integral part of the media ecosystem.[135] Evidence of the level of importance of social media in the media ecosystem is apparent in the findings of a US study where two-thirds of marketers have used social media in some capacity in 2009.[136]

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[130] T O'Reilly and J Battelle, O'Reilly Media Inc., *Web Squared: Web 2.0 Five Years On*, October 2009, viewed 16 November 2009, www.web2summit.com/web2009/public/schedule/detail/10194.

[131] T O'Reilly and J Battelle, O'Reilly Media Inc, *Web Squared: Web 2.0 Five Years On*, October 2009, viewed 16 November 2009, www.web2summit.com/web2009/public/schedule/detail/10194.

[132] www.searchenginepartner.com/SEO-glossary.html.

[133] Technorati, *State of the Blogosphere—Day 2: The What and Why of Blogging*, 20 October 2009, viewed 10 December 2009, http://technorati.com/blogging/article/day-2-the-what-and-why2/.

[134] M Arrington, TechCrunch, *2009 State of the Blogosphere: The Full Blog World Presentation*, 16 October 2009, viewed 10 December 2009, www.techcrunch.com/2009/10/16/2009-state-of-the-blogosphere-the-full-blogworld-presentation/.

[135] T Walker, Telecommunications Journal of Australia 2009, *New audience partnerships for the ABC*, 59 (3): pp. 43.1–43.8.

[136] A Ostrow, Mashable—*The Social Media Guide, Study: Two-Thirds of Marketers Now Use Social Media*, 14 August 2009, viewed 10 December 2009, http://mashable.com/2009/08/14/social-media-marketers/.

YouTube, the world's leading online video service, allows users to share content by embedding video into their social network profile, blog or other website. Popular with a wide age range, by October 2009 YouTube reported it was serving over one billion views per day,[137] up from a reported 100 million videos served each day in July 2006.[138] YouTube was reported to have experienced a 2000 per cent increase in mobile video uploads in 2009, due to the impact of smartphones such as iPhone and Google's Android-enabled devices.[139]

While social media engagement is of considerable influence internationally, engagement by Australian companies appears to be lagging behind international developments.[140] A recent survey by Deloitte's found that Australian companies were behind in exploring the potential of social media for 'awareness and promotion; productivity savings; lower cost customer service; increased employee engagement and more'.[141] According to Deloitte's, the likely stumbling block is the reluctance of many organisations to relinquish control.

Social networking drivers

The growth in social networking online has been phenomenal internationally, with Australians as individual users embracing the trend over 2009.[142] Nielsen's most recent report states that, by the end of 2008, social networks accounted for about one in every 11 minutes of time spent online globally, with Australia running at the global average. More recent information from the US and UK suggests that growth continued over 2009 and 2010. Research firm Mintel reported that:

> Online social networking is expanding in the US. In December 2009, there were 248 million unique monthly users on the top social networking sites, an increase of 41 per cent from January 2009. By April 2010, internet users in the UK were spending more time on social networks and blogs than any other activity, with almost one in every four minutes online accounted for by social networks and blogs. Sites associated with search engines, location services (maps), news and information continue to be the most visited websites. However, participative websites relating to social networking and user generated content (UGC) are also attracting increased web traffic.[143]

By August 2009, comScore reported there were 8.9 million unique visitors to social network sites in Australia in June 2009, an increase of 29 per cent since June 2008. The increase was driven in particular by growth in the use of Facebook and Twitter. Overall, 70 per cent of internet users (nearly nine million Australians) visited a social networking site in June 2009.[144] In November 2009, Nielsen reported that Facebook accounted for 29 per cent of the time Australians spend online, amounting to 7.55

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[137] C Hurley, Broadcasting Ourselves; The Official YouTube Blog, *Y,000,000,000u Tube*, 9 October 2009, viewed 10 December 2009, http://youtube-global.blogspot.com/2009/10/y000000000utube.html.

[138] P Cashmore, Mashable—The Social Media Guide, *YouTube Hits 100 Million Videos Per Day*, 17 July 2006, viewed 10 December 2009, http://mashable.com/2006/07/17/youtube-hits-1-million-videos-per-day/.

