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Networking and wireless

Analysis: Green data centres

At a glance

- The number, size and power consumption of data centres are rapidly increasing.
- Cooling IT equipment takes a large proportion of the energy consumed by a data centre.
- Physical adaptations and changes to the cooling regime can create considerable savings, even in small installations.
- Data centres impact the environment in other ways, including consumption of water and raw materials, physical waste and effects of power generation.
- Industry and governmental groups are taking an increased interest in reducing the impact of data centres.

Introduction

The number and size of data centres continues to grow as an increasing volume of data is stored, while energy consumption rises and these facilities pose other environmental concerns. Such data may include marketing trends, consumer behaviour, personal information, web indices used for search, scientific evidence and much more. Deployment of low power, thin client devices may be associated with server centralisation - saving power at the client but increasing the demand in server rooms. Further, as organisations move processing, storage and key functions into 'the cloud', the demand for data centres is liable to grow even more. (See TechNews 11/08 for a discussion of 'Cloud computing'.) Some of these trends towards centralisation may, in themselves, lead to efficiencies through replacing older hardware and use of purpose-built facilities.

A 2007 report by the US Environmental Protection Agency (EPA) concluded that data centres consumed power equivalent to 5 per cent of all household energy use in the States. Based on existing trends and efficiency improvements known to be coming into widespread adoption, the EPA calculated that the power consumption of data centres would double in the period 2006 to 2011. A 2008 report by McKinsey equated the worldwide production of carbon dioxide (CO_2) from data centres to that of the whole of Netherlands or of Argentina, stating that the average data centre consumed the same energy as 25,000 households.

This problem is not confined to purely commercial uses of data - the lessons that are now being learned could equally apply to small data centres being run by some local authorities and colleges; some of the principles may also relate to server rooms in larger schools.

Green issues

Power consumption and CO_2 may be the current 'headline' issues, but data centres have a range of environmental impacts, including utilisation and disposal of resources used in hardware (especially small quantities of scarce or toxic metals) and effects on local water supply where water cooling is used.

Many companies are becoming 'environmentally responsible', but the trend towards 'greening' data centres is also driven by hard economic realities - estimates from various sources suggest that energy used for cooling comprises 50 to 70 per cent of the total power of many facilities. Further, growth in the sector must be put in the wider context, considering where the raw materials utilised come from, how the electricity used has been generated and planning for decommissioning of plant and equipment at the end of a facility's lifecycle.

An indication of the scale of concern is given by IBM's annual commitment of $1 billion to its 'Big Green' initiative. Although largely invested in developing its own products and services, this reveals the shifting demands of the company's clients.

Solutions
A report from Gartner makes a series of best practice recommendations, relating in particular to cooling techniques, that it claims could reduce expenditure by 35 to 50 per cent. Considerable inefficiency occurs where cold 'input' air is allowed to mix with 'output' flows that have been heated by the processors and IT infrastructure. To prevent this, holes in raised floors should be plugged, blanking plates used for empty racks and 'hot aisles' physically separated from 'cold aisles' using partitions. Other suggestions include widespread use of sensors, coordination of air-conditioning units and use of 'free cooling'. (The latter uses 'energy-free' techniques, for example cooling towers, to release heat from water and other coolants.)

Raising the temperature of the data centre - one of Gartner's recommendations - has been researched by Dell, which claims that allowing a five degree increase in air temperature yields a five per cent energy saving.

Sun Microsystems made a company-wide review of its Bay Area, California, data centres in 2006, during a drive to increase efficiency. The company states that:

> 'By consolidating data centre operations and refreshing the hardware infrastructure with high-performance, energy-efficient Sun systems, Sun was able to reclaim 88 percent of its valuable datacenter floor space and reduce power consumption by 61 percent - all while improving server performance by 456% and storage capacity by 244 per cent with less than half the original hardware.'

Holistic approach
Google's 'Commitment to sustainable computing' reaches across all aspects of its operation, incorporating strategies that include:

- Building hardware to its own specifications. Servers contain no graphics capability and many components - from processors to cooling fans in racks - are power-optimised across range of utilisation profiles.
- Reusing and recycling materials. Sixty eight per cent of redundant hardware is redeployed, or stripped down and components built into new systems, or donated to third parties.

- Working towards a target of using 80 per cent recycled water in its cooling systems by 2010. Such water, which is subject to basic filtration and treatment before use, may come from rainfall run-off or industrial canals.

Air cooling
Intel typically cools air in its data centres to 20C before pumping it across its hardware; the temperature on output may be raised by as much as 32C. In a proof-of-concept system, it installed two sets of 448 blade servers in racks in a shipping container. In one half, an 'air economiser' was used rather than standard cooling systems. This consisted of a modified, low cost air conditioning unit that pumped the air but only cooled it at temperatures above 32C. Rather than recycling the air, it was drawn in from outside through domestic dust filters.

Over a period of ten months, hardware failure rates were not significantly higher than in a nearby data centre, although dust built up on the equipment. On the basis of the local climate, Intel researchers estimate 67 per cent power savings using external air. Intel also noted that capital costs are lower and water savings could be made where water cooling would normally be applied. The experiment was conducted in a dry, temperate climate, so no data was provided that would apply directly to the UK.

Passive cooling systems, which have no need of pumps and fans, reduce costs and are considered more reliable.

Modular approach
Microsoft has developed a modular approach with up to 2,500 servers deployed in racks inside standard 40-foot shipping containers. The small volume and physical containment create a readily controlled environment in which Microsoft has demonstrated a PUE of 1.22 on average load. (PUE - Power Usage Effectiveness - is the ratio of power entering a data centre against power used to run actual IT infrastructure. Ideally, PUE should be 1.) These containerised units can be easily deployed direct from manufacture, reducing shipping costs and packaging. Further, they permit flexibility in deployment and scaling of computing resources.

Other companies - such as HP, IBM, and Sun - have developed data centre solutions based in shipping containers.

Corporate focus
Initiatives focused on reducing energy consumption and carbon dioxide emissions through effective use of technology are supported by a wide range of IT companies. Consortia include the Green Grid, SMART 2020 and the Digital Energy Solutions Campaign (DESC).

The Green Grid has proposed the Data centre infrastructure efficiency (DCiE) and PUE, among other metrics for comparing facilities and new developments. (The DCiE is a mathematical inverse of PUE expressed as a percentage. Thus, a PUE of 1.22 and DCiE of 82 per cent are equivalent.)

The EU has released a 'Code of Conduct' for data centres operators, which commits voluntary 'Participants' to auditing power use, developing an action plan that is submitted to an EU Commission body and reporting on progress. The Code, which is endorsed by the British Computer Society, uses DCiE as its primary efficiency metric.

Lessons for educational establishments

The Sustainable IT in Tertiary Education initiative (SusteIT) found that Sheffield University spent nearly a fifth (more than a million pounds) of its non-domestic energy budget on electricity to power ICT equipment. The UK has set targets for all central government computers to be zero carbon by 2012 and all new school buildings (including installed equipment) by 2016. Becta has published general environmental sustainability information that includes advice on ICT.

Educational establishments can make significant energy savings by simply switching off ICT equipment, including monitors, when not in use. Consolidation of existing hardware may be possible with minimal investment, possibly by integrating curriculum and administration servers. Some efficiencies may be achievable through immediate reconfiguration whilst others are implemented when more capable equipment is purchased to replace existing hardware. Combining processes may be made easier and more secure through running each in its own 'virtualised' server environment. (Virtualisation would allow multiple operating system instances to run simultaneously on the same hardware.)

Institutions with data centres (or larger server rooms) may be able to implement some of the improvements recommended by Gartner and could consider becoming official Participants under the EU Code of Conduct for data centres.

References

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http://www.energystar.gov/index.cfm?c=prod_development.server_efficiency_study
Revolutionising data centre energy efficiency
http://www.mckinsey.com/clientservice/bto/pointofview/pdf/Revolutionizing_Data_Center_Efficiency.pdf
IBM unveils plan to combat data centre energy crisis... http://www-03.ibm.com/press/us/en/pressrelease/21524.wss
Gartner shares data centre efficiency secrets
http://www.techworld.com/opsys/news/index.cfm?newsid=107242
Unlock your hidden data centre
http://www.dell.com/downloads/global/solutions/unlock_your_hidden_data_center_presenation.pdf
Creating an energy-efficient datacenter
http://www.sun.com/aboutsun/environment/docs/creating_energy_efficient_dchw_consolidation.pdf
Commitment to sustainable computing http://www.google.com/corporate/datacenters
Reducing data centre cost with an air economizer
http://www.intel.com/it/pdf/Reducing_Data_Center_Cost_with_an_Air_Economizer.pdf

Out of the box paradox - manifested...
http://loosebolts.wordpress.com/2008/10/20/out-of-the-box-paradox-manifested-aka-chicago-area-data-center-begins-its-journey
The Green Grid http://www.thegreengrid.org
SMART 2020: Enabling the low carbon economy in the information age
http://www.theclimategroup.org/news_and_events/smart2020pressrelease
The Digital Energy Solutions Campaign http://www.behindthegreen.org/about/desc
The Green Grid data centre power efficiency metrics: PUE and DCiE
http://www.thegreengrid.org/gg_content/TGG_Data_Center_Power_Efficiency_Metrics_PUE_and_DCiE.pdf
EU code set to clean up data centres
http://www.techworld.com/news/index.cfm?RSS&NewsID=107317
EU Code of Conduct for Data Centres
http://sunbird.jrc.it/energyefficiency/html/standby_initiative_data%20centers.htm
A fifth of education body's energy supply used by ICT
http://www.headstar.com/egblive/?p=177
World first as Government computers go green
http://www.cabinetoffice.gov.uk/newsroom/news_releases/2008/080717_green.aspx
First step to making all new school buildings zero carbon
http://www.dcsf.gov.uk/pns/DisplayPN.cgi?pn_id=2008_0113
Environmental sustainability
http://schools.becta.org.uk/index.php?section=re&catcode=ss_res_env_02&rid=14635

Networking and wireless news

4G developments

Two main technologies are competing to succeed the current 3G mobile network infrastructure: LTE and WiMAX. Long Term Evolution (LTE) is the preferred option of the 3GPP group of companies, designed to provide a smooth upgrade path from 3G, which is the main technology deployed across large parts of Europe.

LG Electronics claims to have built the first LTE modem on a chip. Modems are crucial to electronic communications, so this development marks a milestone towards commercial deployment of LTE. The company says that a trial in December 2008 in its labs yielded 60Mbps download and 20Mbps upload speeds. While LTE's theoretical throughput could be over 300Mbps, real world speeds are likely to be lower than these lab tests initially. Nevertheless, such speeds should improve on the current maximum download rate for HSPA (see below) of 7.2Mbps.

Finalising the standards and creating the infrastructure, in addition to developing the handsets, will mean that LTE will not appear until the end of 2010 at the earliest, according to Ericsson's John Cunliffe, talking to Silicon.com.

Infonetics Research has suggested a similar date for widespread deployment of mobile WiMAX. Although the IEEE 802.116e standard was available earlier than LTE, and US carrier Sprint has already created a service around Baltimore, investment decisions by many operators have yet to be finalised. Both technologies

need substantial capital investment in new hardware, which may be more difficult to fund in the current economic climate.

LG develops world's first LTE handset modem chip
http://www.lge.com/about/press_release/detail/21031_1.jhtml
Don't expect a UK LTE network before 2011
http://networks.silicon.com/telecoms/0,39024659,39351692,00.htm
WiMax market set to slide next year
http://www.techworld.com/news/index.cfm?RSS&NewsID=108404

HSPA+ update

Many of the 3G mobile broadband dongles available for laptops offer some form of High Speed Packet Access (HSPA) for data downloads and web browsing. HSPA+ is the '3.5G' development of this technology, reaching download speeds of 42Mbps in ideal circumstances, compared with 14.4Mbps that will soon be offered in the UK using standard HSPA. Early in December 2008, Qualcomm demonstrated a test HSPA+ link, which peaked at 21Mbps for download, and commented that they expected to be able to provide twice the throughput within two years and 84Mbps by 2012.

The company expects the first HSPA+ devices to appear towards the end of the year, although the standard has yet to be finalised and carriers will have to upgrade the network hardware to provide the standard. It expects HSPA to supplement LTE in rural areas when the latter starts to roll out in 2010.

