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Networking and wireless

Analysis: Wireless mesh networks

At a glance

- Mesh networks are formed from webs of peer nodes that are self-configuring, using protocols that 'self-heal' the network if nodes or links are unavailable.
- Wi-Fi mesh networks were launched for many cities but experienced technical and commercial issues.
- Mesh networks are quick to set up, suiting them to network extension, military and temporary applications. They can connect otherwise 'hard to reach' places.
- A draft 802.11s standard has been produced for Wi-Fi enabled devices; other systems (such as ZigBee and WirelessHART) are being built on top of the 802.15.4 low power WPAN standard.
- Sense and control networks can benefit because substantial cabling requirements are removed and power saving measures implemented.
- The OLPC's XO laptop uses a mesh protocol to share internet connections and promote collaborative learning.

Making a mesh

Mesh networks are built from communications nodes joined to each other in a web structure; each node acts as a router, passing messages on to linked peers until the final destination is reached, frequently using multiple 'hops' to get there. The network allows additional nodes to be integrated automatically and finds alternative routes to transmit a message when a node or route goes down. The One Laptop Per Child (OLPC) project website has a helpful interactive demonstration (see [left of the page](#)) that illustrates these principles.

The fundamental structure of the internet is a mesh, in that data packets have to travel across many links, some of which may be congested or unavailable, forcing routers to find alternative pathways. However, the internet is strongly hierarchical, with specific devices taking on key functions in its underlying structure. Wireless mesh networks rely on peers - devices having equal capabilities - that take on different roles according to demand.

Wireless mesh networks have the following advantages compared with infrastructure (wired) networks:

- Flexibility due to self-configuration - nodes can be quickly added in, moved or removed
- Rapid, low cost deployment - without wires, there is no need to lay cables, making it easy to expand the network to reach poorly served or difficult areas
- Temporary networks can easily be configured and later taken down
- Self-healing - protocols automatically update routing tables if problems are detected
- Local traffic can travel more efficiently - communications can take the most direct route to their destination without passing through a central router

- Larger networks can be more efficient, as there are more alternative paths for any given transmission
- Mobile nodes can easily be integrated.

Mesh networks also have disadvantages:

- Complex routing tables must be maintained, or large numbers of 'path-finding' packets sent, creating a substantial processing or network overheads on large networks
- Communications can become slow on large networks involving many hops,, or where there is substantial interaction with external networks (wired local area networks or the internet)
- Nodes 'nearest' to external gateways may become overloaded
- Self configuration creates additional security risks compared with infrastructure networks
- Nodes can be 'hidden' - B can communicate to A and C, while A and C may be totally unaware of each other's existence and try to talk to B simultaneously
- Sleeping or mobile nodes create overheads, as the network must adjust to create new paths
- Packets destined for sleeping nodes must be held until the node is available
- The wireless channels used may clash with other services on similar frequencies.

Mesh networks consisting of mobile nodes may also be termed 'mobile ad hoc networks' (MANETs), although the addition of enhanced security and formal routing protocols may not justify the 'ad hoc' implications.

Wi-Fi mesh networks

A number of cities globally put substantial investment into 'municipal Wi-Fi' mesh networks around 2006-07 - access points were mounted on buildings and lampposts, with internet connection ('backhaul') only physically connected to selected nodes. The more ambitious schemes aimed to provide internet access to mobile workers and households, but roll-outs were not as successful as predicted - twice the density of nodes was often needed compared to predictions, signal strength within buildings was poor and the number of mobile Wi-Fi devices was much smaller than today.

The [Oklahoma](#) police and emergency services network [has been judged](#) one of the more successful projects, not least because it does not provide public access, whilst the Cloud's partnership with the [City of London Corporation](#) remains publicly available as a paid-for service in the UK. Solar-powered mesh access points are being investigated in places like [Brazil](#) (reported in [TechNews 11/08](#)) and other developing countries. Mesh networks have been deployed for events, such as the annual Islamic [Haji pilgrimage](#) to Mecca.

Companies involved in developing Wi-Fi mesh networks and related products include: [BelAir](#) (who serve a wide range of sectors); [Cisco](#) (with an emphasis on

larger enterprises), [Firetide](#) (who specialise in video and surveillance); [Meraki](#) (providing [outdoor](#) as well as indoor access); [Mesh Dynamics](#) (with a focus on military and mining environments); [Ruckus](#) (also offering outdoor solutions); and [Tropos](#) (used in Oklahoma).

Solution providers have adapted standard Wi-Fi protocols (802.11a/b/g/n), or added management layers on top, to create mesh networks. A new [802.11s](#) standard is being developed by the IEEE to create greater interoperability between the various mesh-networking products. The draft standard supports a hybrid wireless mesh protocol (HWMP) that combines proactive routing (whereby mesh 'stations' construct routing tables for proven links) and reactive routing. The latter involves broadcast of a route request (RREQ) that travels from node to node until the intended destination responds with a route reply (RREP), which is passed back to the originator by following a 'reverse routing' algorithm. Nodes will try to transmit on the fastest, 'least cost' route available, but must be able to seek out alternatives when intermediate nodes are unavailable or links congested.

The draft 802.11s standard supports broadcast and multicast, is compatible with access points and clients using existing Wi-Fi standards and features power-saving elements. The IEEE working group hopes to publish a final standard in late 2010 or early 2011.

Recent products have incorporated two or more radios to ease congestion created by providing internet backhaul and network management capability. In some mesh architectures, IP addresses are allocated to devices within virtual network containers, rather than the address space of the linked infrastructure network. This makes handover simpler and gives better control over security and available services.

Low power mesh networks

Low power mesh networks - used to connect sensors, controllers and other automation devices - are generally based on the IEEE's 802.15.4-2006 standard. This does not explicitly cover mesh networks, so further layers are added by [ZigBee](#), [WirelessHART](#) and other technologies. 802.15.4 was intended to govern small wireless 'personal' area networks (WPANs), with a diameter of 10m and transmission rates of 250kbps, on 2.4GHz and other frequencies (depending on location). The standard supports guaranteed time slots, secure communications, collision avoidance protocols and basic peer-to-peer connectivity.

Due to use of the 2.4GHz band, which is used by most Wi-Fi devices, many networks built on 802.15.4 employ channel hopping to avoid interference and will note channels that are already in use. WirelessHART maintains redundant paths, while use of time slots avoids collisions and possible multipath effects.

Product developers in this sector include [Arch Rock](#) (which uses an enhanced form of ZigBee), Dust Networks (based on WirelessHART) and Nivis (providing for WirelessHART and a new [ISA100](#) standard).

Mesh networks in hard to reach situations

Mesh networks have been proposed as a way to deliver communications in rural areas, places where it is difficult to create or maintain a fixed infrastructure, in disaster zones and military theatres of operation. [Rajant](#) has a backpack [system](#) that combines radiation sensors with a wireless mesh structure to support soldiers investigating nuclear hotspots.

[TerraNet](#) has been seeking to [develop](#) a mesh mobile phone architecture. Specially adapted mobile phones (or computers with appropriate hardware) can call each other; where the recipient is out of range (1km), the call can hop up to seven times to reach the destination device. Although the system was demonstrated in Ecuador, there is no immediate sign of a commercial product.

Mesh networks have also been proposed for extending broadband in developing countries. A satellite downlink (such as O3b Networks - see [TechNews 05/09](#)) would act as a hub and then clusters of WiMAX linked devices could be daisy-chained to the satellite backhaul.

Mesh networks in education

The OLPC's XO laptop already uses a [version](#) of the draft 802.11s protocol. In addition to providing connectivity in schools where infrastructure is poor (or non-existent), the XO is intended to promote pupil collaboration substantially beyond data sharing, so mesh networking is fundamental to its design. The laptop has dual antennae to maximise bandwidth and alternative paths, and (unlike 802.11s) supports asymmetric communication, where a different channel may be used in each direction. (Just because an XO can receive transmissions on one channel, local interference may prevent it successfully returning data on the same channel.)

Mesh networks can be used in any establishment to rapidly extend an existing network, whether into a separate building, out onto the sports field or just for a one-off event. They may also be suitable in buildings where deploying an infrastructure network would be challenging or where historic building status restricts physical cabling.

A meshy future?

Mesh networks fulfil specific requirements, but are not suited to every situation due to bandwidth demands or the additional costs of hardware. Although there have been moves towards standardising mesh protocols, no single specification looks as if it will dominate; 802.11s is likely to be the basis of more proprietary Wi-Fi based developments.

Deployments in urban areas seemed attractive, as limited infrastructure development would be required, but the outcomes have often been disappointing. Many more people are now using Wi-Fi enabled phones and laptops, but improvements in 3G availability, introduction of faster 'pre-4G' services and relatively inexpensive data plans may continue to limit the viability of Wi-Fi networks. Mesh topologies look attractive for temporary installations and providing access in all kinds of 'hard to reach' situations.

Mesh networking is increasingly important in sensing and control systems, especially where large sensor networks have been created, or in hazardous or difficult industrial environments. These networks are designed to consume minimal power, so batteries need not be replaced for two or more years.

Mesh topologies have a role in some educational networks, but the fundamental principle remains true that the technology should be selected to serve the intended learning outcomes, not the other way around.

Networking and wireless news

First operator 4G trials to start within six months

LTE (Long Term Evolution) is the next upgrade to current 3G mobile phone systems, as defined by Release 8 of the 3GPP's (the Third Generation Partnership Project's) protocols. Unlike the competing WiMAX technology, LTE has yet to be ratified as a final standard by the International Telecommunications Union (ITU), but manufacturers are already developing prototype equipment, based on parts of the standard that have already been agreed, in order to prove the technology and create market share.

Mobile operator Telefónica (the parent company to O2) [has announced](#) six LTE pilots that will run in different locations across Europe and South America in the first half of next year. The company has selected six different suppliers of key equipment, to measure their capability and assess deployment issues in field trials. It expects initial trials to involve data cards or modem dongles attached to laptops, as mobile handsets have yet to appear, and the pilots will be restricted in each country according to the amount of licensed spectrum available. Most of the other main UK carriers have also announced plans to implement LTE on their networks.

In related news, the Chinese networking company ZTE [is reported](#) to have said that the initial roll-outs of LTE will deliver download speeds of about 20Mbps and uploads at 5Mbps. Although Telefónica [demonstrated](#) LTE running at 140Mbps earlier this year on a test rig, speeds are expected to be far lower due to real-world conditions interfering with signals and competition between users (contention) dividing available bandwidth.