[139] KM Cutler, Venture Beat, *YouTube to support 1080p high-definition video; mobile video uploads up 2,000% this year*, 12 November 2009, viewed 10 December 2009, http://venturebeat.com/2009/11/12/youtube-to-support-1080p-high-definition-video-mobile-video-uploads-up-2000-this-year/?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+Venturebeat+%28VentureBeat%29.

[140] B&T Today, *Aussies seek interaction, not friends*, 22 September 2009.

[141] Communications Day*, Australian companies fall short in social media*, 18 November 2009.

[142] NielsenWire, *Social Networking's New Global Footprint*, 9 March 2009, viewed 10 December 2009, http://blog.nielsen.com/nielsenwire/global/social-networking-new-global-footprint/.

[143] The Australian Communications and Media Authority, *Communications Report 2008–09*, 12 January 2010, www.acma.gov.au/WEB/STANDARD/pc=PC_311972.

[144] comScore, *2 Million More Australians Go Social in 2009*, 14 August 2009, viewed 10 December 2009, www.comscore.com/Press_Events/Press_Releases/2009/8/2_Million_More_Australians_Go_Social_in_2009.

hours each per month.[145] Nielsen's data indicates that Australia now 'leads the world for time spent each month on social network sites'.[146]

In July 2009, Universal McCann (UM) reported that social networks are becoming the dominant platform for content creation and content-sharing.[147] Thirty-three per cent of social networkers had uploaded video to their profile, up from 16.9 per cent the year before.

Social networking online is a driver in the growth of mobile data. In October 2009, Telstra reported that over one-quarter of Australians with 3G mobiles access the web on their mobiles. Of those using the mobile web, 40 per cent use it to access social network sites.[148] The high growth in mobile web traffic to social network sites was reported to be due to 'people's desire to connect and share the details of their lives more often'.[149] In a comment about this trend, Facebook's director of mobile, Henri Moissinac, was reported to have said that 'we used to see that happen once a day on the computer, but now we see them doing it 10 or 15 times or more (via mobile)'.[150] Moreover, the anticipated future growth of Twitter is said to be in tandem with the growth in smartphone use and advanced location-based services.[151] Online interactive game-playing is also a popular activity on social network sites, with a reported surge in Facebook gaming applications use.[152]

Social openness

Openness has been a feature of internet technology in terms of its underpinning architecture, software development and open access. Now, it is behavioural changes enabled by the social web that's generating more interest.

The social web is driving the development of software that integrates social networking and social media with online gaming platforms.[153] Geo-location applications enable users to broadcast their locations, either in public or in accordance with their selected privacy settings.[154] Social media activities have been found to provide users with a more diverse social network.[155]

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[145] P McIntyre, The Age, *Woe is Bebo: site to shut down in Australia*, 20 November 2009, viewed 10 December 2009, http://www.businessday.com.au/technology/technology-news/woe-is-bebo-site-to-shut-down-in-australia-20091119-iox3.html.

[146] Ibid.

[147] Universal McCann, Power to people, *Wave.4*, July 2009, viewed 10 December 2009, http://universalmccann.bitecp.com/wave4/Wave4.pdf.

[148] M Shaw, Speaking Sensis, *Is mobile the great marketing enabler?*, 2 October 2009, viewed 10 December 2009, www.speakingsensis.com.au/tag/mobile-phone.

[149] G Thom, News.com.au, *Twitter, Facebook use on the rise on mobile phones*, 16 September 2009, viewed 15 December 2009, www.news.com.au/technology/story/0,28348,26080656-5014239,00.html.

[150] Ibid.

[151] S Subramanian and T Weiss, Trends Spotting Blog, *Twitter users share early adopters symptoms*, 12 November 2009, viewed 15 December 2009, www.trendsspotting.com/blog/?p=1675&utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+trendsspotting-feeds+%28trendsspotting+blog%29.

[152] E Eldon, Inside Facebook, *Asia: Philippines, Taiwan, Indonesia Gained More than 1M Facebook Users Last Month*, 15 October 2009, viewed 15 December 2009, www.insidefacebook.com/2009/10/15/asia-philippines-taiwan-indonesia-gained-more-than-1m-facebook-users-last-month/.