Cellular speeds heading for 42Mbits/sec http://www.pcw.co.uk/personal-computer-world/news/2231893/cellular-speeds-hit-42mbits

Short range wireless developments

Two technologies dominate wireless communications over short distances: Wi-Fi and Bluetooth. The 802.11n standard for Wi-Fi, expected to be ratified late this year, allows devices to connect at up to 600Mbps, with ranges doubled compared with the existing 54Mbps 802.11g standard. Real world speeds are not expected to come close to these maxima, but throughput of 50-100Mbps has been measured for 'draft-n' products already on the market. Maximum speeds for 802.11n require two antennae spaced more widely than is possible in a mobile phone, but Broadcom claims to have achieved speeds of 50Mbps for download.

The latest Broadcom chip integrates 802.11n Wi-Fi with Bluetooth and an FM radio that can both transmit and receive. Bluetooth is a shorter range protocol, designed for connection of accessories and linking mobile to fixed devices in a small area. Although only operating at a nominal 3Mbps, Bluetooth can handle multiple simultaneous connections with low power consumption. Broadcom claims that the combined chip will be available at lower cost, reduce power consumption and require less space within mobile devices than using separate chips and antennae.

Other manufacturers are producing or developing combined protocol chips for use in mobile devices.

Broadcom's new combo chip integrates 802.11n Wi-Fi, Bluetooth...
http://www.broadcom.com/press/release.php?id=1233460&industry_id=2

One of the problems with Wi-Fi is the need for devices to connect to an access point. Each base station has its own identity (BSSID) and will allocate a port to the device as it connects; as devices roam between access points, these details will be reallocated, making it difficult for network administrators to provision network resources to Wi-Fi enabled devices. Meru Networks claims that its pooling and partitioning technologies allow administrators to allocate 'virtual WLAN's': BSSIDs for access points are pooled and allocated to client devices, which keep these details as they roam between physical access points. This allows more effective segregation of data streams, security management and bandwidth control.

Meru Networks brings virtualization to wireless LANs
http://www.merunetworks.com/news/press_releases/index.php?articleID=111008

Wireless USB connectivity

A number of companies are producing wireless products, based on several competing protocols, for remote connection of USB devices. Olidata, an Italian manufacturer, has produced a Wireless USB system, based on ultra-wideband (UWB) protocols, which it claims has a line-of-sight range of approximately 10m.

UWB spreads a series of fast pulses across a bandwidth of more than 500MHz in the unlicensed 3.1 to 10.6GHz spectrum. (Spectrum availability in Europe is more limited.) Due to its low power, pulsed nature, UWB can operate with minimal interference to other devices using the same frequencies. UWB is based on ISO/IEC standards developed by the WiMedia Alliance.

The Olidata Wireless USB system connects a single device (unless a USB hub is connected at the remote location) using an encrypted UWB channel. Most devices that use audio are not supported in the current version, which costs 59 euros in Italy. UK pricing and availability are unknown. The product is based on chips from Wisair, which also power a similar but higher priced system from Cables Unlimited in the US. Compliance of Certified Wireless USB devices is overseen by the USB Implementers Forum.

Ratoc have produced a PC Card (PCMCIA) Wireless USB solution for laptops and other devices that do not have a free USB port. Details of this Japanese product (which integrates a 4-port USB hub) are sketchy, but pricing of around $340 has been suggested.

Olidata sells first kits for wireless connection to USB devices in European Markets
http://www.wisair.com/press/olidata-sells-first-kits-for-wireless-connection-to-usb-devices-in-european-markets
Olidata http://www.olidata.com
USB Implementers Forum http://www.usb.org

Ratoc introduces Wireless USB kit for your PCMCIA-equipped laptop
http://www.engadget.com/2008/12/11/ratoc-introduces-wireless-usb-kit-for-your-pcmcia-equipped-lapto
Ratoc http://www.ratocsystems.com/english/index.html

50mbps (cable) and 40mbps (copper) broadband connections

Network services companies are searching for ways to deliver ever-faster broadband connections to homes and businesses. Use of copper cabling for the 'last mile' often limits the speed of service they can provide, due to interference and the way that networks are switched.

BT and other companies are looking at 'fibre-to-the-home' (FTTH) to replace that 'last mile', or 'fibre-to-the-cabinet' (FTTC), which brings the high speed connection out of the exchange to a local cabinet. (See November 2008 TechNews.) In December 2008, cable broadband provider Virgin Media announced plans to deliver 50Mbps to homes at £51 per month (or less if telephone service is included), using a mixture of fibre and coaxial cabling. Research for the company revealed that data consumption had doubled in 18 months, due largely to much higher use of video services, and that it was predicted to have quadrupled by 2011. Around three quarters of homes had two or more users able to access the internet simultaneously, driving up bandwidth requirements for such homes. Network developments would permit 200mbps connections in future.

Easynet is trialling a 40Mbps managed service to customers using existing copper connections, which it says (with other EtherStream offerings) will be available to 70 per cent of businesses nationally. The offering is based on standard Ethernet (rather than ADSL) technology, is uncontended (not shared) and comes with a bandwidth guarantee. The system is also symmetrical, allowing users to upload data as fast as they download it. BT OpenReach, which supplies other service providers, has made a higher frequency transmission range available, so that Easynet can aggregate 8 copper pairs to reach these speeds. End-users must be within 1km of the exchange. This type of service may be attractive to education users who are increasingly looking to create as well as consume content.

These services are just examples of the range of offerings open to homes, businesses and education. Actual speeds, especially for domestic broadband, may not come near the advertised speeds - recent OFCOM research found average received speeds to be 45 per cent of the headline speed.

Virgin Media Launches the UK's Fastest Broadband
http://pressoffice.virginmedia.com/phoenix.zhtml?c=205406&p=irol-newsArticle&ID=1235740&highlight=
Customers of Easynet Global Services first in UK to benefit from 40Mbps...
http://www.easynet.com/gb/en/about/pressRelease.aspx?SecondaryNavID=52&PressReleaseID=890
Easynet Connect trials 40Mb/sec over copper
http://www.pcpro.co.uk/news/239157/easynet-connect-trials-40mbsec-over-copper.html

UK's most comprehensive consumer research lifts the lid on broadband speeds
http://www.ofcom.org.uk/media/news/2009/01/nr_20090108

Virtualisation update

Virtualisation allows systems managers to run multiple operating system images on a single server, or to otherwise abstract software into an environment not directly linked to the underlying hardware. This permits pooling of resources, optimisation of utilisation and management, and provision of multiple environments from a unified server infrastructure. Desktop virtualisation wraps all the applications and the desktop environment so that a similar experience can be delivered, no matter which hardware client (including remote clients) that the user selects. Thin clients make extensive use of desktop virtualisation and can lead to reductions in total cost of ownership (TCO). (See the 'Thin client computing' analysis article in the Hardware section of this edition of TechNews.)

HP claims that improved protocols used with its thin client hardware will reduce the problems posed by extensive use of multimedia. These protocols deliver screen updates generated by the server to the client device and take user input back to the central processor. However, multimedia applications significantly increase the complexity of screen refreshes and the load that the server must process. HP has enhanced Microsoft's Remote Desktop Protocol (RDP) to push some of the processing into specifically designed thin clients, in addition to improving support for USB devices connected by the user. This update is free, but a more advanced set of protocols - the HP Remote Graphics Software (RGS) - has associated licence costs.

IBM and partners have released a new virtual desktop based on Ubuntu Linux and IBM's Lotus collaboration software. The desktop is built, they say, on open standards - such as the open document format (ODF) - and provides considerable savings compared with more proprietary solutions.

New Citrix App Receiver software will be available for smart phones, including Apple's iPhone, to allow mobile users to interact with their virtual desktop without using a thin client or other large terminal device.

VMware plans to virtualise the mobile phone interface itself, with its Mobile Virtualization Platform. This will enable operators to install critical operating system components (such as authentication or digital rights management) in a secure environment; users will be able to have multiple, distinct personalities that they can migrate between phones; and systems managers will be able to mandate alternative, secure, uniform, business-focused interfaces across an organisation. These issues become increasingly pertinent as manufacturers look to move towards open standards and users install multiple third party applications.

HP helps businesses improve employee computing...
http://www.hp.com/hpinfo/newsroom/press/2008/081208a.html
IBM and business partners introduce a Linux-based, virtual desktop
http://www-03.ibm.com/press/us/en/pressrelease/26230.wss

Citrix to extend desktop virtualization to the iPhone
http://www.macworld.com/article/137462/2008/12/citrix_iphone.html
VMware to bring virtualization to mobile phones...
http://www.vmware.com/company/news/releases/mvp.html

Open Cloud Consortium

Cloud computing (see November 2008 TechNews) is a fairly proprietary environment - data and applications hosted on one service are not readily transferrable to another. This is due in part to the way that they are wrapped up in virtual 'containers', which perform an intermediary function between the hardware being used by the service provider and the data or application in question. Where these cannot be migrated to another service, there are inherent dangers of supplier lock-in, inflexibility and limited pressure for price reductions.

A group of US universities is setting up a not-for-profit company to oversee development of open standards and provide a test bed for cloud technologies. The group also wants to see common interfaces developed to allow communication between cloud-based applications and greater opportunities for open source developers to enter the market. One project, based on UDT rather than the more common TCP network protocol, saw data transferred twice as fast compared with other open source solutions. Cisco has been the first major industry player to join the consortium.

Cloud standards group formed
http://www.techworld.com/news/index.cfm?RSS&NewsID=109212
Open Cloud Consortium http://www.opencloudconsortium.org

IP traffic forecast

Cisco's 'Visual Networking Index' forecast refers to quantities of data that are hard to imagine - petabytes, exabytes and zettabytes. (In decimal terms, a petabyte is a thousand terabytes, or a million gigabytes. Exabytes are a thousand times larger and a zettabyte a million times greater than a petabyte.)

By 2012, Cisco predicts that IP traffic will exceed half a zettabyte, having doubled every two years. IP data is made up from internet traffic, dedicated cable TV links and other systems that use the internet protocol (IP). At the end of 2007, peer-to-peer systems (that link data transfers from a several people's PCs to supply a single file) accounted for half the traffic. Nevertheless, this share was falling, while Cisco calculates that video traffic will increase from 31 per cent at the end of this year, to nearly half of all consumer internet traffic by 2012. The company predicts that internet traffic growth will be highest in Latin America, followed by Western Europe and Asia-Pacific.

Figures from the Office of National Statistics reveal that broadband now accounts for 94 per cent of all internet connections in the UK. More than half of these connections were at an advertised speed of 2Mbps or greater, including nearly 10 per cent at over 8Mbps.

Cisco Visual Networking Index - Forecast and Methodology, 2007–2012
http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-481360_ns827_Networking_Solutions_White_Paper.html
Internet connectivity - September 2008
http://www.statistics.gov.uk/pdfdir/intc1108.pdf

NFC update

Near field communications (NFC) allows mobile device users to automatically access information about an object when within close proximity. This technology underpins the contactless payment trials using, for example, O2 mobile phones. NFC can deliver information about exhibits in a museum, secure electronic ignition systems for cars, provide mobile ticketing and underpin more complex communications, such as downloading pictures from a camera. (See TechNews, Jan 2008.)

In November 2008, Juniper Research predicted that NFC-based transactions and mobile money transfers would form half of all mobile payments by 2013, with a tenfold overall increase in market value by that date. Barclays announced earlier this month that most new Visa debit cards it issues will integrate contactless payment capability, enabling three million customers by the end of the year to make payments under £10 by swiping their cards.

As part of its Pay-Buy-Mobile initiative, a key industry body, the GSM Association, has called for many more new mainstream mobile handsets to incorporate an agreed set of common NFC requirements by mid-2009. Both MasterCard's PayPass and Visa's PayWave systems have payment via phone-based NFC as one option. Rob Conway, CEO of the GSMA, claims that, "there is a huge latent demand for a large variety of mobile transaction services, of which there is universal interest in proximity payments, as trials across the world have already shown."

Significant adoption of NFC equipped phones could be used as a payment option for school canteens, as the device to read information in 'smart posters', or as the basis of specialist applications for visually impaired users to navigate public buildings.

UK consumers want NFC on their mobiles
http://www.o2.com/media/press_releases/press_release_14279.asp
Barclays goes contactless on debit cards
http://www.newsroom.barclays.com/Content/Detail.asp?ReleaseID=1484&NewsAreaID=2
GSMA calls for Pay-Buy-Mobile handsets
http://www.gsmworld.com/newsroom/press-releases/2008/2090.htm
MasterCard PayPass http://www.paypass.com
Visa PayWave http://www.visapaywave.co.uk

Smart personal networks

Considerable numbers of personal devices are becoming network enabled, from MP3 players and cameras, to mobile phones that look like wrist watches. Where these devices link to form a web of communication and information for an individual person (or an object like a car) they are considered a personal network (PN).