LTE and WiMAX technologies are seen as the main contenders for the 'fourth generation' (4G) crown, offering data rates above 100Mbps and offering an all-IP network. LTE is seen as the technology most likely to be deployed in many developed nations, as it builds on the existing infrastructure and is backward compatible with 3G and HSPA standards. However WiMAX has already been deployed in a few US cities and is considered more desirable for providers in developing nations trying to build new mobile broadband networks.

ICT Facts and a billion mobile users to access cloud by 2014

The International Telecommunication Union (ITU) has produced a report, [The world in 2009: ICT facts and figures](#), which gives an excellent overview of communication

trends internationally. It reveals that two thirds of the world's population (4.6 billion people) are expected to have a mobile phone by the end of this year and that just over a quarter will have access to the internet. The graphs presented by the ITU make it clear that mobile connections are increasing extremely rapidly, compared with fixed line telephone connections, which have been on a slight decline since 2005. Although both are rising, access to mobile broadband (9.5% or more than 600 million people) has overtaken landline internet connections (7.1%) during the last year.

These figures hide wide continental disparities, let alone those on a much smaller geographical scale. The report clearly demonstrates the enormous cost differential between developed countries and developing nations - about ten times more expensive - for fixed access to broadband. This is largely due to the much poorer 'wired' infrastructure in most developing nations, so installing a broadband connection is much more than upgrading an existing phone line. Due to dispersed populations and difficult environments, these problems are likely to remain intractable for laying fixed links to many areas.

Mobile networks are much easier to construct in remote areas, as base stations can be deployed and high speed wireless (or satellite) connections used for 'backhaul'; mobile access costs (at a gross level) are largely similar across the world. These practical issues are expected to continue to drive global mobile broadband uptake and services at the expense of landlines. New 4G mobile services will deliver mobile broadband at higher speeds within five years than many existing landline connections today. Although many developed countries will follow the upgrade path offered by LTE, operators in developing nations may opt for the lower costs of WiMAX deployments. (See [TechNews 10/09](#) and '4G' article in [TechNews 11/07](#) for more details of 4G technologies.)

ABI Research [is reported](#) to have predicted that nearly one in five mobile device owners will be accessing cloud services by the end of 2014. Although just over one per cent of mobile users made use of cloud services in 2008, this proportion is expected to rise much more sharply than the number of device owners over the next five years. By 2014 nearly a billion people will be using mobile phones to access a range of applications on the internet, including calendars, contact management, video sharing, music and collaborative writing environments.

It will be much simpler to manage these applications as 'cloud' services, as applications hosted on remote data centres and delivered over the internet, rather than trying to produce custom applications for each mobile operating platform. Updates can be performed centrally, so users always have the most recent version of the software running, while the phone acts as the interface to the functions that the user needs. This style of operating will depend on phone manufacturers supporting a limited number of web application environments, such as Ajax and Adobe's proprietary Flash platform. (See Web applications in [TechNews 01/09](#). and Developments in mobile operating systems in [TechNews 09/08](#).)

ABI Research believes that the trend will be driven by location based services, such as mapping, navigation and augmented reality, with 60 per cent of subscribers using one or more such services by 2010. (See Mobile location-based technologies in [TechNews 03/07](#) and Augmented reality in [TechNews 07/09](#).) Educational users may commonly be using mobile devices to access content and learning management systems in this time frame, as well as using public cloud services for educational purposes.

WiMAX network to provide broadband in rural India

WiMAX is one of the two leading technologies competing to give 'fourth generation' (4G) access to mobile broadband and other services. Unlike the 3GPP's 'long term evolution' (LTE) project, WiMAX is already fully defined in official standards and is being rolled out in a variety of places, such as Sprint's latest deployment in [Chicago](#). However, WiMAX requires new infrastructure, whereas LTE builds on the technologies already in place, which is expected to make LTE more popular among European carriers.

BSNL, said to be the world's seventh largest telecommunications provider, and Intel have [announced](#) a set of initiatives designed to bring WiMAX broadband to rural areas of India. Working with HCL, an Indian systems developer, they will supply 'nettop' computer systems containing Intel Atom chips and WiMAX radios. (Intel defines 'nettops' as the desktop equivalent of netbooks - low cost computers, using less energy, designed primarily for internet access and other less demanding tasks. Intel is one of the main promoters of WiMAX.) Initial network rollouts will be in Kerala and Punjab, in the south and north of the country respectively, while HCL and Intel will ensure that compatible devices (including netbooks and smartphones) will be available.

In related news, a Nokia researcher, Umesh Chandra, is [seeking to build](#) mobile applications that provide internet-like services using low cost hardware. Normal location-based services rely on GPS chips in laptops and smartphones to accurately pinpoint the user's whereabouts; Chandra is seeking to locate the user via the phones 'registered' cell base station and use SMS (texts) to provide requested information, such as friends in the area. Although the system is less accurate than GPS, it is inexpensive and relates well to the cultural understanding of location, which does not require precise details.

Nokia is [launching](#) a set of affordable handsets (priced from £20 to £50 before taxes) in Indonesia. Nokia's 'Life Tools' service, to which consumers have to subscribe, will provide information on animal husbandry, agriculture, weather, language learning and entertainment via SMS and a preloaded Life Tools application. The service is scheduled to start early in December.

IMB to improve data broadcasts for mobile devices

Integrated mobile broadcast (IMB) is a multicast technology that will reduce the bandwidth required when sending the same data to multiple mobile devices. Normally, each device will have its own data stream, but multicast techniques permit the service to broadcast the data once (as occurs for normal terrestrial television) to

multiple consumers, saving on bandwidth. IMB can operate over parts of the 3G spectrum that has been licensed to operators, but which has remained largely unused; it also complements an existing multicast protocol, multimedia broadcast multicast service (MBMS), simplifying integration into new hardware. The technology can support multiple 5MHz carriers, each of which has potential to provide 20 broadcast channels transmitting data at 256Kbps.

IMB has already been approved by 3GPP as one of its standards and the GSM Association (GSMA), which is the key trade body for mobile operators, [has now endorsed](#) IMB for use by its members, having released a [technical briefing paper](#) that discusses its application. Possible services include:

- live streaming of sports, music and political events
- over the air (OTA) software downloads and updates
- news, weather and advertisement broadcasts
- location based services, such as an information guide and rolling advertisements for an airport's services and franchises
- music services and podcasts
- public service and emergency alert broadcasts.

IMB can be combined with normal 'unicast' transmissions (that connect the user directly to the service provider on a dedicated link) to create interactive services more tailored to the user's choices. Shifting multicast data onto rarely used licensed spectrum using IMB will free up bandwidth for other, more personalised services across the normal 3G channels. The IMB services could carry educational information, although agreements would have to be reached with mobile operators to do so. New mobile phones would need to be based on chipsets that support IMB, although plug-in accessory devices could provide the same functionality in the meantime. Operators involved in developing the new technology include Orange, T-Mobile and Vodafone.

Broadband Enabling Technology extends beyond ADSL

Broadband is delivered to many homes and to some smaller schools and businesses via ADSL links. Asymmetric digital subscriber line (ADSL) technology has been improved over successive generations, but it can only transmit signals across good quality connections for about 5km (just over 3 miles), creating problems for premises in outlying areas. A subscriber near the exchange may receive something close to the (say) 8Mbps speed advertised, but signal quality falls off exponentially with distance, with a matching drop in potential line speed, giving rise to a maximum distance for any practical connection.

The Digital Britain report ([see TechNews 05/09](#)) proposed a 2Mbps 'universal service commitment' (USC), which would leave many households in 'not spots' without adequate provision via existing infrastructure. Satellite and mobile solutions have been proposed, but have weaknesses due to line of site restrictions, latency (delay), interference, contention (shared services) and other issues, depending on the technology.

BT [is proposing](#) Broadband Enabling Technology (BET) as an alternative for many homes on the basis of a successful trial. Strictly, the service is provided by Openreach, BT's wholesale arm that controls most exchanges and the 'first mile' of cabling to premises. The company is willing to work with any communications provider that is seeking to provide services for the 'not spots' from a further [ten exchanges](#) in a pilot scheme, starting at the end of this month. If the pilot is successful, the service could be rolled out to more areas in 2010.

BET, based on single-pair high-speed digital subscriber line (SHDSL) technology, can offer a digital connection over copper wire up to 12km (7.5 miles) from the exchange. The new technology could offer 1Mbps (at best) across existing infrastructure, but it can be 'bonded', so 2Mbps is possible where two sets of wires are available. As well as delivering service across longer distances without requiring new infrastructure, BET is 'symmetric', offering upload speeds up to 1Mbps across a single line.

Cable broadband, offered by Virgin in parts of the UK, can deliver much higher speeds than considered in this article, but the infrastructure is only available in major urban areas. BT also offers various types of Ethernet and other leased lines to schools and businesses, although providing these often mean laying new conduits for fibre connections.

Plastic fibre to be deployed for fast local networks

Optical fibres made from chemically 'doped' glass can carry large amounts of data reliably over long distances. Indeed, the modern internet could hardly function without fibre to carry the masses of data consumed by all kinds of users. Fibre optics have moved from the core of the communication providers' networks, out to roadside cabinets and now increasingly to homes. (See details of the latest BT announcement about connecting homes in [TechNews 10/09](#).) Nevertheless, glass optical fibres are difficult to handle and expensive.

Plastic can be used for optical fibres but, although low cost and much more flexible than glass, plastic does not support very high bandwidths, while signals degrade much more rapidly with distance. These disadvantages limit plastic fibres to local communications, perhaps within a small campus or transmitting data between systems in a vehicle. Commercial plastic optical fibre (POF) solutions generally use wavelength division multiplexing (WDM) techniques - different colours of light to carry different data streams. However, time division multiplexing (TDM) could significantly increase the capabilities of POF by creating separate data streams in different time slots. To achieve such increases in bandwidth - while maintaining the price advantage of POF - low cost, highly efficient switches are required. Electronic switches, which have to convert signals from light to electrical pulses and back, introduce delays and added cost to POF systems.