[153] B Dywad, Mashable—The Social Media Guide*, LEAKED: Facebook is Coming to the PlayStation 3*, 11 November 2009, viewed 15 December 2009, http://mashable.com/2009/11/11/ps3-facebook/.

[154] Biz. Twitter Blog, *Location, location, location*, 20 August 2009, viewed 15 December 2009, http://blog.twitter.com/2009/08/location-location-location.html.

[155] Pew Internet and American Life Project, *Social Isolation and New Technology*, November 2009, viewed 15 December 2009, www.pewinternet.org/Reports/2009/18--Social-Isolation-and-New-Technology.aspx?r=1.

Social networking sites continue to grow as integrated hubs for entertainment, information and communication.[156] Blogs, tweets and YouTube videos created by Facebook users' friends, as well as information created by news services, can all show up in Facebook News Feeds—in real time.[157] In a recent speech, ABC Managing Director Mark Scott said that '… we are now creating widgets so people can take ABC content they like … and allow them to share it through their own social networks. They become our distributors'.[158]

With the rise of social media, there is an understandable interest in monitoring and engaging in it; social media analytics is a growth business. Web start-ups as well as established media tracking companies are providing web metrics, content collection and social analysis services.

Information overload

In a world where information is abundant, the challenge for individuals is how to manage the information stream, while the challenge for business, government and other institutions is how to attract attention. In a networked society, content creation and distribution channels are available to anyone with broadband internet connectivity. Power no longer lies in distribution but in controlling 'the limited resource of attention'.[159] For those wanting to successfully market a product or service, or to give guidance and to inform online, they must strive to be relevant to their target group. 'To be relevant today requires understanding context, popularity, and reputation. [New skills are required to be] … living in the streams, consuming and producing alongside "customers".'[160]

Tools and techniques that help to filter the stream of information over the web by relevancy and context are likely to become useful tools to manage information overload. For information to be of value to someone it needs to be of social relevance, both in terms of context and timing. Social search will not be useful unless it is real-time and relevant.[161]

Twitter launched a new list feature in October 2009 to enable users to create Twitter communities of interest. Expected to make the utility of Twitter easier, users can create their own lists or follow the list stream created by others. Twitter lists are a form of digital 'curation'; establishing a repository of tweets around a particular theme or subject matter for current and future ease of reference.

Social media influence

Social media in Australia has been described as 'a powerhouse of consumer influence' and businesses are increasingly recognising that Twitter, YouTube, blogs and Facebook are used as marketing and support tools by companies in Australia.[162]

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[156] Nielsenwire, *Time Spent Viewing Video on Social Networking Sites Up 98% Year-Over-Year in October*, 19 November 2009, viewed 15 December 2009, http://blog.nielsen.com/nielsenwire/online_mobile/time-spent-viewing-video-on-social-networking-sites-up-98-year-over-year-in-october/.

[157] The Facebook Listening To v1.0 application updates a user's Facebook status when listening to songs with the WinAmp application. Facebook applications include Hulu and Invision.TV to watch and share videos from selected websites.

[158] M Scott, ABC, The Drum Unleashed*, The Fall of Rome*, 14 October 2009, viewed 15 December 2009, www.abc.net.au/unleashed/stories/s2714143.htm.

[159] D Boyd, Web 2.0 Expo, *Streams of Content, Limited Attention: The Flow of Information through Social Media*, 17 November 2009, viewed 15 December 2009, www.danah.org/papers/talks/Web2Expo.html.

[160] Ibid.

[161] M Palsule, Skeptic Geek, *Why Google Social Search Will Beat Facebook*, 28 October 2009, viewed 15 December 2009, www.skepticgeek.com/socialweb/why-google-social-search-will-beat-facebook/.

[162] G Farrer, The Age, *Medium puts rocket under the message*, 27 October 2009, viewed 15 December 2009, www.theage.com.au/technology/technology-news/medium-puts-rocket-under-the-message-20091026-hgtg.html.

Citizens and consumers, government, business and non-government organisations, as well as professional media organisations, are developing and maintaining new forms of influence through social media. The reputation of organisations can be harmed or enhanced through consumers sharing their bad or good experiences on social networking and social media sites.