European funding has been given to the MAGNET Beyond programme, which is based on earlier work into personal area networks (PANs). Unlike a PAN, which deals purely with devices in a person's immediate surroundings, a PN can communicate with remote systems too. MAGNET (My personal Adaptive Global NET) Beyond envisages a world where personal systems will be monitoring hundreds - or even thousands - of health and environmental sensors, in addition to all the gadgets that are already part of daily life for many of us. These networks will draw information from the wider world, perhaps by displaying files from your home computer or an internet feed onto your glasses, and will automatically control your environment, possibly by dimming the lights or switching on the air conditioning. The World Wireless Research Forum (WWRF) has predicted that each of us, globally, will have an average of a thousand devices by 2017.

The MAGNET Beyond consortium worked under four guiding principles: ease of use, trustworthiness, ubiquity and low cost. New devices should be able to integrate seamlessly into your personal network, while your network should be able to communicate with those of your home, your friends, your employer or your car. Network 'federations' can be set up on an ad hoc or a permanent basis, with specific levels of security appropriate to the task in hand. Researchers investigated protocols to manage security and communication, developed hardware to provide the 'air interface' (allowing devices to communicate wirelessly) and field tested a limited number of scenarios.

The Network of Everything http://www.physorg.com/news146150493.html
Technology behind the Personal Network
http://www.physorg.com/news146236275.html
Up close and personal networks http://www.physorg.com/news146755459.html

Multimedia

Analysis: Display technologies

At a glance

- Displays are integral to many consumer devices, with considerable innovation aimed at improving image characteristics and 'green' metrics.
- LCD designs have largely replaced older CRT 'tubes' due to their lower weight, bulk and power consumption.
- Brightness, weight and battery drain are significant factors when selecting displays for mobile technologies.
- Newer technologies, such as plasma and OLED, emit light, rather than selectively blocking it, making the image brighter and more vibrant, while consuming less power. They also tend to be thinner and lighter.
- Production issues have delayed commercialisation and mean that newer technologies remain relatively expensive compared with LCD.

- Alternative technologies, such as quantum dots, field emission and interferometric modulation displays, remain largely in the research or prototyping stages.

Display considerations

For most devices and most users, the display is the primary output for information, meaning that it is often central to reducing the power consumption, bulk and weight of hardware. Quality of image is vital in design work, whereas improved battery life, brightness and low weight may be more important to handheld learning devices.

There are three main technologies that will compete in the market in the medium term: LCD, plasma and OLED. LCD replaced the old CRT (cathode ray tube) technologies in most applications, as performance increased and prices fell, but further innovation is being driven by customer requirements and competition from more recent technologies.

The main factors considered by manufacturers and users include:

- Size - cost and portability are frequently limiting factors.
- Resolution - 'full' 1080p HD video requires 1920x1080 pixels.
- Brightness - often quoted in ANSI lumens.
- Contrast ratio, which is a measure of the difference between the darkest and lightest pixels that the screen can display. A ratio of 1,000:1 is better than 500:1.
- Viewing angle - which may impede users not directly in front of the screen.
- The ability of the device to scale images without introducing distortion or 'blockiness'.
- Response time - the ability to update rapidly changing images, such as video and games.
- The gamut, or range of colours produced.
- Power consumption. Emissive displays (that generate an image by producing light) do not need a backlight, requiring less power.
- Weight.
- Lifespan - some current OLEDs may only last 15,000 hours. Used 8 hours per day, this is more than 5 years viewing, which may be an issue for digital signage in public areas.
- The production technology - newer systems will be cheaper if they can use exiting techniques. 'Roll-to-roll' methods are often preferred, as the raw materials can be drawn from one roll, treated, and rolled back at the other end of the production unit, as a continuous process.
- 'Green' issues, including energy used and waste produced during manufacture and disposal at the end of the lifecycle.
- The final cost.

Many manufacturers are involved with the technologies described below. This article does not cover projection technologies.

LCD

Liquid crystal displays work by controlling the passage of light from a lamp mounted in the rear. In a basic LCD, light passes through a polariser, is rotated by the twist of the liquid crystal layer, passes through a second polarised screen (which is arranged perpendicular to the first) and through coloured filters for each pixel. This selective process absorbs light, often as much as 40 to 60 per cent. When a voltage is applied across the liquid crystal layer through an array of transparent electrodes, the twist of the crystals is affected, preventing light from the first polariser passing on through the second.

Different types of LCD are used in a wide range of devices, but issues relating to the brightness of the screen, the limited viewing angle (produced by the combination of polarisation and liquid crystals) and the lack of contrast ratio (due to light 'bleeding' through from the backlight) remain.

Manufacturers have worked hard to improve displays. For example, Philips recently displayed a 32-inch screen that used a 1mm light guide, making the whole unit only 8mm thick. Researchers at University of Central Florida replaced the bottom polariser with a nanowire grid, which reflects light that cannot pass through the grid back to the light guide where it is 'recycled' and may pass through the grid next time. The team suggest this will increase efficiency by 60 per cent.

Some LCDs are now called 'LED' displays. This is really a misnomer, as the basic technology is still liquid crystal, but the cold cathode fluorescent lamp (CCFL) is replaced by a much more efficient, thin, mercury-free LED light source.

Plasma

Plasma displays, also called PDPs (plasma display panels), are made up of thousands of tiny cells coated with emissive phosphors. When a charge is applied across a cell, the gas inside (usually neon or xenon) is excited and produces ultraviolet photons; in turn these strike the phosphors which emit light in the visible spectrum, with the colour of each pixel depending on the particular phosphor used.

Plasma screens are bright and have a wide viewing angle compared with typical LCDs. Although more expensive, they are simpler to produce reliably in large sizes, so they are often used for digital signage and large televisions. For example, in January 2008 Panasonic revealed a prototype 150-inch screen, then demonstrated a conceptual 2,160 by 4,096 pixel display called 'Life Wall' in October and recently showed a 50-inch unit, which was less than a third of an inch thick, that displayed full 1080p HD TV.

A Japanese start-up, Shinoda Plasma, had a prototype 125-inch, flexible plasma display on an exhibition stand in October 2008. The 1mm thick, 3m by 1m device uses very fine glass tubes rather than plates, allowing the screen to be curved horizontally. The resolution is only 960 by 360 pixels, so it would be suited to public information systems rather than television.

The European Union is reported to be concerned about the power consumption of plasma displays, which can use nearly 2.5 times as much energy as an equivalent 42-inch LCD.

OLED

The most promising recent technology is based on organic light emitting diodes (OLEDs). Two thin-film organic layers are sandwiched between the cathode and anode; when a charge is applied, the passage of electron 'holes' causes the outermost layer to emit light - a process know as electroluminescence. This makes OLED screens much brighter, with higher contrast ratios and an improved gamut, better response times (as there is no crystal to be deformed) and using less power compared with LCD.

Sony's recently launched 11-inch XEL-1 television has a dynamic contrast ratio, according to the company, of 1,000,000:1. (This compares with 9,000:1 for some of its Bravia LCD-based models.) Although it can 'downscale' full HD video, its native resolution is only 960 by 540 pixels.

OLEDs, without the need for polarisers, are thinner, weigh less and can be manufactured using flexible plastics. They can use a third of the power of LCDs, producing brighter images, so manufacturers have integrated them in a range of mobile devices. (See the TechNews OLED article from January 2005.)

The greatest drawback relates to manufacturing, especially the deposition of the organic layers. The complexity of current processes makes even small displays expensive - the XEL-1 costs $2,499 in the US. (UK pricing has yet to be announced.) A second problem relates to producing stable polymers, which leads to image deterioration over time.

Sony's television is the only large form-factor OLED unit launched commercially. LG has announced that it will produce a 1,366 by 768 pixel, 15-inch OLED display later this year; Samsung is piloting a production line for 40-inch screens; and Sony has exhibited prototype 21-inch and 27-inch displays.

Samsung announced a foldable display last year, although it is not clear whether the screen itself folds. This Samsung device is based on AMOLED: just as LCDs improved with the introduction of active matrix (AM) technology, individual transistors controlling each pixel for an OLED screen will produce better response times and an improved image. Sony also demonstrated a small, flexible OLED screen earlier this month, but few details were given.

Blue OLEDs are more demanding than red or green, due to producing light with a shorter wavelength. A South Korean scientist has claimed that his team has developed an efficient, 'true blue' (rather than cyan) OLED material.

Emerging technologies

Quantum dots, made from semiconductor nanocrystals measuring 3-12nm, can be sandwiched between two organic films and electrically stimulated to produce light.

These crystals can be finely tuned to produce a particularly narrow band from the visible light spectrum, producing more vivid colours. A start-up company, QD Vision, is commercialising a technique in which the dots are evaporated from solution onto a 'rubber stamp', rather than depositing them directly on the substrate. This allows greater precision in placing the dots and avoids damage to the organic layers from solvents. The stamp could be tubular, permitting fast roll-to-roll manufacture. The company suggested this technology could be in products by 2011.

A University of Illinois team published research in April 2008 that could underpin a new form of field emission display (FED). Five-sided, 70-250nm copper nanowires are deposited on a on a patterned silicon substrate at relatively low temperatures (200-300C). These act like the electron guns for an array of extremely small CRT devices, producing light as the electrons interact with phosphors on the outer surface of the cell. The team made a proof-of-principle device, but this technology is nowhere near commercialisation.

Screens from Field Emission Technologies, that use molybdenum deposition to create 120nm cone-shaped 'Spindt tip' semi-conductor emitters, were incorporated in a range of demonstration devices last year. Other types of FED have been demonstrated, but have tended to be expensive or prone to degradation. Surface-conduction electron-emitter displays (SED) are similar in principle, but have been dogged by technical and legal issues.

A Freestyle Audio MP3 player has an integrated IMOD display from Qualcomm. Interferometric modulation produces colour through creating interference patterns: a reflective membrane and a 'thin-film' stack (which is partially reflective and partially transmissive) are separated by an air gap; light reflected from the thin film and from the underlying reflective membrane will be slightly out of phase, producing a colour. The size of the gap controls the colour produced and closing the gap (using electrostatic attraction) turns the display element off. Since it is based on reflected light, IMOD technology produces bright displays with low power consumption, even in full sunlight.

Conclusion

Due to price, large manufacturing base and acceptability of the image, LCD remains the main display technology of choice for most applications. Mobile devices, which need to work in bright sunlight, and other hardware that requires lower weight or energy consumption, will look towards emissive systems. OLED is the most likely competitor in this market - and is just being seen in televisions too - but there are other technologies, such as FED and IMOD, that also have potential as they mature. Plasma screens can more readily be produced in a large form factor for public displays, and are generally lighter weight but more power hungry.

Due to the widespread use of displays in devices from coffee makers, through MP3 players, to computers and advertising billboards, this sector will continue to see rapid development, with prices continuing to fall and specifications improving. Products which marry large displays to motion tracking or touch, such as Panasonic's Life Wall, may also produce some novel applications.

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Samsung goes brave new world with 40-inch OLED panel
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Multimedia news

Web applications update

Web applications provide processing power within the browser window, so developers can write photo editing, data mashup and business applications that run across the internet. This enables users to run the same application on any internet-connected device, so long as the appropriate browser and associated plug-ins are available. The growth in technologies supporting web applications opens further the possibility for 'anywhere, any time, any device' approaches to delivering educational content and management information systems. (See the 'Web applications' analysis article in this edition of TechNews.)

ARM processors are at the heart of considerable numbers of mobile phones, other portable devices and embedded systems like set-top boxes, while Adobe Flash has been embraced by many web developers who want to deliver multimedia over the internet. In November 2008 the two companies announced a long-term partnership aimed at making Adobe products work more efficiently on ARM-based hardware. In addition to Flash Player, the project will ensure that web applications can run independently of the browser within Adobe's AIR environment.

ARM has further announced that it will join the Open Handset Alliance, the body created by Google to oversee development of its open source Android mobile operating system. Adobe has widened the availability of AIR by releasing a software developer kit (SDK) for a number of Linux distributions, including Fedora 8, Ubuntu 7.10, and openSUSE 10.3. This SDK complements those available for Mac OS X and Windows.