[POLYCOM](#), a European Union funded project, has been investigating optical switches that use visible (green) light to support speeds of a gigabit per second on POF over distances of 100m or more. The team has developed doped plastics that amplify light signals under normal conditions but, when exposed to a second laser

pulse, they enter a super-excited state - where the polymer temporarily releases an electron from an electron-hole pair - preventing further propagation of light. This produces a switching mechanism [reported](#) to be operating at around 500 femtoseconds, which would enable time division multiplexing to produce gigabit speeds. (A femtosecond is one billionth of one millionth of a second.)

The success of this project, if translated into a commercially viable product, could see copper cables in local networks replaced by plastic fibres operating at gigabit speeds.

US to consider net neutrality proposals

Net neutrality is a contentious topic, characterised as the 'freedom' advocates lined up against internet access providers, regarding controls on the types of content that can be transferred across the internet. Many bandwidth-intensive applications, especially video streaming, have begun to dominate traffic on the internet, so companies responsible for providing the infrastructure are facing either heavy investment to expand its capacity or pressures to impose restrictions on those applications, in order to maintain an acceptable quality of service for other users. ([TechNews 08/09](#) reported on some of the most recent statistics for the growth of video traffic.) Proponents of net neutrality argue that giving equal access will encourage services to innovate, driving the market forward and bringing in the additional revenues required to develop the infrastructure.

The US Federal Communications Commission (FCC) [has announced](#) a policy aimed at preserving 'the free and open internet', by adding two new principles to the four it already uses for enforcement of US communications law. The two new principles can be summarised as:

- preventing access providers from discriminating between different types of data
- ensuring that providers are transparent about their network management policies.

The FCC intends to turn all six principles into formal rules later this month, which will then be publicised for consultation. The FCC statement implies an expectation that access providers will apply different management strategies to mobile and fixed connections. Reports [suggest](#) that access providers in the US support these measures in respect to landlines, but that they are [much more cautious](#) in the mobile domain, where maintaining adequate service in the face of growing user demand is much more expensive.

Europe is often seen as following trends in the US, but it has been [reported](#) that the EU will ratify a revised Universal Services Directive, which will effectively give operators the right to curb certain types of traffic. A final decision is due by the end of November. If approved, restrictions on bandwidth-intensive streams could limit the interactivity of educational applications, as well as consumer use for video, voice over IP (VoIP), online gaming and other purposes.

Note: since the time of writing the above, the EU has [agreed](#) a broad telecommunications package, with implications for net neutrality.

Deltacloud API to broker cloud interoperability

Cloud services (see [TechNews 11/08](#)) deliver processing power, applications and storage from remote data centres via the internet; such services are generally flexible and scalable, with charges based on usage costs. Commentators now frequently refer to the 'private cloud' - the in-house virtualised, networked computing resources - and the 'public cloud', with a range of companies, including Amazon and VMware, seeking to bridge the two so that applications can be migrated between the two as required. The ability to 'virtualise' servers and data storage, allowing them to function independently of the underlying hardware, is central to the cloud paradigm. However, the precise 'packaging' processes and management techniques vary between vendors, limiting interoperation and migration of application 'instances' and data storage.

Red Hat [has introduced](#) an open source solution to this problem: [Deltacloud](#), a set of APIs and tools based on representational state transfer (REST). Deltacloud contains drivers for a number of the common cloud platforms that map the application programming interfaces (APIs) into a common environment, allowing system managers to provision an application instance on a private cloud and then move it to a matching instance on one of the public offerings. Likewise, the same tools can be used to move data between two public cloud services, reducing concerns about lock-in to one supplier's resources and pricing structure. Red Hat has provided a web portal with a user interface that manages such transfers, although (as an open source project) any developer can take the APIs and customise them for their own purposes.

Xen.org [has announced](#) that it is developing the Zen Cloud Platform (XCP) to address similar issues, while Amazon [has launched](#) a proprietary Amazon Virtual Private Cloud (Amazon VPC) that will bridge internal resources with its own web offering. In August CNET News [gave details](#) of a number of initiatives aimed at developing standards for delivering cloud services.

Wi-Fi Direct to simplify connecting wireless devices

Wireless gadgets generally connect to a network via an access point (an 'infrastructure' connection) in order to share resources or communicate with other hardware. It has always been possible to create direct 'ad hoc' connections between two devices for 'casual' purposes, but the process behind this is frequently both obscure and insecure. The Wi-Fi Alliance, an industry body that defines the process that certifies equipment as compliant with Wi-Fi standards, has [announced](#) an interconnection to be known as Wi-Fi Direct.

The new set of protocols will offer users a quick way to link hardware for tasks such as syncing data, printing and sharing content without being in range of a wireless 'hotspot'. Devices can advertise their presence and services before they are fully authorised, making it simpler for users to identify what is available before creating a connection. WPA2 security (which is much more resilient than WEP) can be

enforced to limit the possibility of hackers gaining access to data or hijacking connections. It will also be possible to use a device with network connectivity via an access point to bridge Wi-Fi Direct hardware to the internet, with each set of connections having its own security protection.

Wi-Fi Direct will make it easier for learners to print or display photographs on compatible hardware, or to transfer files between themselves. When in the field, they will be able to create 'groups' so that collaboration can continue, even though they have no conventional Wi-Fi network available.

Wi-Fi Direct will be backward-compatible with most older Wi-Fi certified devices (except those that only use 802.11b) and users of legacy hardware may also find manufacturers releasing upgraded firmware to provide the new functionality. The 'standard' (which has not been formally approved by the IEEE) will be applied to new products that will appear from the middle of next year.

Wireless personal area networks (WPANs) have been promoted for some time, but Bluetooth and related technologies have proven awkward for consumers. Wi-Fi is faster and works over longer distances, but Bluetooth is more power efficient. Now that many new handheld devices come with Wi-Fi at manufacture, Bluetooth is an additional cost and takes space on circuit boards that could be used for other functionality, so manufacturers may be tempted to drop it entirely.

Nanoantennas to make 'radio' transmission using light feasible

Wireless networks generally use radio signals to transmit data. Basic (dipole) radio antennae used to transmit and receive data operate most efficiently when their size is half the wavelength of the radio frequency used. A 3GHz signal (which is around that used in mobile phones and Wi-Fi) has a wavelength of about 10cm (4 inches) and optimally requires a 5cm dipole aerial.

Light, which is part of the same electromagnetic spectrum, could - in principle - be used in the same way. However, visible light operates at very high frequencies (allowing it to carry much more data than radio signals) but at far shorter wavelengths. Thus yellow light, which has a frequency around 50THz (or 500,000GHz), has a wavelength of about 600nm - unsurprisingly, creating antennae around 300nm in size is extremely difficult.

Researchers in Germany are [reported](#) to have developed a system that uses electron beam lithography to create gold nano-antennae that are as small as 100nm. Such antennae could be used in optical computing and communication systems, removing the need to wire certain components or devices together. However, the researchers are also working on structures that focus light to within 10nm in order to ensure that light can be transmitted at low power and arrive at the receiver with minimal interference. In addition to having extremely high data transmission capacity, visible light is non-hazardous (unless at very high energy levels), but is readily blocked by solid objects, water vapour and all other barriers that we are used to observing.

Multimedia

Analysis: Music delivery services

At a glance

- Music in digital formats can be distributed using physical media (like CDs), downloaded or streamed across the internet.
- Music publishers, concerned about illegal file sharing, have forced the closure of peer-to-peer networks, introduced digital rights management (DRM) and sought laws to make ISPs responsible for dealing with file sharers.
- Streamed music, although requiring less bandwidth, uses formats and playback applications comparable to video. Likewise, it could create a substantial load on education networks.
- Streamed music offers a more controlled environment through which publishers can offer music.
- Music may be used in a wide range of curriculum contexts, but users need to ensure that they are complying with copyright and the relevant terms and conditions.

Changing tunes

Music consumption has shifted from broadcast radio and physical media to online delivery, including downloads and streaming. The BPI, representing recorded music publishers in the UK, [reports](#) that 95 per cent of all singles are now sold in digital format. Publishers are concerned that digital music can be readily copied and have made various attempts to introduce digital rights management (DRM) and legal measures to deter such activities. The BPI estimates that the industry loses £200 million from illegal copying across all formats in the UK.

A Nielsen research report in June 2009, [How teens use media](#), said that MP3 players (39%) are just ahead of computers (33%) as the 'primary' device used to listen to music globally; radio trails substantially in comparison, at just 16 per cent. Physical media still have a place, with three quarters listening to some music on CD each week and a fifth listening to five or more hours. Of course many will be listening to music while engaged in other activities, including doing school work or playing games.

Downloading

Peer-to-peer (P2P) file sharing networks, such as the original incarnation of Napster, created considerable controversy and gave rise to litigation by music industry bodies earlier this decade. P2P networks allow anyone to publicise the availability of files on their own computer, which other users can find and download. Even when users assembled a file from multiple chunks provided by others on the same service, the publishers considered this a breach of copyright when it related to recorded music. 'BitTorrent' networks, operating today, work on a similar principle and often contain illegally copied material or files bundled with malware.

Music files are frequently digitised in MP3 format, especially by users 'ripping' CD collections for use on their computers and personal music players. MP3, properly

referred to as MPEG-1 Audio Layer 3, can contain music sampled at various levels (effectively determining the quality of the compressed file), but has no DRM restrictions and suffers from a number of limitations. Apple uses AAC encoding (which is standardised within the IEC's MPEG-2 and MPEG-4 specifications) and a few others prefer Microsoft's WMA format, both of which support DRM and a greater range of encoding options. Nevertheless, when given the choice, MP3s remain extremely popular among users, as they are supported by most applications and music players, allowing users to easily share and backup music files and synchronise them between devices.

The music industry has become increasingly sanguine about digital downloads and DRM. Talking to [BBC news](#), Geoff Taylor, chief executive of the BPI, has admitted that the industry should have been more supportive and flexible over music downloads, rather than concentrating on destroying Napster. ([Napster](#) subsequently re-launched as subscription-based service for legal, DRM-protected downloads.) Since 2002 most of the publishers have agreed to the removal of DRM from music in the catalogues of many online music retailers, including the extremely successful [iTunes Store](#).

These moves do not mean that the controversy has gone away; rather, the publishers have sought to deal with illegal file sharing through other routes. The main strategy has been to lobby for legislation to require internet service providers (ISPs) to enforce '3-strikes' policies, under which users get two warnings and are subsequently cut off from all internet access.