Value-chain shifts

The applications development community is now a significant player in communications and media. In the two years since the iPhone was launched, users have downloaded over two billion applications. There has been a flurry of applications development over 2009, with 65,000 having been developed by August 2009, up from 25,000 in January 2009.[163] With some online media content sitting behind third-party pay walls, there are expectations of revenue growth from online content accessed by mobile phone applications.[164]

From another perspective, content revenue streams from 'walled garden' telecommunications provider content is under pressure. Gartner was reported to be of the view that smartphone 'app stores' are 'increasingly sidelining mobile carriers [and that] carriers will face off against internet giants and handset makers for control of app stores over the next five years'.[165] Gartner forecast that, by 2012, the Symbian operating system will be the global leader, followed by Google's Android and Apple's iPhone.

Online media platforms have been integrating social media into their websites for some time now. Integration enables users to comment on articles or share articles with others; for example, a reader adding an article to their Facebook news feed, their RSS feed or a social bookmarking site.

In December 2009, the Australian Government published a Government 2.0 Taskforce report to advise and assist the government to make public sector information more accessible and usable, and to increase engagement with the community.[166] The Taskforce sponsored projects that promote Government 2.0 initiatives. One such initiative was the Emergency 2.0 Australia project, announced on 11 November 2009, which examined how social media can assist in emergency management.[167]

In March 2009, the Australian Broadcasting Corporation (ABC) announced User-Generated Content (UGC) guidelines as a fifth content category to be incorporated into ABC Editorial Policies. Developed as an enabler of its strategy to host Australia's 'virtual town square', the aim is 'to allow people to engage and collaborate, to share stories, to create relevant content, to ask questions and provide answers'.[168]

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[163] B Parr, Mashable—The Social Media Guide, *iPhone App Store: 65,000 Apps and Counting*, 15 August 2009, viewed 15 December 2009, http://mashable.com/2009/08/05/flurry-iphone-apps/.

[164] R Wray. The Guardian, *Media organisations turn to mobile phone applications to raise revenue*, 5 October 2009, viewed 15 December 2009, www.guardian.co.uk/media/2009/oct/05/mobile-phone-applications.

[165] L Coleman, Communications Day, *Carrier dominance wanes, smartphones rise: Gartner*, 20 November 2009.

[166] Department of Finance and Deregulation, *Engage: Getting on with Government 2.0: Report of the Government 2.0 Taskforce*, December 2009, 27 January 2010, www.finance.gov.au/publications/gov20taskforcereport/index.html.

[167] M van der Vlugt, Government 2.0 Taskforce blog, *Emergency 2.0 Australia*, 11 November 2009, viewed 15 December 2009, http://gov2.net.au/blog/2009/11/11/emergency-2-0-australia/.

[168] Australian Broadcasting Corporation, Editorial Policies*, User-Generate Content (UGC) Amendments to the ABC Editorial Policies, Effective 1 March 2009*, viewed 10 February 2010, www.abc.net.au/corp/pubs/documents/EdpolsAmdts-Mar2009.pdf.

Meanwhile, the ABC's widget initiative enables the broadcaster's content to be linked to and aggregated on social network sites or any other website of the user's choice.[169] Rather than going to a 'virtual town square', content will appear in the news feeds on social network sites along site feeds from people they connect with, including friends, family, co-workers and other members of their local community. Social media has become so integrated in the media value-chain that the distinctions between 'social media' and 'media' are now difficult to make.

[169] ABC News, *ABC gets record funding boost*, 13 May 2009, viewed 10 February 2010, www.abc.net.au/news/stories/2009/05/12/2568513.htm.

Conclusion

Developments in infrastructure, and smart services and applications, provide a platform for digital economy developments in Australia. Ongoing network investment in transmission and access networks that provide mobility and higher bandwidth offers the capacity for customised multimedia services through smart multifunctional devices.

But these developments bring a level of complexity associated with the provision of diverse digital media and create challenges for both service providers and users. Cloud computing, virtualisation and the power requirements associated with the management and distribution of exponential growth in the data volume are changing the structure of service provisioning.