Supported by Novell and Microsoft, an open source community has also released a Linux implementation of Microsoft's Silverlight web application development platform. Moonlight is available for more recent versions of Fedora, Ubuntu, and openSUSE distributions. The main beta version of Moonlight was released in December 2008, with a final version expected at the end of this month. Silverlight is available for Mac OS X but, as with the other operating systems, support is also browser dependent.

Sun Microsystems wants multimedia applications developed using its Java programming environment to be available on 'all the screens of life'. JavaFX 1.0 is a suite of new and existing development tools and resources aimed to achieve this goal. JavaFX Desktop, downloaded as part of the standard Java pack, can allow JavaFX applications to be dragged from the web browser onto the end-user's desktop. JavaFX works with Windows and MacOS. A version for mobile devices is expected later this year.

Google has released an open source, early research version of its Native Client (NaCl) - a plug-in, which allows users to run applications built on standard x86 program instructions within the browser's window. Most web applications are mediated by technologies like Flash and Java, which limit access to the machine's hardware and reduce potential processing speed. Direct access to x86 instructions could produce significant gains in speed for processor intensive tasks, such as photo

editing or decoding video information. Microsoft's ActiveX solution for Internet Explorer performs the same task, but has raised a number of security concerns, so Google would like developers to test its 'inner sandbox' to reveal such weaknesses as soon as possible. Native Client, which is also browser dependent, will operate on x86-based Linux or Mac OS systems, as well as Windows. Support is not yet available for Internet Explorer. Google intends to create versions for other operating systems and browsers in the future.

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http://www.arm.com/news/23776.html
ARM announces support for Open Handset Alliance
http://www.arm.com/news/23930.html
Adobe AIR 1.5 now available for Linux
http://www.adobe.com/aboutadobe/pressroom/pressreleases/200812/121808AdobeAIR1.5.html
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http://google-code-updates.blogspot.com/2008/12/native-client-technology-for-running.html
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http://arstechnica.com/news.ars/post/20081209-safer-than-activex-a-look-at-googles-native-client-plugin.html

HDTV home network via mains

Power line communication (PLC) networks have been launched a number of times for a variety of purposes. These networks overlay a data signal on the alternating current waveform of mains electricity, but are prone to electrical interference caused by appliances or hardware producing strong magnetic fields near power cables. Within a building, power line communication will only work across a unified mains network, which is why most short range (high frequency) systems are aimed at the domestic market.

The HomeGrid Forum is seeking to promote a new standard for delivering HD television and other signals using power line technology, which will also integrate existing coaxial or telephone cabling where available. The G.hn standard for 'next generation home networking' is being overseen by the ITU, with parts already agreed and a final specification expected later this year. It is hoped that systems based on the standard will deliver 400mbps over co-axial cables and 200mbps on power lines.

New standard promises HDTV over home networks
http://www.vnunet.com/vnunet/news/2232740/standard-promises-hdtv-home
HomeGrid Forum http://www.homegridforum.org

Graphics support for laptops and netbooks

Laptops and netbooks are often limited in their ability to display graphics. Key design considerations for laptops include weight, power drain on batteries and production of heat - graphics processing units (GPUs) tend to cause problems on all three counts. This will either mean that manufacturers will choose lower cost, lower power graphics processors integrated into the mother board's chip set, or they have to provide a more powerful (but heavier or more expensive) battery. Many educational applications use considerable graphics power to drive interactive multimedia, 3D, CAD and design applications.

In June 2008, AMD announced support for an external graphics processor via a PCIe 2.0 port supplied on some of its partner's notebook computers. Fujitsu Siemens has produced one such product, the AMILO Notebook Sa 3650 with AMILO GraphicBooster. The latter measures about 7.5 inches (18cm) in length, weighs just over a pound (0.5kg) and contains an ATI Mobility Radeon HD 3870 graphics card, which has 512MB of graphics memory and a range of graphics connectors. The laptop contains an integrated ATI Radeon HD 3200 chipset for normal use, but is complemented by the external graphics platform (XGP) when the user requires greater graphics processing power or connection to additional monitors. UK pricing is not yet available. The XGP unit also provides additional USB 2.0 connections.

In principle, other graphics card designers and notebook manufacturers could produce compatible systems, since the PCIe 2.0 bus is already a standard component in many designs. Some laptop computers that use NVIDIA's GeForce 9M Series GPUs can be switched between the onboard chipset and the separate internal graphics processor without powering down. (See Multimedia News in Nov 2008 TechNews.)

Quartics has developed a programmable media co-processor (MCP) to take some of the processing load away from the CPU and more basic GPUs. The MCP can power full 1080p HD decoding and playback, or support transcoding of multiple standard definition video streams. The company claims that this could bring full HD processing power to computers with processors that run as slowly as 800MHz, such as netbooks and low power laptops.

AMD announces revolutionary external graphics solution for notebooks
http://www.amd.com/us-en/Corporate/VirtualPressRoom/0,,51_104_543~126234,00.html
The dynamic duo from Fujitsu Siemens Computers
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AST co-founder seeks room inside the PC http://news.cnet.com/8301-13860_3-10093011-56.html
Quartics http://www.quartics.com

Pico projectors reach market

Many students can now capture images and video on mobile phones and store them on personal media players. The size of screen - often around 2.5 inches - is

inadequate for individuals to see the detail, let alone share with a group. Screens on netbook computers are also limited and not suited to class use.

Texas Instruments (TI) first introduced 'pocket projectors' based on its DLP technology in 2006. Digital Light Processing (DLP) chips are covered in an array of tiny mirrors that can be flipped to reflect coloured light sources through a lens system onto a screen. As the mirrors are built onto the chip, DLP systems can be extremely small, light-weight and bright (since the light does not have to pass through LCD screens).

TI's latest portable system is known as the Pico Projector. (See TechNews, March 2008.) Systems based on this technology can be smaller than a pack of cards and weigh around quarter of a pound (115g). Such projectors are available from companies including Dell and Optoma, with UK entry-level pricing ranging from £249 to £329. Specifications vary, so purchasers must consider resolution, image size, projection distance, brightness, weight, whether speakers are included and battery life and availability. The Dell M109S supports SVGA (858 x 600 pixels), projects up to 60 inches (150cm) at nearly 8 feet (240cm) but the output is only rated at 50 ANSI lumens. This suggests that users would rarely expect to get a reasonable image at the maximum size. The Optoma Pico Pocket projector uses an analogue composite video input, has a similar image size and is powered by internal, rechargeable batteries. Samsung is due to release a Pico Projector later this year.

Pocket projectors based on different technologies are available from other manufacturers. These include devices from Aiptek and 3M, both with slightly smaller stated maximum image sizes (50 inches), operating on rechargeable batteries and supporting VGA (640 x 480 pixels) and WXGA (1280 x 786 pixels) resolutions, respectively. Prices are in a similar range as the DLP-based systems.

Connectivity to some types of personal media player or mobile phone may require users to purchase product-specific cables.

Dell continues to deliver laptop innovations for digital nomads
http://www.dell.com/content/topics/global.aspx/corp/pressoffice/en/2008/2008_09_24_rr_001?c=us&l=en&s=corp
Optoma launches the UK's smallest Pico Projector
http://www.optoma.eu/uploads/press/21-11-2008_PR-P-en.pdf
Aiptek PocketCinema V10
http://www.aiptek.de/index.php?option=com_product&task=view&productid=175&Itemid=327
3M MPro110 http://www.3mmpro.com

Camera with built-in browser

Uploading images and video from a camera can be tricky as the user needs to find the correct lead and a PC which has the appropriate software installed. Direct upload to the internet should simplify this process.

Sony has launched a digital camera which has a cut-down, embedded web browser. The new Cyber-shot DSC-G3 uses Wi-Fi to communicate with websites like Flickr, Picasa or YouTube through a dedicated Sony Easy Upload Home Page, or directly through the browser. Users can connect via public as well as domestic Wi-Fi access points, although consumers may prefer to take pictures and share them using the camera provided on their mobile phone. The Sony camera is available in the US for around $500.

Sony unveils world's first Wi-Fi digital camera with web browser
http://news.sel.sony.com/en/press_room/consumer/digital_imaging/digital_cameras/cyber-shot/release/38265.html

Minoru 3D webcam

A low cost 3D webcam priced around £50 has been released in the UK. The system uses two offset webcams to create stereoscopic images and red/blue anaglyphic glasses to provide the correct image to each eye. (See '3D displays' analysis article in the November 2008 TechNews for details of how such systems work.)

The hardware, which comes with five sets of glasses, works with several common instant messaging platforms, for example Skype and Windows Live Messenger, as well as recording 3D video to disk or for upload to video-sharing services on the web. Of course, the person watching the video chat or recording also needs to wear anaglyphic glasses, but these cost under £1 each when bought in a pack of five. Good hardware can drive the system at up to 30 frames per second for a maximum resolution 800 x 600. When operating in 2D mode, the second lens can be used for 'picture-in-picture' close-ups of an object that you are discussing. The system works with Windows PCs but a Mac edition has not been released.

3D video can be used in design or science lessons to demonstrate properties of solid objects, in ICT or media studies as a basic example of the range of new '3D enabled' products coming to market or simply as a means to engage and enthuse learners. This type of 3D system does not give good colour reproduction.

Novo Minoru - the world's first 3D webcam
http://www.reghardware.co.uk/2008/12/30/review_webcam_3d_minoru
Minoru http://www.minoru3d.com

Foldable displays

The Industrial Technology Research Institute (ITRI) in Taiwan has previewed a conceptual mock-up for a foldable, 5-inch mobile phone screen. The screen flips open across the longest edge of the unit and then slides out from under the base to reveal the full area, although other arrangements are possible. The display is based on the same electrophoretic technology used for e-paper and many e-books. (A charge is applied across electrodes embedded in two parallel surfaces, causing charged particles to migrate through a dark-coloured liquid. When at the surface, these particles reflect incident light that would otherwise be absorbed in the liquid. An array of filters in the transparent upper plate can be used to create pixels for a coloured display.)

Samsung also demonstrated a 5-inch folding screen for mobile phones in November 2008, but based on OLED technology. (Organic light-emitting diode displays produce light when a voltage is applied across layers containing organic polymers. As they are based on organic materials, it is easier to make the display flexible. Unlike LCD devices, which need a backlight and an LCD layer to selectively block the transmission of light, OLEDs emit light, producing brighter, thinner displays.) Other manufacturers, including Philips and Sony, are working on foldable OLED displays.

Folding screen adds flexibility to smartphones
http://www.pcadvisor.co.uk/news/index.cfm?RSS&NewsID=107410
Samsung unfolds OLED phone
http://www.pcpro.co.uk/news/238986/samsung-unfolds-oled-phone.html

Erasable paper

Xerox is working with the Palo Alto Research Centre on producing erasable paper. The company's research suggests that the average worker in the US uses 10,000 sheets of copy paper per year, of which up to a third goes into waste the same day it is printed. No doubt the same will be true of many school computer suites and college offices! Apparently producing a sheet of copier paper uses the same energy as running a standard 60W light bulb for an hour.

The prototype system uses supplementary hardware attached to a standard laser printer equipped with an array of LEDs tuned to a specific frequency. The paper contains a chemical that reacts to that light (in a similar way to how photochromic sunglasses react to sunlight) to produce a monochrome image. The image can be read as normal, but fades after 16 to 24 hours.

Feeding the paper back through the printer erases any existing image, as the heat from the fuser unit hastens this return to the neutral state. Sunlight can degrade the paper more rapidly and Xerox is working on making the image more stable for longer. The erasable paper is coloured yellow to distinguish it from ordinary copier paper and can be recycled in the normal way once it has become too worn.

Experimental Xerox paper erases itself...
http://www.xerox.com/innovation/news-stories/erasable-paper/enus.html
The future of paper (video)
http://news.zdnet.co.uk/emergingtech/0,1000000183,39568098,00.htm

A touch from behind

An engineer at Microsoft Research is working to solve the problem of fingers obscuring the information on small form-factor touch-screen devices. The physical presence of the finger can make it difficult to interact with the information presented on a touch-screen phone, so Patrick Baudisch has put a touch sensitive surface on the rear of the device and made it display a translucent image of the user's fingers on the screen. This 'pseudo-transparent' LucidTouch technology, which supports multi-touch input, is easier to use and more accurate. It has been further scaled down to produce a prototype 2.4-inch 'nanoTouch' device.