Campaigners have objected that this policy unfairly penalises users who would lose access to other online services, possibly as a result of misidentification or other users sharing the same connection. ISPs have also raised technical issues involved trying to determine which streams are illegal (by 'snooping' the contents of data packets) and are reluctant to become the 'police' of the internet. Musicians have also been deeply divided over restrictions on file sharing, although many reached an accord [earlier this month](#) that called on ISPs to reduce connection speeds rather than cut off all internet access.

Nokia's '[Comes with music](#)' mobile phones have pioneered a novel way to legally download music. These handsets have unlimited download restrictions for the duration of the linked mobile contract, with customers entitled to retain tracks after the subscription expires.

An [Audio Network Education Licence](#) is available to schools and colleges for downloading several thousand tracks via the National Education Network (NEN).

Streaming

Improved internet connections are already moving the ground under these arguments, as users have increasingly turned to streaming music services. In many senses, streaming music is better for the publishers as the providers have much more direct control over how the music is used. Although a small amount of data

may be 'buffered' on the user's hard drive, most systems ensure that complete tracks are never stored.

Streaming music services may not match the quality of output offered by file downloads, but users seem not to mind if they are able to access a large catalogue for free or at very low cost. Streaming music doesn't take as much bandwidth as video, but is otherwise similar in operation. (See Live streaming in [TechNews 05/09](#).) Services use either the standard internet TCP protocol, or UDP (user datagram protocol) which is more suited to streamed media, as it can ignore lost data without holding up a stream waiting for further transmission attempts. Some services use the open source Ogg container (rather than MP3, which has potential licensing issues) and Vorbis compression routines. Like AAC and MP3, Vorbis has a 'lossy' compression format, allowing more data to be compressed in a stream but losing some details from the original audio input.

Internet radio stations use streaming formats, allowing users to listen to the genre of a particular station but giving no control over specific content. More recent services allow users to select songs that will be played at some point in the radio stream, or build custom playlists over which they have direct control. Many services are now building in 'recommendation engines' based on past choices and adding social features for sharing playlists and discussing choices. Examples of these services include [Blip.fm](#), [Grooveshark](#), [Last.fm](#), [Pandora](#) (US only), [Spotify](#) and [WE7](#) (mainly UK).

Most free services use Adobe's Flash Player software, which has built-in support for streamed media, including MP3 and AAC. However, Spotify requires installation of client software that plays the Ogg Vorbis format, [stating](#) that this produces better sound quality. Many of the services have launched mobile clients, or will soon do so. As native Flash playback becomes more widely available on smartphones, specific clients may no longer be necessary, but getting a presence in the mobile market and building a following is seen as essential.

The question remains - as with so many Web 2.0 services - how will they make a profit? Most are supported by advertisements, but paid-for 'premium' services with higher bit rates, no advertising, opportunities to download songs for offline playback and other features are being added by several companies.

The disc is not dead

Sales of digital music in the US may overtake CDs before the end of next year - and by 2016 globally - according to [an extrapolation](#) of figures from the International Federation of the Phonographic Industry. The CD still has a place, especially in cars, for backups and storing user-generated custom 'mixes', but its importance is waning. Radiohead, an 'alternative rock' band from the UK, first released its album *In Rainbows* as a digital download, before releasing the CD. Many new 'indie' bands have all their music online, often promoted through the streaming services as well as via their own websites.

Alternatives

Broadcast radio remains part of the mix, with even the latest Apple [iPod Nano](#) boasting an FM receiver. Britain has announced proposals to put all national radio channels and many others into digital 'multiplexes' by 2015 (see [TechNews 07/09](#)), which may give a boost to broadcast programming. On the other hand, the need to buy new DAB receivers and the rise of mobile devices able to stream music could reduce the impact of this change.

Music video is also extremely popular, either on dedicated music channels on cable and satellite services, or through [YouTube](#) and other online video sharing sites. As streamed video comes to mobile devices, we can expect many people to consume music from original videos or user-generated mixes and mashups.

Notes for education

Many music services have specific geographical limitations that depend on copyright laws and local agreements with the music publishers. The 'terms and conditions' for streaming services often state that they are for 'personal' use, so educators intending to use them in classes should check with the companies concerned. In general, use of recorded music for curricular purposes does not require a license (see the [CEFM website](#)), but teachers in schools should contact the appropriate body as listed at [licensing-copyright.org](#) if in doubt.

Download and streaming services will give learners access to a very large catalogue for music and media studies and give openings to talk about copyright and appropriate use in ICT. Many services actively welcome new talent, creating opportunities for young people to compose or perform for a much wider audience than their local area.

Streaming services can add significantly to network traffic, as discussed in the Media distribution article in [TechNews 07/08](#). This can be alleviated by local media caching at the 'edge' of the local network, but users will often find that music services are blocked by institutional and regional filtering policies due to legal and bandwidth concerns.

The whole market for music distribution is in the throes of a massive shake-up, with people neither clear how music will be consumed in ten years time nor the shape of the legal framework that will control it. At present, with falling connectivity costs, it seems likely that streaming will become the leading channel, even in mobile markets, permitting greater control for copyright holders. However, if public perception remains that the terms are unfair, they will continue to find other, less legal ways to listen to music.

Multimedia news

Manufacturers preview new 3D-enabled technology

The IFA exhibition in Berlin was the platform that a range of companies used to launch or talk about up-coming 3D-capable displays and imaging systems. (3D displays were covered in more detail in [TechNews 11/08](#).)

Sony [demonstrated](#) three-dimensional televisions, using polarised glasses to conduct the correct image to each eye, and projected 3D film clips using its own hardware. The company's CEO, Sir Howard Stringer, referred to future PlayStation games consoles and Vaio laptop PCs with built-in 3D. The company's first 3D 'ready' Bravia TVs and Vaio laptops are expected in 2010. Sony has also [indicated a commitment](#) to producing 3D still and video cameras, although no specific details were provided.

Panasonic's [presentation involved](#) the producer of the forthcoming 3D film *Avatar*. The company claimed that it would be 'first to market' with a compatible 3D television and Blu-ray player, highlighting the absence of an agreed standard for recording 3D content on Blu-ray disks. However, the Blu-ray Disc Association [announced](#) its intention to publish a finished HD 3D standard - which Panasonic will be using - in December. These announcements show that 3D content, agreed recording formats and innovative display systems are converging, creating a potential for 3D in the consumer market, although it has yet to be seen whether consumers will take to the technology in sufficiently large numbers not to repeat the disappointments of past initiatives.

Philips, also [reported](#) to be behind the new Blu-ray HD 3D standard, demonstrated a prototype television with cinematic widescreen (21:9) proportions. Like Sony, Philips sees polarised glasses as most likely to be favoured by consumers for 3D viewing, but it is said to be investigating a range of technologies. (The 'active' technology, which uses wireless LCD shutter glasses to blank out alternate images to each eye, is heavier due to the system's batteries and embedded electronics. Shutter glasses are also much more costly to manufacture compared with polarised lenses.)

In July 2009, Fujifilm [announced](#) a new range of 'Real 3D' products. The Real 3D W1 camera is already on sale in Japan and [is expected](#) to go on sale in Europe for €499 (about £450) in October. The camera incorporates a paired lens system capable of a 3x optical zoom and two 10-megapixel image sensors. Software in the camera adjusts the images for tone and colour balance and displays them on an LCD on the rear of the camera, creating a 3D image visible to the 'naked eye'. (The screen uses a parallax barrier, with micro-fine slots directing appropriate portions of the image to each eye. This system has the disadvantage of a narrow viewing angle.) The camera can capture video as well as still images.

Nokia [recently demonstrated](#) its N810 internet tablet with a 3D display. There were suggestions that it would join other companies in putting similar technology into some of its phones.

Following the announcement by Sky TV in August that it would be broadcasting 3D content on one of its channels (see [TechNews 08/09](#)), Channel 4 [is reported](#) to have said that it will be broadcasting a selection of 3D programmes this autumn. The system will use [ColorCode 3-D](#), with glasses that have one amber and one blue filter. This might appear to be a modernised form of the anaglyphic system used in cinemas back in the 1950s, but it has a much more detailed coding which does not

give the unfiltered image the obvious appearance of a pair of superimposed, stereoscopic images. In fact, the amber (left) filter effectively produces the proper colour information, while the blue (right) filter transmits parallax information that gives the required sense of depth to the image.

Finally, the European Space Agency (ESA) [is involved in](#) a programme of trial transmissions for 3D broadcasts over satellite channels. Broadcasts began in March 2009 and are being monitored at test sites designed to replicate viewing conditions at home and public venues, with final broadcasts during November 2009.

New 360° 3D screen revealed by Sony

Many 3D display announcements and demonstrations have been made over the last few months, as reported in [TechNews 09/09](#). Most of these involve flat screens and some system stereoscopic to generate a three dimensional image. (That is, creating the slightly different views required by the left and right eyes. See [TechNews 11/08](#) for more details of 3D displays.)

Sony recently [demonstrated](#) a system that generates a 3D image that can be viewed from any direction. The early prototype of the 360°, 3D 'screen' was under a foot (actually 27cm) tall and 6 inches (13cm) in diameter. Sony gave few details of the technology involved, but it does not appear to use the approach of previous 'volumetric' displays, which mainly employ spinning mirrors and multiple projectors. The report states that an LED light source is used and that the display has a mere 96x128 pixels, presumably from any given viewpoint.

The greatest problem for any volumetric system is generating the image. Stereoscopic displays assumed a single point of view, although the 3D effect will still be visible from wider angles. To produce the appearance of a complete solid that can be viewed from any angle requires computation of all those views (or at least a reasonable subset of views). Very few computers have the processing power to generate such an image in real time, so Sony's demonstration relied on a combination of earlier photography and previously generated, static 'objects'.

A Sony spokesperson suggested that the technology could be readily scaled up and that it would have applications in design and education. However, given the availability of rapid prototyping systems in schools and colleges, and (presumably) much lower cost of existing three dimensional displays (on which the objects themselves are manipulated), it is difficult to envisage such a system becoming widespread in education.

New 3D system for mobiles and games devices

3D is about to become the technology of the moment, if the number of recent product announcements and rumours are to be believed. To create a 'stereoscopic' 3D view, which provides a sense of depth, each eye must be provided with a slightly different image, as though taken from the appropriate angle. Most systems use special glasses that filter the image or alternately cut the view so that each eye receives the correct picture. ([TechNews 11/08](#) described 3D displays in general and an [11/09](#) article covered some of the latest product announcements.)