Smart devices have enabled service convergence on a mass scale. Applications development is active in the areas of micro-payments, location sensing and home networking, which are all offering new forms of participation and connectivity in the digital economy. Consequently, the capacity for interactivity with new media and content within the digital economy has grown beyond traditional rigid models.

The ACMA will monitor technology developments and consider their implications for regulation.

Glossary

Table 1: Glossary

AR	**augmented reality** Virtual computer-generated imagery overlaid on live video or on the users physical environment in real time.
3G mobile networks	3rd Generation (3G) mobile networks enable users to access a wide range of services, beyond the voice centric second generation mobile services. These networks support a range of new services including mobile VoIP telephony, video calls and broadband wireless data access. All major mobile carriers now offer 3G mobile broadband through a variety of access devices including handsets, plug-in cards for lap-tops and fixed modems for desktop personal computers.
3GPP	**Third Generation Partnership Project (3GPP)** A collaborative project for the maintenance and development of GSM technical standards and reports.
Beta	When used in reference to software, is the release of an initial or upgraded program or system for testing by the public. Users may experience bugs with beta software.
Blogosphere	A collective term encompassing all blogs and their interconnections. As all blogs are on the internet by definition, they are perceived as existing together as a connected community (or as a collection of connected communities) or as a social network.
Botnets	Groups of computers infected with malware and controlled by a malicious bot master.
Cloud computing	Refers to the use of web-based computing systems, applications and services that are accessed independently from the underlying infrastructure or geophysical location.
Communications	Includes all voice (fixed-line, mobile and VoIP) and internet (dial-up and broadband in all its forms such as ADSL, cable, satellite and wireless) services.
Consumers	A consumer is someone who owns, uses or has otherwise access to communications equipment or services.
Convergence	A converged environment is one in which a user can access a wide range of multimedia services using any device and any type of network connection. Examples of converged services currently available in Australia include internet access using a mobile phone and accessing television broadcasts via the internet.
DSL	**digital subscriber line** Transmission technique that dramatically increases the digital capacity of telephone lines into the home or office.
DWDM	**dense wavelength division multiplexing** DWDM is a technology that puts data from different sources together on an optical fibre, with each signal carried at the same time on its own separate light wavelength. Using DWDM, up to 80 (and theoretically more) separate wavelengths or channels of data can

	be multiplexed into a light stream transmitted on a single optical fibre. Each channel carries a time division multiplexed (TDM) signal. In a system with each channel carrying 2.5Gbits/s, up to 200 billion bits can be delivered a second by the optical fibre. DWDM is also sometimes called wave division multiplexing (WDM). Since each channel is demultiplexed at the end of the transmission back into the original source, different data formats being transmitted at different data rates can be transmitted together. Specifically, internet (IP) data, Synchronous Optical Network data (SONET), and asynchronous transfer mode (ATM) data can all be travelling at the same time within the optical fibre. DWDM promises to solve the 'fibre exhaust' problem and is expected to be the central technology in the all-optical networks of the future.
EMI	**Electromagnetic Interference** EMI is any undesirable electromagnetic emission or any electrical or electronic disturbance, man-made or natural, which causes an undesirable response, malfunctioning or degradation in the performance of electrical equipment.
Ethernet	Refers to the IEEE 802.3 standard used in computer networking technologies for local area networks.
ETSI	**European Telecommunications Standardisation Institute** Produces globally applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, broadcast and internet technologies. Officially recognized by the European Commission as a European Standards Organization.
FDD	**frequency division duplex** FDD is where the transmitter and receiver operate at different carrier frequencies; to be able to send and receive a transmission at the same time by slightly altering the frequency at which it sends and receives.
FTTB	**fibre to the building** This is in reference to fibre optic cable, carrying network data, connected all the way from an Internet service provider to a customer's physical building.
FTTH	**fibre to the home** This is in reference to fibre network connections running from the central office to a residence, or very small multi-unit dwelling.
FTTP	**fibre to the premises** FTTP is where an optical fibre connection is directly run to the customers' premises. The P (premises) can be business, commercial, institutional and other applications where fibre network connections are distributed to a campus, set of structures, or high density building with a centrally located network operations centre.
GB	**Gigabytes** A billion bytes.
GHz	**Gigahertz** One billion Hertz, where one Hertz is the measurement of frequency equal to one cycle per second.
GiFi	The GiFi chip technology delivers short-range multi-gigabit data transfer in an indoor environment.