Prototype goes 'see-through' with touch screen
http://news.cnet.com/8301-11386_3-10127840-76.html
LucidTouch http://research.microsoft.com/en-us/um/people/baudisch/projects/lucidtouch/index.html

New optical disk technology

The blue laser technology behind Sony's Blu-ray Disc format for HD video is being applied to audio CDs. Blue lasers use a shorter wavelength of light, allowing closer spacing of the reflective 'pits' and higher data densities, compared with the near infrared lasers on which CDs were based. In this case, use of the blue laser source and other improved manufacturing techniques provide greater precision in pit placement leading to improved audio quality, according to Sony. The resulting Blu-spec disks can be used on a standard CD player.

Sony to launch new Blu-spec CD format http://www.pcpro.co.uk/news/234462/sony-to-launch-new-bluspec-cd-format.html
Blu-spec CD (Wikipedia) http://en.wikipedia.org/wiki/Blu-spec_CD

Hardware

Analysis: Thin clients and desktop virtualisation

At a glance

- Thin client computing is based on 'presentation virtualisation' - display to the user and basic input/output are separated from the main processor.
- Basic thin clients are hardware devices that have sufficient processing power to control input/output and communicate with a server.
- In the thin client model, all application processing is carried out at the server with results transmitted to the client as screen updates.
- Fat clients, with local processing capability, can nevertheless be operated as thin clients, or deliver the same service through a browser.
- Thin client technologies can be used to provide remote desktops and could deliver similar functionality to small mobile devices, including smart phones.
- Thin clients have been proven to reduce total cost of ownership and improve user satisfaction when appropriately deployed.
- Software licenses can be more carefully controlled by allocating applications as required.

What do we mean by 'thin client'

The ‘thin client’ concept is by no means a new one - ever since terminals were attached to mainframes, the thin clients have been with us. Thin clients stand somewhere on a continuum between fully functional, standalone PCs to client-server installations that simply use a number of screens for controlling what is going on centrally. There is no fully agreed definition for the term.

Generally, a 'thin client' refers to a computing device that contains sufficient logic to receive and communicate user input with a server across a network and reproduce

the resultant display changes. A thin client is a hardware device that forms part of the virtualised computing model that creates user environments at the server and replicates them at remote locations.

Thin clients have been shown to save money through use of lower specification hardware, reduced power consumption, longer equipment life spans and reduced support costs. Thin clients were last covered in TechNews April 2006.

Thin client as hardware
Thin clients - which may also be called lean or slim - are contrasted with fat, thick, or rich clients. Primarily, they have a display, a network connection, basic input devices and some permanent memory (ROM, flash or very small hard drive) in which to store the bare minimum logic to communicate with the server. HP and Wyse are among the hardware vendors with product lines designed for thin client computing.

No application processing is carried out on a basic thin client; everything is done at the server and the results mirrored on the client device. This means that thin clients can have much lower power processors, reduced memory, simple graphics drivers, no requirement for a hard disk and no support for peripherals other than a keyboard, mouse and screen. Hardware is low cost and, with no need for moving parts, long life.

The downside to this model is that everything has to be communicated from the server to the client via a network; therefore rich graphics environments, audio and multimedia all require high bandwidth. The user may be constrained to a fixed interface with no access USB devices.

It is evident that a fat client could deliver all the functions of a thin client, so it is possible to have a mixed environment, in which some machines perform a wider range of tasks locally.

The hardware advantage
When using thin client devices, the main advantages include:

- simple, low cost hardware which has a longer lifespan
- opportunity to re-purpose older hardware as thin clients
- low power consumption
- reduced support costs, due to a simpler, more constrained environment
- greater centralised administration, with control over backup and security
- a simpler security model, with no need for a full virtual private network (VPN) for remote connections
- reduction in required bandwidth (as no files are transferred), unless multimedia is widely used
- rapid client booting, with some systems almost 'instant-on'
- availability of 'hot desktops', with appropriate software and usability settings for each user

- opportunity for remote and home working using the same desktop as in the office.

The cost of such systems, in terms of hardware, is largely in providing adequate reliable network bandwidth and sufficient processing power at the server.

Virtualisation - delivering software to thin clients
In order to function, the thin client must have some form of basic operating system, which is usually hidden from the user. In the past, this may have been a simple boot loader in ROM, but now often comprises some form of compact Linux distribution or Microsoft's Windows Embedded in flash memory.

In addition to controlling the local hardware, the embedded operating system hosts a set of protocols that communicate user input/output requirements with the server. Two of the main protocols are RDP (remote desktop protocol, championed by Microsoft) and Citrix's proprietary ICA (Independent Computing Architecture).

The server also needs to host the same protocols to communicate with the clients and deliver the appropriate desktop. Citrix, VMware and Microsoft are among the companies offering products designed to achieve this. There is also a Linux Terminal Server Project. The operating system on the server, embedded in the thin client and that the user's desktop is apparently running in can all be different.

It is also possible to host the complete desktop environment within a browser, using plug-ins (for example Microsoft ActiveX controls) to host RDP or ICA-based sessions.

The virtual desktop solution
Virtualisation is crucial to effective delivery of applications on thin clients. Presentation virtualisation, as it is referred to in this context, separates the input and display that the user experiences from the actual processing in a server located elsewhere. The server creates unique, robust, secure operating containers for each user, in which the target operating system, desktop environment and applications are assembled to fulfil the user's requirements. This experience could be connected via any fixed or mobile networked device, to the extent that Citrix has talked about an 'App Receiver' client running on Apple's iPhone hardware, although requirements of specific applications may limit use on smaller devices.

The virtualised desktop, because it is created and maintained on a central server, can readily be configured and controlled by system managers. This may optimise use of hardware, reduce support costs and ease application deployment and patching. Other advantages include controlling data loss (as stored data cannot be left on devices in a public place), direct software licence administration and greater safeguards against malware being inadvertently introduced by users.

Issues and solutions
The education environment creates particular challenges to the thin client computing model, due to the demanding nature of the software used and range of peripherals

connected to client computers. Research for Becta in 2007 identified these as two of the main issues facing schools deploying thin client systems. Multimedia requires constant screen refreshes, so processing graphics information at the server and communicating this to a thin client produces high levels of network traffic. Users moving between classrooms, or having requirements for access technology, often need to connect peripheral devices or software, such as whiteboards, cameras, flash drives, specialist input devices or screen readers, each of which needs to be installed. High bandwidth, local connectivity and some degree of configurability of the operating system image are required if such users are not to be restricted in their activities.

Vendors are working to reduce these bottlenecks by offloading tasks to local clients and modifying protocols. Developers, including HP and Wyse, have extended the ICA and RDP protocols with routines to handle multimedia, USB devices and multiple displays on their own systems. Nevertheless, some educational software may remain entirely incompatible with thin client systems.

Thin client in education

Thin clients can produce a more consistent, stable computing platform. This can be a real advantage for both teachers and learners who are put off by unpredictable ICT systems. Thin client solutions have the potential to deliver a full learning platform and all MIS applications throughout an establishment, as well as to the homes of learners and teachers. (However, some LA or sector requirements may limit delivery of management functions through thin client networks.) A pilot project, run by the AIMES Centre at Liverpool University, is using thin clients to deliver a full home desktop experience based on a wireless mesh network.

The Becta reports reveal that total cost of ownership (TCO) - including hardware, network infrastructure, applications, training, support and planned replacement - was nearly 40 per cent lower for secondary schools involved in the case studies, but slightly higher for the primaries. The latter finding may relate to additional training or the style of ICT deployment, since direct support costs were lower. All of the figures are based on small sample sizes, making it difficult to draw robust conclusions. None of the thin client systems, alone, fulfilled Becta's 'Functional specification for institutional infrastructure'. The summary report (pages 9 to 10) provides advice for schools considering implementing thin client solutions.

The future of thin client in education

Thin clients are unlikely to effectively deliver every ICT function of an educational establishment, but can be deployed in a 'mixed economy', to reduce costs and the complexity of the organisation's ICT infrastructure and to offer remote desktop access. Fat clients can often be configured to deliver an alternative thin client desktop or offer the same services through a browser.

Delivering applications through a browser may become increasingly common, as numbers of low cost netbooks and personal mobile devices grow. These applications may be driven entirely by the server, or through web applications - but in both

scenarios, less power is needed in the client device. It could be argued that computing will move towards a thin client paradigm.

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Hardware news

Processors update

AMD has launched its new 45nm quad-core ranges, with Opterons announced in November 2008 and Phenom II CPUs earlier this month. These new 'Shanghai' processors are based on the same architecture as the older 'Barcelona' chips, but the processor size has been reduced to enable greater component densities, faster speeds and more energy-efficient systems. AMD has embedded structures to support virtualisation, inter-core communication (using its Direct Connect Architecture) and power efficiency (through powering down unused components). New 65nm Neo chips for slimline notebook computers were also announced in January.

During 2009 and 2010 AMD will launch further 2- and 4-core designs based on its 45nm process. Opterons are aimed at the server market, but other packages will support desktops (such as processors with the 'Deneb' codename), notebooks ('Conesus') and ultra-portable notebooks ('Caspian'). These latter designs will compete with Intel's Atom, but AMD's Chief Executive, Dirk Meyer, told reporters, "first order, we're ignoring the netbook phenomenon, concentrating on PC notebooks

above that form factor". During 2011, AMD intends to bring in new 32nm technology and new 'Fusion' designs that integrate graphics with the main processor unit.

Freescale Semiconductor is among manufacturers developing netbook platforms based on 65nm ARM Cortex A8 technology. The company states that its reference design, which is pitched at under $200 with the Ubuntu Linux distribution, will deliver 8-hour battery life in hardware featuring an 8.9-inch screen.

Also in November last year, Intel officially launched its 45nm Core i7 processor family, based on its new 'Nehalem' architecture. (See 'IDF Update' news item in the September 2008 TechNews.) Intel has also announced that it is on track to begin production of 32nm-based processors at the end of this year. In Intel's terminology, the new Nehalem architecture was a 'tick' (a significant update to the design) and the 32nm technology will be a 'tock' (a change in the manufacturing process).

AMD announces... new quad-core AMD Opteron processor http://www.amd.com/us-en/Corporate/VirtualPressRoom/0,,51_104_543~129135,00.html
AMD releases the Dragon, desktop platform... http://www.amd.com/us-en/Corporate/VirtualPressRoom/0,,51_104_543_15944~129698,00.html
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AMD answers Atom with 'Conesus,' roadmap update
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Intel completes next generation, 32nm process development phase
http://www.intel.com/pressroom/archive/releases/20081209corp.htm

Educational notebook update

The vision of the One Laptop Per Child (OLPC) project was to create a laptop computer that would cost just $100 when produced in large volumes. The resulting XO laptop has been marketed to developing countries, with many showing interest, although recent figures suggest that only 600,000 machines have been sold at prices around $188. To boost availability, the OLPC project launched a 'Give One, Get One' scheme in the US in the run-up to Christmas 2007. In autumn 2008, OLPC signed a deal with Amazon to renew the scheme and broaden availability to Europe and other areas. The latest price quoted by Amazon in the UK was £275, with units now in stock. OLPC says that $35 million was effectively donated through the original scheme in the US.

In May 2008, Microsoft announced that it was developing a version of the Windows XP operating system to drive the XO PC, as an alternative to the original Linux distribution. A regional governor from Colombia supported that announcement and has now signed a deal to supply the machines to two schools in that province.

Intel and partner companies exhibited the latest 'convertible clamshell' Classmate designs at this month's Consumer Electronics Show - the screens are mounted so that they can swivel 180 degrees and fold back down as a touch tablet. A 'palm rejection' mode allows pupils to rest their hands on the surface without interfering with intended gestures made using a stylus or a fingernail. The company is encouraging its partners to promote integrated development of hardware, software and services, through the Intel Learning Series initiative.

CMS Computer Systems is amongst the UK distributors of Zoostorm's FizzBook PCs, based on Intel's reference designs. The company was present on Intel's stand at BETT demonstrating the new systems. UK prices vary from £275 to £299. NEC, who had a demonstration machine on their stand, plans to launch an Otomo branded Classmate netbook, loaded with their own management software, later in the year.

A consortium of UN agencies announced a new UNeLearn programme in December 2008. The UN press release states that

> 'The initiative, inspired by the UN "Delivering as One" concept, aims to maximize coherence and effectiveness among UN projects at the country-level as parts of efforts to implement the Millennium Development Goals (MDGs)... By agreeing to pool and share their collective training resources and shift towards technology supported learning, the initiative will help UN agencies eliminate duplicative activities, reduce costs, and reach a wider client base.'