3M recently [announced](#) that it had developed a special film that could be integrated into the backlight assembly of a standard LCD display to create 3D images. A pattern of lenses directs the backlight through a single liquid crystal layer, which produces the picture, towards the viewer's eyes. Due to the way that the lenses work, the right eye cannot see the image intended for the left and vice versa, removing the requirement for the user to wear glasses. Such a system necessarily has a limited field of view, so 3M are aiming it at handheld devices. Other systems based on 'lenticular' displays are available from a variety of manufacturers.

Commercial DVDs and games have already been produced with 3D in mind and there are cameras and graphics packages that can create stereoscopic images. However, the output from these is mainly aimed at devices with larger displays. It remains to be seen whether sufficient 3D content will be developed for handheld devices and whether 3D will become popular among users.

New flexible OLED prototypes from Sony

Liquid crystal displays (LCDs) use rigid components, since the alignment of the molecules dictates the visibility of the image. (This is why LCD screens viewed 'off centre' lose some of their colour or contrast.) The liquid crystal layer and polarisers selectively block the backlight to create a picture, but this process reduces the overall brightness, contrast and 'vibrancy' of LCD displays.

Alternative OLED technology has been under development for many years. (See Display technologies article in [TechNews 01/09](#)). Organic light-emitting diodes produce light when a voltage is applied across layers containing organic polymers, so they are potentially much brighter and require less energy than conventional LCDs. They can be very flexible precisely because of the nature of the organic molecules from which they are constructed, but these molecules degrade relatively rapidly compared to LCDs.

Sony, which is among the manufacturers investigating flexible OLED displays, recently [demonstrated](#) products based on a flexible film that is a mere 0.2mm thick. The conceptual prototypes included a notebook PC, a foldable e-book reader and a Walkman device that could be worn as a bracelet while the screen was not being used.

Manufacturing costs for OLEDs remain very high, as production techniques often require individual display components to be treated in a vacuum chamber as part of a gas deposition technique. Newer processes, akin to inkjet printing, may bring prices down to a level where OLED can compete with LCDs. Some mobile phone manufacturers have begun to use OLED displays, as they are much more visible in bright sunlight and draw less power, but very few large displays are either in production or expected to reach consumers in the near future.

Intel introduces 45nm chips for internet-connected TVs

There are three basic distribution channels for video and other streamed content: broadcast, wired and wireless. In the past, television could only be received as an

analogue signal from a broadcast network, while interactive content required some sort of wired connection. However, cable systems and applications like iPlayer now distribute television content, mobile devices have dropped in price and are becoming fast enough to display a decent video stream, and television has nearly completed a digital transformation. These trends have been collectively described as 'convergence'.

The huge growth in watching video over the internet is a clear sign that people want to watch television on broadband-connected devices, but it is not nearly so clear that people appreciate the value of having access to an internet connection from their television. However, Intel anticipates that a significant market will emerge for the latter, [suggesting](#) that there will be 15 billion devices capable of displaying television content by 2015. Intel [recently introduced](#) a range of 45nm system-on-chip (SoC) products, based on the Atom processor, aimed squarely at the internet-connected television market. The company hopes that television and set-top box manufacturers will use them in products, rather than custom silicon or processors based on ARM technology. This would make it much easier for software developers to port applications from computers into these products, as the processors will use the 'standard' x86 microcodes. However, some commentators [have argued](#) that most manufacturers will be unwilling to use Intel chips, unless they come down further in price.

Intel, as part of its announcement, said that it was working with Adobe to ensure that applications based on Flash Player 10 will be able to work on the CE4100 and other new Intel media processors. This would allow developers to provide sophisticated channel guides - combining video, graphics and viewer response systems - to assist consumers in selecting content from the huge range of programmes and channels now available. Further, users will be able to receive recommendations or engage in discussions about the content they are viewing, keep up-to-date on the latest news and weather, and play internet-based games on their television.

Personalised content on television could broaden access to educational materials, through interactive applications and customised video streams. This may appear to be a way to close the 'digital divide' but users would still require an internet connection to use such services. The only saving, therefore, would be the cost of a computer (or other internet access device), although consumer-orientated services might prove easier to use for people less confident with computers.

MHL to connect mobile devices to HD displays

A working group has been established by a consortium of companies, including Nokia, Samsung, Sony and Toshiba, to develop a standard interface for connecting mobile devices to television sets. A range of hardware can already be connected to displays using S-Video, custom interfaces and dock connectors, but there is no agreed standard across all equipment. A universal connection system would be a clear benefit in the classroom, as it would be possible to connect a large range of mobile phones, cameras, netbooks and handhelds to a large display or projector using just one type of cable.

The new standard will be based on Silicon Image's Mobile High-Definition Link (MHL), with a specification that would support 1080p high definition transmissions. [Reports](#) say that the companies will establish a trade group, open to other companies, to develop and promote the standard.

Program your own camera

When purchasing a camera you may consider its price, the sensor's resolution (in megapixels) and the features it offers. Once bought, you are limited to the functions provided by the manufacturer - even 'program' modes are really opportunities for the user to select existing options rather than do anything novel.

A Stanford University research team [has produced](#) the specifications for an 'open source' camera, in which the fine details of its operation can be programmed with precision. Developers could instruct the camera to perform a sequence of actions, including sensing the ambient light, focussing at different depths, combining flash effects and performing multiple shutter releases at different exposures. The whole thing is controlled by a Texas Instruments 'system on a chip' (which combines image processing with general processor functions), captures images using the camera sensor from a Nokia N95 phone through Canon lenses and is programmed using Linux. The team is supported by a number of large companies in the imaging field and hopes to be able to do a limited production run next year with units costing less than \$1,000 (about £610).

The researchers hope that others will develop new applications for the Stanford Camera, exploring the possibilities of finely controlled digital photography. For example, the 'dynamic range' of the camera could be enhanced by taking a series of readings from the sensor and selecting the best setting for each pixel from the data set, yielding better contrast and tonal depth for an image. The team also suggest that video could be improved by interleaving regular frames with high resolution images, which the software could then use to enhance the neighbouring images.

Open source hardware projects, such as the Stanford Camera and the NOR_/D multi-touch screen (see [TechNews 11/08](#)), allow students to investigate real problems in control technology. Although the Stanford Camera is unlikely to be purchased by most schools and colleges, future projects might make such devices accessible to computing and multimedia departments, or for specialist vocational courses.

Mixed reality merges Second Life with videoconferencing

Finnish researchers, working with IBM and Nokia, have developed a system which 'mirrors' real people and objects from different locations within a single, virtual, meeting space. Cameras, sensors and microphones are combined to capture movement and sound, which is then used to control avatars within the virtual room and to produce a single audio feed.

The IBM [press release](#) refers to the ACME system (augmented collaboration in mixed environments) as 'proof-of-concept'. (A [YouTube video](#) shows the system in action.) Open source components are used to keep costs low, including a viewer for

the Second Life virtual world and components from the ARToolkit and OpenCV libraries. (The ARToolkit is used for augmented reality and OpenCV is a computer vision library based on original work by Intel.) The project is conceptually related to IBM's Sametime 3D collaboration environment, covered in [TechNews 04/09](#), although that system does not employ cameras and sensors to track participants. IBM plans to further test ACME with Nokia at their respective facilities.

Videoconferencing has long been seen as a practical alternative to bringing people together for meetings and classes. As well as saving energy and reducing carbon emissions, videoconferences may enable participation from individuals who would not otherwise be present. These systems are adequate for individuals and groups to see what is occurring at the other 'end' of the conference, but become much more difficult when multiple participants are involved. Telepresence systems seek to bring a representation of these others into a single, physical meeting room, but they are generally too expensive for most educational purposes, unless rented (or borrowed) for a specific task. Virtual reality systems, like Linden Labs' Second Life, offer a much more cost effective alternative, but can feel artificial to participants. By mirroring gestures and body language, ACME could help users feel more directly connected to the other people involved, as well as providing the opportunity to discuss and manipulate virtual representations of objects.

New algorithms to improve sounds in virtual worlds and games

Sound effects in virtual worlds and most games rely on libraries of pre-defined or pre-recorded audio. These are suited to creating the right atmosphere, but they are not realistic - sounds are tempered by objects in the immediate area and some effects are far too complex to generate on the fly. Particularly difficult to simulate in real time are objects like metal dustbin lids, cymbals or plastic bottles, whose thickness is far less than their length and breadth. In such structures, sounds do not just emanate from a point, but are generated throughout and interact as they propagate through the material.

Existing approaches to generating such sounds are said to take hours or even days. [Researchers](#) have found a way to dramatically reduce the time for simulating sounds generated by objects made from thin 'shells' by modelling the vibrations produced at a subset of points. One 5-second effect that took 19 days to simulate on a cluster of 16 high-end PCs - using standard engineering models for propagation of vibrations - took just 90 minutes under the new approach.

The algorithms are a long way from integration into commercial games and virtual worlds due to the length of time it still takes to create an effect. However, they serve as an illustration of how modelling is used in computing and they may lead to commercial applications in future. Members of the [same team](#) were also involved in simulating sounds made by water.

EU to limit output on MP3 players, phones

Sustained, loud noise has long been recognised as an important source of damage to people's hearing. Personal music players (including MP3 players and mobile phones) equipped with headphones push sound directly into the ear, often creating

an almost closed chamber within the ear, increasing the chance of damage. In an [EU press release](#) announcing new controls on the audio output of personal music players, it is suggested that people listening to loud music for more than an hour per day, for five years or more, have a five to ten per cent risk of total hearing loss.

The new controls will mandate manufacturers to identify a 'default' level above which users are at much greater risk of long-term hearing loss. Users will be able to select higher volumes, but they must be warned of the consequences of exceeding the default level. Users must also be warned about the possible effects of replacing the headphones supplied by the manufacturer.

The EU has started a process, which can take up to two years, for drawing up the necessary standards. Although the standards will not be mandatory, equipment that is non-compliant cannot be presumed safe.

Young people need to be taught about the risks of prolonged exposure to music at high volumes. Further, schools should consider the maximum volume that can be selected when learners are regularly engaged in activities that involved headphones.