GPS	**global positioning system** A US space-based radio-navigation system that provides reliable positioning, navigation, and timing services to civilian users on a continuous worldwide basis at no cost to users.
GSM	**global system for mobile communication** The widely used European digital cellular network standard.
GSMA	**GSM Association** A global trade association representing the interests of GSM mobile phone operators and vendors.
HD	**high definition** A digital video system with higher resolution.
HFC Cable	**hybrid fibre coaxial cable** Network element consisting of optical fibre on main routes, supplemented with coaxial cable closer to a customer's premises.
HSPA **HSDPA** **HSUPA**	**High-speed packet access protocol** **High-speed downlink packet access protocol** **High-speed uplink packet access protocol** 3G (third generation) mobile telephony communications protocols which allow networks based on Universal Telecommunications System (UMTS) to have higher data transfer speeds and capacity.
IEEE	**Institute of Electrical and Electronic Engineers** The IEEE is a non-profit organization and a leading professional association for the advancement of technology.
IMT-2000	**International Mobile Telecommunications 2000** The global standard for third generation wireless communications, defined by a set of interdependent ITU Recommendations.
Index Matching Gel	A gel with an index of refraction close to that of the optical fibre used to reduce reflections caused by refractive-index differences between glass and air.
Information Shadow	A digital representation of information about people and things captured by users and sensor networks. People have information shadows in emails, messages, social network status updates, photos uploaded or blog postings. The internet of things and information shadows can be used by semantic web applications to provide contextually relevant data.
IoT	**Internet of Things** The Internet of Things was the title of a 2005 ITU report that has captured the imagination of many developers and commentators. The concept includes tagging items with RFIDs or other such identification mechanisms, incorporating sensors and coupling capabilities in the items and interconnecting them so as to add to the ability to use, track or manage the articles.
IP	**Internet Protocol** The key member of the suite of internet protocols at the logical layer, specifying packet addressing and routing data through the internet.
IPoDWDM	**Internet Protocol over DWDM** The premise of IPoDWDM is to reduce the electrical transport layer as much as possible as this provides the highest bit-rate robustness, future protocol

	robustness and functional robustness. Integration of the IP and DWDM layers can improve the overall reliability of the network by creating visibility of the optical layer into the IP layer enabling faster protection at Layer 3.
IPv6	**Internet Protocol version 6** IPv6 allows $3.4x10^{38}$ addresses. This is mainly due to the number of bits in each protocol. Internet Protocol version 4 (IPv4) addresses have 32 bits in them and so allow a maximum of four billion addresses. IPv6 addresses have 128 bits.
ISOC	**The Internet Society** ISOC is an international organization that promotes internet use and access. ISOC aims to provide a corporate structure to support the ad-hoc bodies active in the growth of the internet.
ISP	**internet service provider** An ISP is a Carriage Service Provider offering internet access to the public or another service provider.
ITS	**Intelligent Transport Systems** Aims to improve transportation safety and mobility and enhance productivity through the integration of advanced communications technologies into the transportation infrastructure and in vehicles. ITS encompass a broad range of wireless and wire line communications-based information and electronics technologies.
ITU	**International Telecommunication Union** The leading United Nations agency for information and communications technologies, including radiocommunications, standardisation and development.
Kbits/s	**Kilobits per second** Data transfer rate of 1,000 bits per second.
Linked Data	**Linked data** means that users—and semantic web applications—can find data sets of relevance in different places in the web, and aggregate them or parts of them in other locations to create a more personalised web experience.
LBS	**location-based services** Refers to services based on the physical location of the user and/or device (such as targeted advertising or information tailored to a specific location).
LCD	**liquid crystal display** An electro-optical amplitude modulator that forms a thin, flat display in digital devices.
LTE	**long term evolution** LTE is considered to be the successor of UMTS 3G technology, which is based upon WCDMA, HSDPA, HSUPA, and HSPA. LTE is not a replacement for UMTS in the way that UMTS was a replacement for GSM, but rather an update to the UMTS technology that will enable it to provide significantly faster data rates for both uploading and downloading.
LTE Advanced	**long term evolution advanced** 3GPP proposed mobile systems that go beyond those of IMT-2000.
Magnetometer	A device used to measure the intensity and direction of a magnetic field.
Malware	Malicious software designed to intrude or damage a