Give a laptop, get a laptop - change the world
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European debut for '$100 laptop' http://news.bbc.co.uk/1/hi/technology/7728881.stm
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UN Launches E-Learning Initiative in Over 160 Developing Countries
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SoC processor extends netbook battery life

Qualcomm has developed a system-on-a-chip (SoC) Snapdragon processor package, to power netbooks, that they say will enable 24-hour battery life. SoC processors reduce power consumption and improve system speed, since communication distances and intermediate components (like cache) for buffering data can be reduced. The tight integration of SoC designs also save space and reduce heat flux.

Codenamed Alaska, the prototype unit (produced by Inventec) had a 1GHz ARM-based processor, an 8.9-inch screen and a 12 megapixel camera. A digital signal processing (DSP) chip provides Wi-Fi, Bluetooth and 720p HD video decoding. Samples of a 1.5GHz dual-core version, which will support full 1080p HD transcoding, will be made available later this year.

Versions of the Intel Atom are among other processors competing in SoC market.

Qualcomm shows off all-day netbook http://www.pcw.co.uk/personal-computer-world/news/2231889/qualcomm-shows-day-netbook
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UEFI-based motherboards come to market

The PC's BIOS (Basic Input/Output System) began life as a simple boot loader used to get a computer started, although it now serves to store all kinds of other information to manage system devices and provides system routines required as the computer boots up. The BIOS architecture is based on the early 16-bit, 'real mode' x86 instruction set (although more modern extensions have been incorporated) and has to be programmed using assembly language. Computers based on non-Intel architectures use different boot-loader systems.

UEFI is a development of Intel's Extensible Firmware Interface, a non-processor-specific set of routines to initialise the hardware and interface with the operating system's loader. The Unified EFI (UEFI) is managed by an industry forum set up in July 2005 to adapt the original EFI 1.10 to changing hardware requirements. The structure is modular, can be programmed in C and is extensible, so firmware authors can add component-specific routines for low level hardware drivers. These extensions can be stored in any non-volatile medium associated with the hardware device. UEFI systems will still need a simple, hardware-specific BIOS to perform the initial self-test and setup.

This architecture enables system developers to add boot-time applications that can run without needing a full operating system. This allows hardware manufacturers to provide a graphical interface with mouse support, advanced system diagnostics and even an internet browser, without performing a full system boot. In addition to low-level system services, this will allow users to quickly access media, email and web pages, and will reduce power consumed when using such applications.

Hardware and operating systems from a number of providers have supported Intel's original EFI for some years, but UEFI products are only just coming to market. Two examples are Insyde Software's firmware solutions designed to support embedded systems powered by Intel's Atom processor and MSI's latest P45 Platinum-based motherboards. The other companies involved in UEFI are American Megatrends, Phoenix Technologies, AMD, Apple, Dell, HP, Intel, Lenovo, IBM and Microsoft.

UEFI Forum http://www.uefi.org
Insyde Software touts UEFI BIOS for latest Intel Atom Processor N270
http://www.insydesw.com/press/2008/press_092508.htm
First MSI EFI BIOS available now!
http://www.msicomputer.co.uk/index.php?func=newsdesc&news_no=577

Mobile and micro power developments

Providing power for mobile devices remains a problem. Nearly every phone, camera and MP3 player uses rechargeable batteries, but most owners have experienced power failure as the charge is exhausted at a critical time. Chemical units that produce power from raw materials are properly called fuel cells. TechNews reviewed some of the up-coming technologies for this market in September 2008, with further updates in November. Other companies are involved in developments related to those mentioned below.

A Swedish company, myFC is developing flexible fuel cells based on hydrogen as the power source, although it is not clear how hydrogen will be supplied to the units. The 1636 Chip produces 0.5-0.75W and multiple units can be linked to produce more power, so four 1636 Chips can produce 3.2W at 2V. Due to their structure, the flexible, planar FuelCellStickers can be attached to moulded surfaces. The company has built a prototype recharger, called Excess Charger.

Researchers from University of Illinois have developed a low-power fuel cell that measures just 3mm square and 1mm thick. The flow of water vapour to the metal hydride (with which it reacts to produce hydrogen) is controlled by a membrane containing nano-scale holes. Back-pressure closes the holes, but as the hydrogen is consumed to make electricity, the membrane relaxes and permits more vapour into the reaction chamber. The fuel in the cell was able to produce a current of 0.1 milliamps at 0.7 volts for 30 hours.

Power Air is among the companies developing zinc-based fuel cells by commercialising a system first proposed by the Lawrence Livermore National Laboratory in the US. Zinc powder is suspended in an alkaline electrolyte gel; when exposed to air, the resulting chemical reaction produces electricity and stable waste products. Power Air claims that the ZPAC 40, which is provided with connectors for a range of mobile devices, produces the equivalent energy of 40 standard, alkaline AA batteries. The unit is activated by removing a seal and can be used all at once or over a period up to three months. Once the fuel has been depleted, consumers can post the pack back to the manufacturers for recycling. The ZPAC 40 will cost around $20, with exchange cartridges costing somewhat less. The advantages of zinc

include that it is abundant, has a high energy density, is easy to produce, not explosive and the resultant zinc oxide is readily recycled. The company's main commercial targets are backup and emergency power generation.

Another solution produces energy from movement. The principle is same as has been used for nearly two centuries in millions of generators worldwide - a wire coil moving in a magnetic field. One such new system, from M2E, has miniaturised and optimised the electronics sufficiently to create a charger, a little larger than a mobile phone, which could provide an extra 30 to 60 minutes of talk time from 6 hours of movement. Although the prototype is now a separate device, M2E believes that the technology could be embedded directly in mobile phones and other products within a couple of years. In addition to topping up batteries and saving fossil fuels, these chargers could prove useful in developing countries, where access to reliable power is severely limited.

Infinite Power Solutions' THINERGY micro-energy cells can be recharged through third-party, trickle-charging systems that employ a range of 'environmental' sources, including solar, thermal, RF, magnetic and vibration energy. These low-power cells are designed to sit on top of electrical components or to be built into circuit boards and housings. The THINERGY system is based on lithium battery technology, According to the manufacturers, who have recently completed commercial production facilities, the micro-energy cells have extremely low leakage rates, low cell resistance, an operating temperature range of -40C to +85C and high power output. The flexible, thin-film devices are aimed low power applications, including powered smart cards, wireless sensors, medical devices and consumer electronics.

One way to create power from small movements is to use piezoelectric-based devices - when a mechanical force is applied to certain types of crystal, a small burst of electrons is produced. Researchers at Texas A&M University have identified that barium titanate crystals measuring 23nm produce optimum power. Although at an early developmental stage, the team envisages the technology powering mobile phones that can be charged just through the vibrations caused by speech.

Intel researchers are exploring a number of systems to produce energy from body heat, sunlight, radio-frequency radiation and the action of mechanical elements (such as a track ball) embedded in a device. Initial research is targeting sensors that can be powered indefinitely to monitor environmental stress in buildings and for medical applications. Engineers from other companies, including Texas Instruments, are investigating similar technologies.

Bendable, ultra-thin fuel cells coming soon
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World's smallest fuel cell promises greener gadgets
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Wireless power

Electromagnetic induction is already used to charge devices like toothbrushes and shavers - instead of connecting a cable, the hardware is dropped into a docking unit that contains an induction coil, like in a standard transformer. When connected to the mains, the coil creates an alternating field that transfers power to a coil in the rechargeable device, which in turn charges its batteries.

One company in this field, Powermat, has embedded low voltage coils in a mat that is about the size of a sheet of A4 paper. A variety of MP3 players, phones and other hardware can be dropped into a cradle to be charged. Each cradle is specific to a set of devices to ensure the correct connection and rate of charge. Mats can charge up to 4 devices simultaneously and only provide power when an appropriate cradle is present. The company claims these mats will be safer for children, as well as more convenient, since there will be no need to keep plugging chargers into a wall socket. Mats will cost around $100 and cradles $30, with US availability from September. The company also has an 'international' product line and suggests that their technology could be used to synchronise data in future.

A number of consumer product manufacturers have joined together to form the Wireless Power Consortium, which aims to unify the market around a set of standards enabling interoperability. The standards will allow hardware to charge at the same rate as if it were cabled, will be compliant with electrical safety standards and will permit products to carry a logo that the consortium hopes will become widely recognised. The first standard will be for devices that charge using 5W or less.

Powermat joins wireless power charge
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Powermat launches line of wireless charging products at CES 2009
http://www.pwrmat.com/docs/PM_PRESS_%20RELEASE.pdf
Consortium aims for wireless battery-charging standard
http://www.technewsworld.com/rsstory/65555.html

First international Wireless Power Consortium pursues standard
http://www.wirelesspowerconsortium.com/news/press-releases/first-international-wireless-power-consortium-pursues-standard.html

SuperSpeed USB 3.0

The USB Implementers Forum (USB-IF) released the final specification for USB 3.0, to be known as SuperSpeed USB, in November 2008. Drivers and connectors for the new standard will be backward compatible with older USB 2.0 devices and transfer times will increase by a factor of ten, to a maximum 4.8gbps - a 25GB HD movie file could take 70 seconds rather than nearly 14 minutes to copy. The standard improves power consumption by enabling a sleep mode for devices, reducing polling and no longer broadcasting to all connected devices. Rechargeable hardware, such as cameras and MP3 players, will now be recognised even when their batteries are flat.

Controllers on PCs and other hardware are expected later this year and consumer products in 2010. An Intel spokesperson said that there were already six billion USB devices in the market and that the new protocols provided room to develop faster standards for optical communications channels, which could reach 25gbps.

USB 3.0 specification now available http://www.usb.org/press/USB-IF_Press_Releases/2008_11_17_USB_IF.pdf
Intel talks up joy of USB 3.0
http://www.techworld.com/news/index.cfm?RSS&NewsID=109179

Ethernet used to create virtual switched PCI Express configurations

PCIe 2.0 is the latest approved version of the Peripheral Component Interconnect Express standard, designed to connect devices to a PCs mother board. (An updated PCI 3.0 standard, that gives a maximum per 'lane' throughput of 1GB per second, rather than 500MB, is expected at the end of 2009.)

PC chipsets and I/O buses on servers have a limited number of PCI Express channels available, so hardware switches may be embedded to expand the number of connected PCIe devices. However, this only works with devices locally connected to the system, as PCIe manages communications across very short ranges.

NEC has created an industry consortium to oversee development of its ExpEther standard. The technology enables connection of PCIe devices over Ethernet networks. For example, this allows system managers to connect remote hard drives, make use of Fibre Channel connections from other units or aggregate CPUs in a virtual LAN (VLAN), as though they were present at the main processing unit. The management software permits 'hot-swapping' of connected devices by reassigning VLAN numbers. The potential maximum range for connections may be considerably over two kilometres.

ExpEther consortium launched by institutions supporting virtualization technology
http://www.nec.co.jp/press/en/0811/1202.html
ExpEther Consortium http://www.expether.org

NEC ExpEther boosts PCI Express up to 2km
http://www.pcadvisor.co.uk/news/index.cfm?RSS&NewsID=106965

SDXC memory card launched

Many mobile device use memory cards to store user data, such as music, pictures and video. Despite improvements to compression algorithms, recent imaging and recording technologies have increased the size of files stored, requiring larger memory cards. Such cards include SD, Compact Flash, Memory Stick, MMC and related formats.

The SD Association was formed in January 2000 and now oversees the SD (maximum 2GB storage) and SDHC (32GB) standards, each of which also comes in 'Mini' and 'Micro' variants. To these, the Association has announced the addition of SDXC (eXtended Capacity) cards that can store up to 2 terabytes of data - that represents 100 HD videos, tens of thousands of high quality pictures or more than 4,000 images in RAW format. The new specification will allow data transfers at 104MB per second, with plans to increase this to 300MB/s. Files are stored using Microsoft's exFAT file system, meaning that cards can be easily read by devices connected to Windows Vista (Service Pack 1) PCs and other computers with appropriate drivers.

SDXC signals new generation of removable memory with up to 2 terabytes of storage http://www.sdcard.org/press/SD_Association_Announces_SDXC_FINAL_1-6-2009.pdf

Cognitive computers to be built

The brain is a massively complex organ, so trying to create a computer that can 'think' in the same way is a challenging task, especially based on our limited understanding of how the brain functions at both the physical and information-processing levels. Nevertheless, a team based at IBM is seeking to achieve just that, a cognitive computer. The undertaking is not just esoteric research, but has been initiated in view of the rapid increase in information facing decision-makers. The end goal, as IBM describes it, is to produce:

> 'Ubiquitously deployed computers imbued with a new intelligence that can integrate information from a variety of sensors and sources, deal with ambiguity, respond in a context-dependent way, learn over time and carry out pattern recognition to solve difficult problems based on perception, action and cognition in complex, real-world environments.'