Hardware

Analysis: Wireless power

At a glance

- Mobile devices still need power cords for charging. Proprietary connectors have given rise to a profusion of cables where dissimilar devices are in use.
- Some researchers have a vision of pervasive wireless power, where users would be able to dispense with batteries for mobile hardware.
- Two technologies, conductive and inductive transfer, are well proven and just entering the market.
- Resonant energy transfer is a relatively new field, based on the propagation of magnetic fields between resonant coils, but has been shown to work in laboratories.
- There is no dominant technology and work has only recently begun on relevant standards. Batteries and chargers are likely to predominate for the medium term.

The spaghetti sprawl

The 'wireless office' seems as elusive as the 'paperless office' - just as keyboards became wireless, their cables were replaced with charging connectors for a wide variety of mobile devices. As these wires multiply in teaching space, so confusion mounts and safety risks increase; power consumption may increase too due to the number of transformers plugged in, wasting power while unconnected or supplying power to a device that is already charged.

Rechargeable batteries have helped reduce the number of wires, but it means finding the correct charger or connection when the power is exhausted. It would be so much easier if you could walk into a room and all your gadgets just started charging themselves. If wireless power became pervasive, not only would charging

cables become redundant, but batteries would also be irrelevant and a great deal of polluting waste avoided.

Conductive pads

Docks and charging cradles are nothing new, but conductive charging pads seek to do away with these. They use metal strips on the pad and charging attachments with carefully positioned contacts to channel power to the hardware. Since a direct electrical connection is made, these pads are virtually 100 per cent efficient in channelling power, although they will lose energy where the mains supply is stepped down and turned into direct current (DC).

Users may fear that this arrangement could give rise to shocks, or suffer from short circuits if a liquid was spilt. However, manufacturers claim that the low power (under 15W at 0.4A), intelligent monitoring and safety cut-outs make conductive pads safe to use.

[WildCharge](#) is one of the main proponents of this system, with products already available, but it has licensed its technology to Duracell. The latter intends launching its [myGrid](#) range this month. A basic WildCharge pad, which can charge up to four gadgets, costs around £50 (including VAT), while the charging attachments cost between £25 and £35, depending on the device. (Adaptors will only fit a limited number of mobile phones and other gadgets, as many have proprietary charging connectors. Specially designed replacement backs, with connection points embedded, can be purchased for the cases of some phones.)

Because direct contact is made on the pad, no large electrical or radio field is generated, so there should be no interference with other hardware.

Inductive charging

Induction is used in the transformers installed in many appliances and power cords for mobile hardware. Induction works on the principle that a coil moving through a magnetic field will produce a current, although the coil can also be motionless and the magnetic field rapidly varied. The two parts of the transformer must be in very close proximity to capture the maximum amount of power because the magnetic field decays rapidly with distance. Inductive power transfer, which has been understood for nearly 200 years, uses exactly the same principles to produce a current in the receiving device.

The coils can be completely sealed in plastic, as the power transfer derives from an electrical field, which almost eliminates the danger of accidental shocks or short circuits. Inductive chargers can readily operate within safety limits required for bathroom appliances, as a number of brands of electrical toothbrushes and razors have demonstrated.

Inductive charging pads use coils that are laid out flat within the casing. Such coils need to be highly efficient in order to transfer the maximum amount of power. This requires the receiving coil to be correctly aligned, which the systems just coming to market achieve with small magnets. RFID (radio-frequency identification) 'tags' and

intelligent monitoring systems in the adaptor units for the hardware to be charged can ensure that the best charging profile is used and that power is shut off as soon as the process is complete.

[Powermat](#) is launching a range of pads and adaptors this month. The desktop pad, which has zones for three devices, costs around £70 and the fold-up portable pad £80. Once again, specific adaptors are available for many types of phone and other hardware, each of which costs £30-35.

Fulton Innovation is seeking to license similar [eCoupled](#) technology as widely as possible. It has already been integrated into an (optional) charging stand, which is [said to be](#) 70 per cent efficient, for Dell's high-end [Latitude Z](#) laptops. (The new Palm Pre mobile phone also has an optional [Touchstone](#) charging dock based on similar technology.)

Fulton suggests that inductive power transfer can be as high as 98 per cent efficient when delivering 1,400W using 120V, although power will be lost in the downstream rectifier that converts alternating current (AC) to DC. A high frequency signal can be overlaid on the standard AC carrier, allowing data to be transferred at up to 1.1Mbps, which could be used to monitor the progress of charging or for syncing information on the device.

Inductive charging is not as efficient (overall) as direct cabling or a conducting pad, but Fulton suggests that it will have a net energy benefit, as optimum charging profiles will be applied, charging switched off when complete and various extraneous transformers will not be left plugged in to live sockets. Further, the company emphasises the safety benefit of a sealed system with minimum cabling, but accepts that its technology could interfere with appliances that use wireless transmissions. (Nevertheless, it suggests that most have sufficiently robust filters to prevent this becoming a problem.)

Fulton would like to see its technology built into both the hardware and into surfaces of work units so that users could just place a gadget down anywhere at home, school or work and have it charge without the user really thinking about it.

Resonant energy transfer

The technologies described so far are 'cordless', but they assume direct contact between the device and the charging pad. Resonant energy transfer has the potential to 'fill' a room with power but only transfer energy to a suitably tuned device. This could enable gadgets to charge without the user initiating the process and totally remove the need for batteries for mobile devices that only operated in that location. Nikola Tesla outlined the basic principles of resonant energy transfer and created a number of prototype applications around the turn of the twentieth century.

The principle is akin to that of acoustic resonance - a singer who pitches a high note will cause certain glass objects to resonate at that frequency, to the extent that the energy transferred may break the glass. Electrical transfer is achieved by producing a magnetic field around a coil that then causes the coil to 'ring'; a secondary coil

placed at a suitable distance will resonate at the same frequency and 'capture' a very large proportion of the energy from the first. The energy captured can then be used to power or charge a device attached to the secondary coil.

Resonant energy transfer is considered safe, if the frequencies used are in the magnetic part of the electromagnetic spectrum, as the human body is barely influenced by magnetic fields. Some designs of pacemaker have used the principle, although significant gains in efficiency have led to most units now using batteries.

[Marin Soljagic](#) at MIT has pioneered new research into resonant energy transfer based on non-radiative fields. (Until a receiving coil of the correct design is placed within range, the energy remains 'bound' to the primary coil.) Typically, prototype systems have used a wavelength around 30m. Since the secondary coils has to be within about a distance of a quarter of the wavelength, this limits transmission to a moderately-sized room. However, the waves produced are low frequency and can easily pass around objects, so the receiving coil need not be in line of sight but anywhere in the room.

Several companies have sought to develop the arrangement proposed by Soljagic, including [WiTricity](#), which was spun off by the researchers. Intel has demonstrated Wireless Resonant Energy Link (WREL) research prototypes - see page four of this [PDF](#) and this [video](#) - and claims power efficiencies of up to 70 per cent. Sony has also [developed](#) a system that it says can transfer 60W over 50 cm (19 inches) with a 60 per cent efficiency (including 20 per cent power lost in the rectifier); adding a 'passive extender' could increase the distance to 80cm without loss of power.

WiTricity envisages coils built into the base of laptops, but quite a lot more development may be needed before manufacturers commercialise the technology. The lower power requirements of handheld hardware would be more attractive, except the current size of the secondary coil makes this impractical. Given consumer perceptions regarding various types of radiation and magnetic effect, even where studies suggest fears are groundless, gaining acceptance in the market may prove difficult. The researchers have said little about how pervasive magnetic fields could affect other hardware.

Alternatives

There are alternative energy transfer systems, such as lasers and microwaves, but these generally require line of sight and use a concentrated beam of energy, such that the receiver has to be in a known location. [Powercast](#) has developed energy transmitters based on radio frequency (RF) power, but these are targeted at very low power devices - such as sensors - that only need microwatts or milliwatts; higher output could interfere with a variety of electronic equipment. There are several 'energy harvesting' technologies under development, which pick up heat, vibrations or 'free' wireless power in the environment, but these are also aimed at very low power devices.

Barriers to a wireless future

All the technologies described suffer the same 'chicken and egg' challenge: hardware and furniture manufacturers are unlikely to add to their costs by installing power transmitters until there is sufficient demand, but developers will not integrate the receiving system until transmitters are commonly available. As often with new technologies, several systems are beginning to compete and there are different implementations within these, so standards are required. A group of manufacturers, which includes some household names, has formed the [Wireless Power Consortium](#) (WPC) to drive interoperability and promote inductive charging technology, but other approaches are either more proprietary or insufficiently developed to have taken this step. (The proposed WPC Qi standard was covered in [TechNews 09/09](#).)

Batteries are likely to be found in mobile devices for a long time yet, although fuel cells could supplement or supplant some in the medium term. (See [TechNews 09/08](#).) Connection issues may be reduced, with the EU developing standards for universal power connections for smaller portable devices, which will make it much easier to produce inexpensive adaptor kits. (See [TechNews 03/09](#).) Technology developments for transformers and new EU standards for power adaptors will make current technologies more efficient, although conductive and inductive wireless systems will also derive benefit from these changes. (See [TechNews 07/09](#) and [TechNews 04/09](#).)

Strategy Analytics is [reported](#) to have said that a fifth of mobile phones will use inductive charging in five years time, the price of which price will have fallen to just £10 by 2014. If this price point is achieved, inductive charging may become mainstream, but resonant power transfer is unlikely to appear in the short term, if ever it proves commercially viable.

Hardware news

ARM update: Cortex A9 for netbooks, low power Cortex A5

ARM-based processors are found in many mobile phones, set-top boxes, printers and a range of embedded applications, due to their size, power efficiency and cost. ARM processors use a 'reduced instruction set computing' model (RISC) that is incompatible with the x86 microcode (hardware instruction set) developed by Intel and also used by AMD. Manufacturers like Freescale, Qualcomm and Texas Instruments license ARM designs and use them in their own products.

ARM [has announced](#) a 'hard macro implementation' for its Cortex A9 chips that other hardware developers can integrate in their own 40nm 'system on a chip' (SoC) architectures. (The macros consist of a library of functions - core logic, memory control and input-out interfaces - all of which can be combined in a single SoC package.) These new hardware designs can be integrated in dual-core devices with a processor speed of 2GHz, or above, setting them in direct competition with Intel's Atom range in many embedded applications. The Cortex design handles code by using 'out of order execution' (allowing the chip to process instructions as soon as the required data is available, even if 'older' instructions are waiting in the queue) and sophisticated snooping techniques (letting the main controller view which code is

being processed to ensure that the correct data is available). Because of this, it can execute certain types of code much faster and at lower power than Intel's Atom chips.