	computer system without the user's informed consent.
Mbits/s	**Megabits per second** Data transfer rate of one million bits per second.
MHz	**Megahertz** One million Hertz.
Microblogging	Differs from a traditional blog in that its content is typically smaller.
Naked DSL	A digital subscriber line service without a PSTN service.
NFC	**near field communications** A short-range wireless technology that evolved from a combination of existing contactless identification and interconnection technologies, also known as ISO 18902.
P2P applications	**peer-to-peer applications** Applications where data is exchanged directly between users.
PSTN	**Public switched telecommunications network** The PSTN is operated by a carrier to provide services to the public.
QAM	Quadrature amplitude modulation is both an analog and a digital modulation scheme. QAM is used extensively as a modulation scheme for digital telecommunication systems.
QPSK	**Quadrature Phase Shift Keying** A phase modulation algorithm used in digital communications systems.
RFI	**radio frequency interference** RFI is any undesirable electrical energy with content within the frequency range dedicated to radio frequency transmission.
RFID	**radio frequency identification** RFIDs are small electronic devices that consist of a small chip and an antenna. The chip typically is capable of carrying 2,000 bytes of data or less. The RFID device serves the same purpose as a bar code or a magnetic strip on the back of a credit card or ATM card; it provides a unique identifier for that object. And, just as a bar code or magnetic strip must be scanned to get the information, the RFID device must be scanned to retrieve the identifying information.
RSS	**really simple syndication** The automated repackaging of information from one web site to another.
Semantic Web	**Semantic technology** is expected to provide context relevancy/awareness, intelligent search and retrieval functions.
SIP-I Protocol	An ITU defined extension for interworking between PSTN and IP Networks (IMS).
Smartphone	**Smartphones** provide advanced computing functionality beyond feature phones or PDAs. Smartphones have more powerful processors, larger displays and complete operating system software providing a standardised interface and platform for application developers.
Social web	A term used to describe the social nature of the internet, where people interact and socialise using social media and social networking applications.
Spyware	Software installed on a computer that may occur without the user's knowledge and which transmits

	knowledge about the user's web activities over the internet.
Substitution	**Substitution** refers to instances where consumers replace a service for another service offering the same functionality, for example a consumer replacing their fixed-line phone with a mobile service.
TB	**Terabytes** One thousand gigabytes.
Telepresence	Provides a video-based immersive system which attempts to imitate a face-to-face meeting using high-resolution 3D vision and audio.
Thin client	A computer with a **thin client** software reliant on a server in place of applications stored on a hard disk drive to perform data processing.
Virtualisation	Enables one computer to do the job of many computers.
VoIP	**voice over internet protocol** A protocol for transmitting voice over packet-switched data networks.
W3C	**world wide web consortium** W3C develops interoperable technologies (specifications, guidelines, software, and tools) to lead the web to its full potential.
Web 2.0	Refers to a trend in web design and development, a perceived second generation of web-based communities and hosted services (such as social networking sites, wikis, blogs, etc) which aim to facilitate interaction, creativity, collaboration and sharing between users. Value in the form of 'collective intelligence' is co-created by and for the connected community of users.
Widget	In computing, a web widget is portable code that any user can install and execute on their web pages.
WiFi	**wireless fidelity** Used generally to refer to wireless local area network (IEEE 802.11) technology providing short-range, high data rate connections between mobile data devices and access points connected to a wired network.
WiGig	A multi-gigabit speed wireless communications technology operating over the readily available unlicensed 60 GHz frequency band to enable communications among devices.
WiMAX	**worldwide interoperability for microwave access** Industry group organised to advance the IEEE 802.16 standards for broadband wireless access networks for multimedia applications with a wireless connection.

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