Initial research will focus on nano-scale devices that mimic synapses - biological structures that underpin information switching in the brain - and modelling the associated micro-circuitry. Previous research has simulated information processing functions equivalent to those found in the brain of a small mammal, although it used the processing power of IBM's BlueGene supercomputer to achieve this. A functioning cognitive computer could monitor data from a vast sensor network and other information flows, analyse it and produce responses based on loosely defined

objectives, such as maximising profit from stock transactions, setting objectives for military units in battle or controlling global water supply systems.

IBM seeks to build the computer of the future based on insights from the brain
http://www-03.ibm.com/press/us/en/pressrelease/26123.wss

Software and internet

Analysis: Web applications

At a glance

- Increasingly universal and reliable internet connections, combined with advances in browser technologies, make application delivery through the browser a practical reality for most users.
- Ajax, Flash, Silverlight and other technologies are providing a rich interactive experience that will benefit learners as well as other users.
- Reliance on internet connectivity can be mitigated using products like Gears and Adobe AIR.
- Users of mobile devices and those who rely on access software, such as screen readers, may receive limited or no content and functionality where these web technologies are deployed.

Introduction

Software running in a browser is becoming increasingly available from the web. A few years back functionality was limited, powering some imaginative educational content that made the best of the facilities available and many trivial Flash games. Recent software developments have allowed most browsers to run sophisticated email packages, capable word processors and other applications. The same technologies are behind modern interfaces for online banking, social networking and much more.

These technologies have been exploited by educational content producers for some time, for example in the BBC Bitesize revision sites. More powerful computers and the latest browsers can create a richer interface and a more interactive experience, giving users deeper understanding of a topic and better assessment feedback, as well as more powerful tools for learning.

Due to the way that these applications are accessed through a browser, there is real potential for 'anywhere, any time, any device' learning. However, browsers in mobile devices remain more limited in the technologies they support, beyond standard web pages written in HTML.

Browser technologies

Many web pages use script languages to control the browser interface and for functions like printing, launching new windows, navigating through pages and validating user input. Scripts are based on command languages written in plain text, embedded in normal HTML files, and are interpreted as they are processed by the

browser. One of the most common, JavaScript, was first developed by a Netscape programmer back in 1995. Although coded in a similar way to Sun Microsystems' Java language, there is no direct dependency between the two. Other script languages, based on the same underlying ECMAScript standard, include Microsoft's Jscript (used by Internet Explorer) and Adobe's ActionScript (embedded in more recent Flash applications).

The second key technology is XML (extensible markup language), which is governed by a W3C standard. Standard HTML is a 'markup language', in that text is marked up with tags that tell the browser what must be done to render it correctly on screen, but the number of tags used is pre-defined. Being extensible, XML can have any number of new tags added to perform specific functions, especially for interpreting strings of structured data. Browsers generally require some sort of 'template' (such as cascading style sheets) to display the results in a meaningful fashion.

Since 1996, browser developers have been adding programmable objects to permit background (or 'asynchronous') loading and processing of data. When combined with JavaScript, this collection of programming techniques is covered by the umbrella term Ajax (asynchronous JavaScript and XML).

Extending browser functionality

Ajax provides significant functionality for controlling the browser and manipulating data. However, developers also need to interact with the file system, produce custom graphics and display video streams. This can be done with plug-ins (such as ActiveX controls in Internet Explorer) and embedded applications. The latter are separate modules that run within the browser but are not under its direct control. Common development platforms for embedded applications include the Java language from Sun Microsystems and Adobe Flash, both of which require plug-ins to be able to operate in a browser.

Adobe Flash is an authoring tool that creates .swf (Shockwave Flash) files. Early versions produced simple animations and basic interactivity using a timeline, but subsequent editions have greatly enhanced its capabilities, so that applications can now play Flash Video (.flv) files, stream media of all kinds and render 3D objects. Users must first download the appropriate Flash Player for their system to view Flash content.

Adobe has developed its own set of asynchronous Flash and XML techniques which have now been formalised into Adobe Flex. Adobe is working on Flash Lite for mobile phones and other small internet enabled devices.

Microsoft released Silverlight in the autumn of 2007, with support for its .NET programming environment, as its answer to developer demands for browser-based interactivity. At the release of version 2 in October last year, Microsoft claimed that Silverlight had been installed on PCs accessible to a quarter of all consumers, although there is a long way to go to match the near-universal availability of Flash Player. Silverlight is also available for a number Linux distributions through the new open source Moonlight project, supported by Novell and Microsoft.

Many of these technologies have compatibility issues with particular operating systems and browsers, especially on mobile devices, including phones and games platforms.

Open Screen Project
Adobe has launched an Open Screen Project with one overriding aim, to, 'enable consumers to engage with rich Internet experiences seamlessly across any device, anywhere'. If successful, it will make Flash and AIR available on a wide range of devices from mid-range mobile phones upwards. (AIR is the Adobe Integrated Runtime platform.) One plank in Adobe's strategy has been to announce a technology partnership with ARM to enable native Flash Player 10 and AIR content to work on devices powered by ARM processors later in 2009.

Microsoft has announced that Silverlight 2 will work on the Windows Mobile 6 and Symbian Series 60 platforms.

Gears
Google has accounted for the requirement for always-on internet access by releasing Gears, which is now an open source project, allowing offline access to certain applications through the browser. Gears has functions that enable parallel execution of JavaScript, support access to offline databases and provide basic geolocation. Gears is used extensively within the Google Docs and Google Reader, and supports aspects of Zoho, MySpace and recent versions of WordPress.

Adobe AIR takes a different approach by running applications, written using Flash, Flex, Ajax or HTML, outside the browser. This allows greater access to operating system resources, although applications need to be installed by the user.

In December 2008 Sun announced JavaFX, a new development environment with integrated video support for a range of hardware, which will include mobile devices and TV set-top boxes, to produce applications that will also work outside the browser.

Example applications
Web users daily access sites that have web applications built in, such as browser-based email, blogs and e-commerce, without realising the revolution that has gone on 'under the bonnet'. Many teachers use YouTube, TeacherTube and similar video sharing in their lessons. All of these have backend databases to store and retrieve information and use Ajax or Flash Player to deliver content to the user.

Many readers may immediately think of online contact and office application suites, such as Zoho, Yahoo's Zimbra, Thinkfree or Google Docs, but editing facilities and much of the interface for photo sharing sites like Photoshop.com and Flickr are driven using Flash and Ajax techniques. Adobe has developed an online word processor called Buzzword, while Microsoft has announced that 'lightweight' versions of its key office applications will be online in the near future. A number of developers

are producing online equivalents of the user's desktop, but Xcerion's beta iCloud suite is powered by its own XML-based XIOS operating system.

Issues
One of the key issues for education is accessibility to content provided through web applications for users with various types of disability. In particular, screen readers for the visually impaired cannot easily locate and describe content in Flash files and other applications, as these readers normally rely on HTML and related content contained in plain text files. Search 'bots' are equally hampered in indexing such content, unless they have been given accessible metadata information that they can read.

Web applications are not supported by all browsers: most recent versions of Internet Explorer, Firefox, Safari and Opera support many of the technologies described, although the new Google Chrome browser, Linux-based products, many mobile platforms and set-top boxes have 'lite' versions or no support at all. Well-written web applications will detect the absence of required technologies and allow the interface and functionality to 'degrade gracefully' according to available resources.

To operate, unless either Gears or AIR is available, the device must have an active internet connection. While this may be true of most desktop devices, it creates problems for mobile users who need some form of reliable and inexpensive wireless link. As more applications and content move into the 'cloud', this will put greater pressure on bandwidth for both fixed and mobile infrastructures, and introduce a new range of security issues.

Conclusion
The technologies underpinning web applications are maturing and becoming more stable. In conjunction with more reliable and universal internet connections - even on mobile devices - it is possible for users to run most common applications within a browser, although some sacrifice in functionality will have to be made. Among other users, learners should find a growing range of rich, interactive content available through a browser on many types of device, allowing a large measure of 'anywhere, any time, any device' learning to take place.

Access to the full range of web applications and functionality is likely to be constrained for some years on smaller form-factor devices by a lack of generally accepted standards and the size of the screen. There is a significant danger that learners with disabilities will be disadvantaged by these advances as accessible technology struggles to catch up with developments in the wider market.

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http://www.ecma-international.org/publications/standards/Ecma-262.htm
Extensible Markup Language (XML) http://www.w3.org/XML
Sun Java http://java.sun.com
Java downloads http://www.java.com/en/download/manual.jsp

Adobe Flash http://www.adobe.com/products/flash
Adobe Flash Player http://www.adobe.com/products/flashplayer
Adobe Flex 3 http://www.adobe.com/products/flex
Adobe Flash Lite http://www.adobe.com/products/flashlite
Microsoft Silverlight http://www.microsoft.com/silverlight
Microsoft releases Silverlight 2...
http://www.microsoft.com/presspass/press/2008/oct08/10-13Silverlight2PR.mspx?rss_fdn=Press%20Releases
Moonlight http://www.mono-project.com/Moonlight
Open Screen Project http://www.openscreenproject.org
Adobe AIR http://www.adobe.com/products/air
Adobe and ARM Accelerate Flash and AIR for ARM Platforms
http://www.adobe.com/aboutadobe/pressroom/pressreleases/200811/111708ARMAdobeFlash.html
Gears http://gears.google.com
JavaFX http://www.javafx.com
YouTube www.youtube.com
TeacherTube http://www.teachertube.com
Zoho http://www.zoho.com
Zimbra http://www.zimbra.com
Thinkfree http://www.thinkfree.com
Google Docs http://docs.google.com
Photoshop.com https://www.photoshop.com
Flickr http://www.flickr.com
Adobe Buzzword http://www.adobe.com/acom/buzzword
Microsoft to extend Office to the browser
http://www.microsoft.com/Presspass/Features/2008/oct08/10-28PDCOffice.mspx
icloud http://xcerion.com/internet-os

Software and internet news

Collaborating in the browser

Blue Spruce is an IBM project designed to enhance collaboration through the browser. Users interact (as far as the client is concerned) on the same web page, reference to which is maintained and updated through the central Blue Spruce server. (Each user actually runs their own browser session while the server coordinates and mirrors the events in each.) The participants can open a web page, call up data or comment on the display while everyone else sees the results. This could have implications for distance learning as well as collaborative project work in educational settings.

The current prototype software is based around Apple's Safari software, but any browser that supports HTML 5 could, in principle, be used. (HTML 5 is the new version of the internet's key markup language that describes the content of pages. One of the main developments in HTML 5, which is currently in draft, is native support for streaming audio and video.) Ports to Internet Explorer and Firefox are expected soon, using plug-ins for HTML 5 support and other services. The research project team is hoping to test the software with six companies later in the year.

Sharing the browser http://www.technologyreview.com/web/21718
Walking the talk - Web as a platform
http://www.ibm.com/developerworks/blogs/page/web20work?entry=walking_the_talk_web_as

Search developments

Yahoo's new Glue service draws together information on a given topic, event or person on a single page. Searching for 'Barack Obama' produces a page of news, images, YouTube videos and results from How Stuff Works and Yahoo's Answers. Searching for 'Battle of Britain' adds in the start of the relevant Wikipedia entry, while 'Madonna' produces a list of the pop star's albums from LastFM. This beta service has pages on a limited number of popular topics.

Google has launched a voice-powered Mobile App for the iPhone, as the first iteration of an application that should extend to other devices. Once the application has been called up, the user speaks the desired search terms, which a Google server converts using a voice-to-text engine. Text input can be used to amend or supplement search terms, which may assist British speakers, as the current version of the software works best with US accents. The software also uses Google's My Location feature to return results, such as restaurants, in the immediate neighbourhood of the user.