ARM [is reported](#) to claim that their chip operate eight times more efficiently, as measured in performance per watt of power, compared to the Atom. The precise power usage is a trade-off between speed and efficiency, so using similar power to the Atom, ARM claims a fivefold throughput. These designs will be available during the last quarter of this year, with actual products available next year. The hardware macros are based on dual-core operation, but quad-core and 8-core versions of the Cortex A9 processor are expected next year.

Faster embedded processors will provide enhanced support for intensive applications, such as HD video or 4G mobile phone services, while lowering the power requirements will extend battery life and reduce problems caused by overheating. ARM chips cannot run Microsoft's desktop Windows products, although they can be used in Linux devices, including netbooks. (Linux-based netbooks have not been nearly as popular as those with Windows, but may be given a fillip when Google's Chrome OS is released.) There has also [been discussion](#) about the Cortex A9 being used as the basis for a lower cost server platform, which could be attractive in data centres running large numbers of Linux servers, especially with a view to meeting carbon reduction targets.

ARM has also [announced](#) its forthcoming Cortex A5 MPCore processor range. Aimed at low cost and mid-range 'feature' phones, smart phones, set-top boxes and all kinds of embedded systems, the Cortex-A5 is a low power alternative to Intel's Atom chips.

The Cortex-A5 system-on-a-chip (SoC) range, using 40nm technology, will be available in single- and multi-core versions, depending on space and power requirements. (Intel is in process of moving to smaller 32nm designs, but its chip architecture is both significantly larger overall and takes more power than most of the ARM alternatives already available to system designers.) All designs include multimedia processing circuitry, to power video and a soon-to-be released version of Adobe's Flash player for mobile devices.

The Cortex-A5 will replace earlier ARM9 and ARM11 designs. It will be compatible with the more powerful Cortex-A8 and Cortex-A9 processors, so developers will not need to re-write applications to run across the most recent ARM platforms.

Cortex-A5 designs will go to developers at the end of this year, but [Ars Technica](#) does not expect devices to appear in shops until 2011.

IDF update, September 2009

The Intel Developer Forum (IDF) is a regular event at which Intel launches products and gives a glimpse of future technologies. This autumn's Forum was more about iterations in current products and plans, rather than significant new announcements, with a demonstration of Intel's forthcoming multi-purpose Larrabee graphics

processor, a first glimpse of silicon from 22nm manufacturing process, details of a new integrated chip architecture underpinning new Core i5 and i7 lines, reductions in transistor size for existing chips and new processor lines aimed at embedded and mobile platforms.

AMD is rolling out 45nm manufacturing technology (see [TechNews 01/09](#)), but Intel is already in the process of moving its designs over to 32nm technology during the next year. The 22nm process, [shown](#) in San Francisco, is the next step to producing smaller, faster, more power-efficient components. As the size of transistors is reduced, distances between them are shorter and electrical resistance lower, reducing power requirements and heat yields, but the materials used have to be highly engineered to limit signal leakage. Manufacturing at this scale is at the edge of current expectations for photolithography - the process involving patterned masks and ultraviolet light used to chemically alter layers in the chip which are to be removed by etching. Whether any manufacturer will be able to produce smaller components using lithography remains to be seen, although a number of assumed thresholds related to the wavelength of light have been passed due to complex manufacturing techniques, improved materials and new light sources.

Processor designers have increasingly looked at multiplying the processor cores and integrating other key functional units on the same processor die (segment of silicon) to improve speeds. This has become more practical with the reduction in component size, removing the need for much of the data to flow through external buses, which are slower and often heavily congested. Intel [is following](#) AMD by integrating the memory controllers into the main processor die, as well as PCIe connection to the graphics card, removing the need for what has been known as the 'northbridge' - part of the chipset that has become a major bottleneck in recent years. This allows the processor to deal directly with data flows to and from the memory and the graphics processors, as well as allowing the power management logic to directly control the amount of power consumed by these functions. This design will feature in Intel's new P55 chipset, which will support Core i5 and i7 processors based on a design known as 'Lynnfield'.

The next step in functional integration is the full 'system-on-a-chip' (SoC), in which the actual graphics processor (GPU) and other functions are brought on board too. ['Moorestown'](#) is Intel's name for this mobile platform and 'Lincroft' the SoC that embeds Intel's low power Atom mobile processor onto the processor die, alongside video encoding and decoding, the memory controller and the GPU. The Moorestown platform, due out in 2010, is targeted at 'mobile internet devices' (MIDs), set-top boxes and smartphones. Lincroft is a 45nm chip, but the successor platform ('Medfield', [due out in 2011](#)) will be based on 32nm. A range of other manufacturers are developing SoCs, including AMD, ARM (along with its technology licensees) and NVIDIA.

A totally new product that Intel did announce has the code name Light Peak. This will be a new optical cable connection technology designed to replace slower connections, which could include USB and the video connections like HDMI, although Intel has not named these standards. Light Peak will be based on opto-

electrical converters to turn normal electrical signals into light for transfer down optical fibres and convert them back at the receiving end. The initial product, which Intel [hopes to bring to market](#) later next year, will be able to combine multiple communications - using different protocols - up to a total transmission rate of 10GB per second. The company expects further generations of Light Peak to transfer 100GB per second within the next decade.

In related news, Intel has announced its Braidwood technology. Flash memory has been seen as a faster and more robust means to store data than on conventional hard disks, although there have been concerns about the lifetime of each memory 'cell' and prices have remained considerably higher (per megabyte) in comparison. Having no moving parts that can break or that need to be aligned to read data, solid state disks (SSDs) built from flash memory are popular in small storage devices, mobile hardware and in contexts that need rapid a response. The last of these includes file servers, where data can be read much more rapidly from SSDs than hard disks, although the cost of providing many gigabytes of SSD storage is generally prohibitive. (The Auxiliary storage article in [TechNews 03/09](#) examined the benefits of a range of storage media and gave an indication of the prices then prevailing.)

Intel latest design for motherboards is reported to include a portion of flash memory as cache to speed up disk access to bring it within the parameters of SSD without the cost. Cache memory is nothing new, having been built into disk controllers and used for many other types of buffer, but is generally based on volatile forms of RAM. This strategy leaves data waiting in cache to be written to disk vulnerable to power outages and other hardware failures. However, much of the latency in disk access comes from read operations - as programs must be loaded and data accessed for processing. Here flash memory has a considerable speed advantage, so putting a substantial amount onto the motherboard to cache reads could considerably improve performance.

Intel's Braidwood technology, [now expected](#) to be used on its '5-series' motherboards next year, may provide between 4GB and 32GB of disk cache, into which most of the working programs and commonly used data could fit. Intel has attempted to achieve the same goals in the past with its Turbo Memory technology, but the cost, quantity of memory and connection topology did not make it sufficiently beneficial for many manufacturers to build it into their machines. The new design connects the cache directly to the main memory controller hub, rather than to another controller via the PCIe bus, putting it one 'hop' closer to the CPU and on a much faster connection. Although flash is non-volatile, it does not perform well for 'random writes' (such as the many small files used to cache web pages) so it is unlikely to be used for write-caching.

AMD has had the memory controller fabricated on the main die alongside the processor, rather than using a separate 'northbridge' layout, since 2003. Although not used for connection of flash cache, this topology can improve memory access times and other aspects of system performance.

In related news, Adaptec [has launched](#) a new MaxIQ hybrid storage array system, which combines an Intel X25-E Extreme SATA SSD with Adaptec's own caching and management technology. The MaxIQ cache can be associated with a range of SATA hard drives, SSDs and high performance storage systems to optimise input-output (I/O) operations in data centres. Adaptec claims that the flash cache structure can reduce costs by a half while increasing data access speeds by up to five times compared with hard disk only arrays. Each MaxIQ SSD kit with 32GB flash storage costs \$1,295 (about £785). SSDs and storage cache technologies are available from other manufacturers.

Intel discusses next generation 2D interconnects

Modern processors work at incredible speeds, but they require data to be supplied at the same rate if they are to operate at optimum efficiency. Cache memory on the processor chip is fed data for the current and most likely subsequent operations, as it is 'closer' to the processor core. This speeds up 'fetch' operations, as relatively limited bandwidth to the main memory is not required each time. However, the latest multi-core processors introduce further problems as the same or dependent tasks may be divided between the available processors, requiring extremely high speed interconnects to keep everything synchronised.

This detailed audio [presentation](#), with slides from the Intel Developer Forum in September, describes some of the problems created when connecting increasing numbers of nodes. (Nodes can include processor cores, memory controllers and other functional units.) Simple solutions have been based on essentially 'linear' ring networks in the past, such that data travels from node to node until it reaches its destination. Various physical and logical adaptations improve the performance of this structure, but as the number of nodes grow, so congestion increases and latency (delay) for packets reaching their destination becomes unacceptable. Two dimensional structures allow data to be passed directly to nodes on both the 'horizontal' and 'vertical' axes in some type of grid arrangement.

The researchers have been examining various factors affecting performance and possible solutions:

- Mesh networks (where connections form a rectangular grid) perform better than rings, but the number of potential 'hops' still grows with the number of nodes. Significant congestion is also experienced by nodes down the main diagonal on an unmanaged network, as they have to pass on messages from all the nodes in the column above to any of the nodes in the row to the left or below, plus any messages coming from nodes to the right. (This assumes that messages travel down through the grid and then to their left to reach the required destination.)
- 'Fully connected' networks - where each node is wired to every other node - are much more efficient but create significant physical wiring problems on the chip die. The number of connections increases almost exponentially - four nodes require six connections, five need ten, and six give fifteen connections.
- Multiple potential paths offer fault tolerance and potential for load balancing.