Gluing together the best content on the web
http://ysearchblog.com/2008/11/19/gluing-together-the-best-content-on-the-web
Yahoo Glue http://glue.yahoo.com
Google Mobile App for iPhone now with Voice Search and My Location
http://googlemobile.blogspot.com/2008/11/google-mobile-app-for-iphone-now-with.html
Google Voice Search: worthy of the iPhone's bottom row
http://www.technewsworld.com/rsstory/65202.html

Video traffic dominating rapidly

Further to the Cisco report mentioned in the Wireless and Networking news section above ('IP traffic forecast'), Gartner predicts that video will take an increased share of the internet content accessed by users in the workplace, rising to over a quarter by 2013. The trend in education establishments is likely to be far higher, as staff and students make increasing use of video resources. This will have implications on bandwidth and the degree to which popular content is cached at the 'edge' of the institution's intranet.

Internet search analysts ComScore says that a quarter of searches performed through Google in the US are on its YouTube video site. If it were a completely separate entity, this would make it the second ranked search engine in the US. Google's share of the search market continues to rise in the States.

Mobile video services provider QuickPlay Media reports that both aggregate and average downloads per client using its solutions had increased substantially in the

last quarter. The mean duration of a single mobile video stream was a little under three minutes.

Video will dominate content by 2013 http://www.itpro.co.uk/609132/video-will-dominate-content-by-2013
ComScore: YouTube now 25 percent of all Google searches http://www.techcrunch.com/2008/12/18/comscore-youtube-now-25-percent-of-all-google-searches
Mobile video viewing on the rise http://www.wirelessweek.com//Mobile-Video-Viewing-Rise.aspx

Browser virtualisation

Security firm Symantec is researching a browser virtualisation technology known as Vibes. (This is similar, in principle, to desktop and application virtualisation. See 'Thin clients and desktop virtualisation' analysis piece in this edition.)

The browser has become one of the most common routes through which malware, such as viruses, worms and trojans, enter an organisation. The browser environment can be run in 'trusted', 'user' and 'playground' modes. The software automatically switches to 'trusted' mode when a secure connection is made, for example to a bank, and uses 'playground' mode when downloaded files that might contain malware are executed. The Vibes prototype is based on VMware and Linux. Symantec has no public plans for commercialising the technology in this configuration.

Symantec also has a public trial of GoEverywhere, a website that centralises web applications. A single password gives access to all the applications a user selects, (presumably services that they have signed up for directly) within a single desktop environment, which will work in the browser on any type of compatible hardware. The beta service will not permit editing or saving. Potential applications include online office productivity suites, email, social networks and photo and video sharing sites.

Symantec turns to virtualisation, cloud computing http://news.zdnet.co.uk/security/0,1000000189,39591966,00.htm
GoEverywhere http://www.goeverywhere.com
YouTube video http://uk.youtube.com/watch?v=g1hY47le1SI

Identifying content, IPR and piracy

A researcher at the University of Toronto has developed a system called Tiny Videos that compresses and can then search video information. In addition to identifying copyright content embedded in larger files, it can be used to identify segments relating to specific events or similar themes. This could enable video search tools to automatically tag and return suggested clips based on content, rather than any tags that the person uploading the file may (or may not) have added.

Digital rights management (DRM) seeks to prevent users from copying digital content like music and films. DRM has proven unpopular with users, especially when it prevents backup of the original file or transfer to a second personally owned

device, and flaws in many of the systems have been exploited by people involved in file sharing. Watermarking can insert hidden information in a file which can be 'exposed' using the relevant algorithm. However, such information is degraded when digital media are compressed, as most compression systems are 'lossy'. (In other words, some minor areas of detail are omitted in order to improve compression ratios.) ECRYPT, an EU-funded project, has been studying methods to improve such watermarks and to secure them against attacks.

The same project also studied perceptual hashing. Hashes - numerical codes related to the content of a set of data - are frequently used to validate data transfers to ensure integrity of the information transmitted. However, algorithms designed to reflect the visual or auditory content of media files can also be used to index similar content and to track copyright infringements.

JISC, the Joint Information Systems Committee managed by representatives of further and higher education, has created an animation to help teachers and lecturers identify the risks of using media, which may be copyrighted, within blogs, podcasts and mashups. The Web2Rights site provides an online diagnostic tool to assist professionals in this regard.

New system can improve video-sharing web sites like YouTube
http://www.physorg.com/news147959509.html
Robust watermarking offers hope against digital piracy
http://www.physorg.com/news147701945.html
Web2Rights http://www.web2rights.org.uk

The true cost of email

Forrester Research has been analysing the costs for different types of email delivery. The report (which must be purchased) contains a spreadsheet tool for calculating service and support costs. The latter include adding or amending users, setting mailbox limits and backing up.

Enterprise systems managers were mostly unaware of the true costs of hosting their own email, giving estimates generally ranging from $2 to $11 - Forrester's research suggests a true monthly cost averaging $25.18 per user. In comparison, they found that Google's hosted email service cost $8.47, making an in-house solution uneconomical for most companies or divisions with less than 15,000 people

A growing proportion of the cost related to dealing with malware and other 'mal-mail'. Rising costs, or other reasons to re-examine provision, were causing the large majority of those surveyed to consider new approaches to email delivery, including fully cloud-based or hybrid solutions.

A range of factors can considerably affect the equation, such as legal requirements in some organisations to archive certain streams of email. Nevertheless, these figures could be used by educational establishments as part of the justification to moving to a wholly outsourced service, so long as their internet connection was deemed sufficiently reliable.

Report: Gmail about one-third as expensive as hosted e-mail
http://arstechnica.com/news.ars/post/20090108-report-gmail-about-one-third-as-expensive-as-hosted-e-mail.html
Should your email live in the cloud? A comparative cost analysis
http://www.forrester.com/Research/Document/Excerpt/0,7211,46302,00.html

Semantic developments

Language Technology for eLearning (LT4eL) aims to improve discovery of learning objects in large e-learning repositories - a 'keyword extractor' first analyses each document in the learning management system and uses the results to generate relevant tags. To minimise ambiguity, the system assigns definitions to each key word based on the contexts in which it is found. These definitions are automatically placed in a hierarchy of meaning, so related terms appear together. The system relates terms from eight European languages. LT4eL is based on open source tools and is due to be redeveloped (to provide a more user-friendly interface) as LTfLL (Language Technology for Lifelong Learning).

Effective research relies on coordinated flows of related information, which become more complex as teams become larger and spread across several institutions in different countries. Computer systems may impose their own definitions on the data they contain, limiting the interoperability of such applications and the free flow of data. OpenKnowledge defines how disparate researchers will interact and the information that should flow between them, using the Lightweight Coordination Calculus (LCC) language. Researchers develop interaction models, publicising their requirements to others, using the OpenKnowledge system. To aid cross-communication between researchers or component applications, the system will discover existing ontologies - dictionaries of meaning that set a term within a given context - and can develop its own where these are lacking. Due to research data residing in numerous internet-based repositories and the way that definitions can be built from users' interactions, the system uses a variety of techniques to assign higher levels of authority to trusted users. OpenKnowledge is an open source project that used funding from the EU.

Online tools help students search for meaning
http://www.physorg.com/news145632802.html
Unlocking the dynamic web http://www.physorg.com/news149345949.html
OpenKnowledge http://www.openk.org

Web accessibility

The basic standards that underpin content on the internet are held by the World Wide Web Consortium (W3C). Version 2 of the Web Content Accessibility Guidelines (WCAG) was released in December 2008, based on modifications resulting from user feedback and the experience of developers. According to the W3C press release:

'WCAG 2.0 explains how to make content:

- Perceivable (for instance by addressing text alternatives for images, captions for audio, adaptability of presentation, and colour contrast);
- Operable (by addressing keyboard access, colour contrast, timing of input, seizure avoidance, and navigability);
- Understandable (by addressing readability, predictability, and input assistance); and
- Robust (for instance by addressing compatibility with assistive technologies).'

W3C has published a range of materials to enable designers to understand and implement the guidelines, and to update existing sites.

The British Standards Institute (BSI) has published a draft standard (BS 8878) relating to the process of making websites accessible.

The next release of Microsoft's Internet Explorer browser, IE8, will have better support for disabled users, according to the company's official blog. A function key can be used to enable caret browsing - a cursor appears in the text to make it easier to select and copy text, and to navigate around the page using the keyboard or alternative devices. Other standard features of the new browser have similarly been made accessible to people who prefer not to use the mouse. For users with visual impairment, IE8's zoom function will actively redraw the page to fit the browser window and, to produce smoother text and images, use more pixels (where possible) to display rescaled objects. Microsoft has also implemented a range of application calls to enable developers to comply with the standards embedded in the new W3C guidelines. A final beta version of IE8 is expected to be released to developers soon, before a public launch later this year.

W3C web standard defines accessibility for next generation web
http://www.w3.org/2008/12/wcag20-pressrelease
New guidelines boost web access
http://news.bbc.co.uk/1/hi/technology/7789622.stm
BS 8878 http://www.bsi-global.com/en/Shop/Publication-Detail/?pid=000000000030180387
New Accessibility Features in IE8 http://blogs.msdn.com/ie/archive/2008/12/10/new-accessibility-features-in-ie8.aspx

Accessible interfaces

A researcher from the University of Portsmouth has developed a system that reacts to the bio-potentials - thoughts, eye movements and muscle responses - of extremely brain-damaged people. A small number of targets are presented on the computer's screen that have responses like 'yes' and 'no', links to favourite web pages or which control a switch to another device. The actions of these targets can be configured to suit the needs of each user. Sensors are mounted on a headband to pick up very small movements that the computer then interprets to control the cursor. Training a user to operate the system may takes months of patient trial and

error, but can create a real outlet for people who would otherwise be entirely 'locked in'.

A Google researcher, T V Raman, is working on a system to make touch screen phones - specifically those powered by Google's Android operating system - work for people who, like himself, are blind. The first point touched on the screen is interpreted as representing the number 5; relative finger movements towards the other positions on which numbers would sit on a dial pad are interpreted as a selection of that number. The digits are read out as they are selected and a simple shake of the phone (which must contain an accelerometer) can be used to erase mistakes. The New York Times quotes him as asking, “How should something work when the user is not looking at the screen?” This approach is not just relevant to the blind, but to users (such as drivers) who should be looking elsewhere as they use a device.

Mr Raman is also investigating how image recognition could be used to read out street signs (the text of which could be translated when navigating in a foreign country) and a range of other technologies around screen readers and accessible web technologies.

Computer that reacts to thought a lifeline for brain injured
http://www.port.ac.uk/aboutus/newsandevents/news/title,88611,en.html
Google works on Android for the blind
http://www.vnunet.com/vnunet/news/2233292/google-works-android-blind
For the blind, technology does what a guide dog can’t
http://www.nytimes.com/2009/01/04/business/04blind.html

Becta announcements: Next Generation Learning Charter and Home Access suppliers

Becta announced the Next Generation Learning Charter at this year's BETT exhibition. Complementing the existing Next Generation Learning campaign to get parents involved with technology in their children's school, the Charter encourages schools to take positive steps towards embedding technology throughout their education and management processes.

The Next Generation Learning Charter is largely based on the schools' Self-review Framework. The four stages are: commitment, recognition, accreditation and excellence.

All schools that sign up to the Self-review Framework will be able to use the 'Committed to ICT' logo, while those that complete three sections (including Leadership and Management) will be able to publicise the fact that they have been 'Recognised for ICT'. Schools already using the Framework will be emailed details of their 'commitment', while those who are ready to have their work to date 'recognised' will need to be supported by an appropriate professional who knows the school.

The Becta press release states that:

'By signing up to the Next Generation Learning Charter schools will be saying that over the next three years they will:

- develop a shared vision for the use of technology
- plan the use of ICT across the curriculum
- use technology to enhance learning and support
- assess how technology is supporting their pupils' learning
- ensure all staff and learners can use technology effectively and safely
- use technology to extend learning beyond the school
- make sure they have safe, secure and sustainable resources
- use technology to help learners progress and achieve.'

The two higher 'stages' in the Charter will be covered by the existing ICT Mark accreditation and ICT Excellence Awards scheme.

Becta launches new technology charter to help schools join the digital revolution
http://news.becta.org.uk/display.cfm?resID=39101&page=1658&catID=1633
Next Generation Learning Charter
http://www.becta.org.uk/nextgenerationlearningcharter
Self-review Framework http://schools.becta.org.uk/index.php?section=srf

Becta also announced the five approved suppliers who will provide 'Next Generation Learning @ Home packages' for the pilot phase of the Home Access programme. Details of this scheme were covered in the November 2008 edition of TechNews.

Home access brought a step closer with announcement of approved suppliers
http://news.becta.org.uk/display.cfm?resID=39103&page=1658&catID=1633
Home Access http://becta.org.uk/homeaccess

TechNews Information

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