- Various compromise topologies (layouts) are possible, each of which has its own advantages depending on the type of network load that is applied and where 'hotspots' are located.
- Larger networks that are not fully connected require some sort of intermediate switching to create more efficient topologies. These networks are known as 'indirect' as the nodes do not connect with each other, but put packets onto a 'separate' communications network. This can add to latency as each switch makes decisions about where to route packets.
- Small control packets, or 'flits', are sent around the network to check for open routes, congestion, switch states and so on. Because they are small, flits can be packaged and processed rapidly, reducing latency for the main data.
- One design goal is to increase the frequency at which the network operates, as this will increase throughput, allowing designers to reduce the number of links and overall complexity of the network for a given workload. Driving the network at higher frequencies requires less complex operations to be performed on each clock cycle, affecting other areas of performance and the physical manifestation in silicon of the logic operations.
- A second consideration for designers is power consumption. (Mobile devices will rapidly lose charge where multi-core processors operate inefficiently, while 'green' considerations require net reductions in overall power consumption.) Each topology will have its own trade-offs between energy use and network efficiency.

The researchers have built a physical model using field programmable gate arrays (FPGAs) which they connect up according to a required topology and test in real time to analyse how throughput and latency are affected by each design for a given number of nodes. (FPGAs are chips in which the logic can be 'physically' programmed to test new circuit designs.) Hardware simulation has proven much faster (by three orders of magnitude) than using software.

The results of this research will feed into designing more efficient multi-core processors. Advanced level and college students may also benefit from the first (less technical) part of the presentation, so as to understand some of the issues involved in network design. (In principle, these issues are independent of scale, so they can apply to on-die networks, data centre networks, or to the internet as a 'whole'.)

Samsung launch 512 megabit phase change memory module

Samsung has been [recently speaking](#) about the phase change memory (PCM) modules that it is putting into production. PCM (also known as PRAM) could eventually, according to the Samsung representative, save 30 per cent in power and 40 per cent of the space compared to equivalent flash memory.

Most consumer electronic devices use flash memory to store parts of the operating system, applications and user data while power is switched off. Unlike standard RAM, flash memory can retain data because it can store charge in 'cells' that represent the data. However, flash memory has a relatively slow response times and degrades quite quickly - cells are only expected to last between 10,000 and 100,000 write cycles, depending on the type of cell used. PCM stores data by changing the

phase of a glass-like material - depending on the temperature to which it is heated and how it is cooled, it can be in a crystalline or an amorphous state. The latter has a much greater electrical resistance, allowing measurements of output current to be used to determine the state of a cell. These phase changes occur rapidly compared to flash (which cannot be written until a 'charge pump' has sufficient power to erase the existing contents of a block of cells).

The new 512 megabit (effectively 64Mb) PCM chips are initially targeted at replacing the NOR flash modules in devices like smartphones. (NOR flash is slower and has a shorter lifespan but has greater reliability compared with NAND flash. It is used for the operating system rather than user data storage.) PCM is expensive to manufacture and install on circuit boards, as soldering often reaches temperatures at which the phase change occurs. This means that, unlike NOR chips, PCM cannot be installed pre-programmed. No details were given for pricing, but Jim Handy, an analyst at Objective Analysis, did not see PCM generally replacing flash within the next decade.

Intel and ST Microelectronics [demonstrated](#) a variant of PCM in 2008 that could store 4 states (2 bits) per cell, doubling the potential storage density of a chip. FeRAM (ferroelectric RAM) and MRAM (magnetoresistive RAM) are being investigated as other potential replacements for flash. (See [TechNews 03/09](#) for details of FeRAM.)

New green laser makes HD micro projectors more viable

Pico projectors, based on Texas Instruments DLP technology, and other mini projectors have been available for some time (see [TechNews 01/09](#)), but their size limits both the brightness and the resolution of the resultant image. TI's digital light processor (DLP) system relies on chips covered with arrays of micro-mirrors, whereas other systems generally use liquid crystal lattices, neither of which can easily be reduced in size while maintaining adequate brightness and resolution. The alternative closest to commercial realisation is based on lasers, steering red, blue and green sources to light individual pixels. Lasers could create a very sharp, bright image at high definition (HD) resolutions.

QD Laser [announced](#) at the end of September that it had developed a green laser source in a module that measures just 5.6mm (under a quarter of an inch) in diameter. Green laser sources have proven difficult to develop, although [TechNews 05/09](#) reported on a system that uses 'up-conversion' to double the wavelength of infrared light to produce green. The QD Laser system works on the opposite principle, by producing a photon stream at with a wavelength of 1064nm and employing second-harmonic generation techniques: pairs of photons are transformed using a non-linear crystal, emerging as a single photon with twice the frequency but half the wavelength This produces a true green light with a wavelength of 532nm. QD Laser claims that the arrangement is highly efficient at low power and requires no cooling until temperatures exceed 60°C.

The QD Laser source would need to be linked with miniature red and green lasers, which are already available, in order to create a mini projector. The company

expects commercial products to become available next year. Micro projectors based on this technology would be highly portable, allowing students to share pictures and video directly from cameras, mobile phones and other handheld devices.

EC calls for IT to cut energy use by a fifth by 2015

The European Commission (EC) [has called on](#) the ICT industry to reduce energy consumption by 20 per cent by 2015. At present, information and communication technologies account for eight per cent of the energy used across the EU and two per cent of carbon emissions. To achieve this reduction, the EC said that the industry needed to define robust measures of energy use during next year so that it could set specific targets in 2011 to achieve the 2015 goal.

Considerable attention is being paid to energy consumption by data centres, but simpler strategies - such as switching off equipment - can yield large savings. Some IT equipment is covered by Energy Star requirements, including servers and monitors (see [TechNews 06/09](#) and [TechNews 05/09](#) respectively), but purchasers should take power utilisation into account for all new contracts and individual procurements. Energy use could have a much sharper focus with Ofgem [warning](#) that domestic prices could spike by as much as 60 per cent over the next eleven years.

The EC is also looking for IT to contribute to other energy-saving initiatives. Not only can it be used for modelling in the transport, building and other sectors, but greater use of videoconferencing could create direct cuts in energy consumption and carbon production. As broadband becomes more widely available, the Commission suggests up to two per cent decreases through moving more national and local government services online. Another part of the EC's proposals would see common standards for 'smart metering' so that householders will more readily see how they are using energy, as well as permitting suppliers to intelligently manage electricity networks and remotely read meters.

The *Green data centres* article in [TechNews 01/09](#) mentioned the zero carbon plans for [government computers](#) by 2012 and [new build schools](#) by 2016, as well as Becta's [environmental sustainability](#) guidelines.

Fuel cell Update

Fuel cells (see [TechNews 09/08](#)) generate power by combining hydrogen, or an alternative fuel, with atmospheric oxygen in the presence of a sophisticated catalyst. Hydrogen fuel cells only create water as a waste product, but have proven difficult to develop and questions remain over how the hydrogen would be stored and distributed. However, methanol has been seen to be a more viable fuel source - generating only a very small amount of carbon dioxide as well as waste water - since it is commonly available, inexpensive and simple to distribute.

Toshiba has [launched](#) its first commercial power source based on direct methanol fuel cell (DMFC) technology. Known as Dynario, Toshiba says that a single methanol refill cartridge provides sufficient power for a single charge to two 'typical' mobile phones via a USB connection. The device measures about 15x7.5x2cm (6x3x0.8

inches) and contains a microprocessor and lithium battery to ensure optimum charging. The Dynario has been made available, in limited quantities, for direct purchase from Toshiba's Japanese online store. If sold in the UK, the charger would cost about £200 and a set of five refill cartridges under £22. Toshiba says that it is market-testing the device before increasing availability or further developing the product, according to consumer response.

The news release does not indicate how long charging will take, but it must be assumed that it would be similar to any other USB-connected power source. Further, the lithium-ion battery is said to store charge - if an optimum charging rate is to be achieved, the DMFC unit may need to operate for some time before use to store charge. There is no suggestion that non-USB devices can be charged.

Fuel cells have been promoted by a number of companies as an emergency back-up power source for all kinds of gadgets, including mobile phones, cameras and MP3 players. Although flammable, appropriate methanol fuel cartridges have been approved for use on planes in the US, but there are no widely accepted standards for the physical design of such cartridges to ensure compatibility across similar products. Very few products have been brought to market by other companies, although prototypes have been demonstrated on several occasions.

A Taiwanese team is [reported](#) to have developed a charging system for mobile phones and other gadgets that would cost around \$30 (£19), when mass produced, with fuel packs costing \$0.30 (nearly 20p).

Existing mobile fuel cells largely use methanol or hydrogen as their primary fuel source. Methanol has the disadvantage of being more difficult to catalyse to produce energy and results in some small carbon dioxide emissions, while hydrogen is complex to handle as an explosive gas. The new system, developed by the Industrial Technology Research Institute in Taiwan, utilises hydrogen in a plasticised form, which is released when dissolved in water. The chemical reaction in the fuel cell itself is entirely 'green' with a little water as the only by-product, although there will be energy consumed and waste products generated through production of the fuel. Each fuel tube, which could be stocked by convenience stores, would produce electricity for two hours, but no details were given for the output of the prototype system.

The rise of the multi-touch mouse

Apple has started to sell a product it has named [Magic Mouse](#). The main innovation is a multi-touch surface for the body of the mouse, allowing gestural control rather than simple clicks. Many manufacturers have made alterations to the mouse to try to improve control and navigation, but these largely rely on additional buttons or a scroll wheel. Apple has done away with all of these and simply left the user with a touch-sensitive surface.

The Magic Mouse can be used like a standard mouse by tapping the surface, but multi-touch allows gestures including swiping with one finger to scroll and with two to flick through photos or web pages. According to [reports](#), the surface is capacitive,

which is unsurprising as this works best with fingers. (Capacitive surfaces, which sense changes in voltage caused by the touch of a finger, have been added to many recent handheld devices.) The mouse connects wirelessly to the host via Bluetooth and features an improved laser-based movement sensor system. It is only compatible with Apple PCs and costs £55 (plus VAT) in the UK.

However, Microsoft has also been investigating similar technology, with researchers demonstrating five alternative concepts. One prototype is very like Apple's, but another has a curved surface, LED lights and cameras that record light scattered from the user's fingers moving across its surface. A third device combines a central 'mouse' with articulated arms, moved by two of the user's fingers, that have their own buttons and sensors. Brier Dudley embeds a 15 minute Microsoft video of the demonstrations in his [blog](#). The researchers discuss the user interactions that could be associated with different gestures, while some of the clips reveal on a separate screen how touches are registered. A [Technology Review](#) article gives further details of the prototypes.

Multi-touch mice could initially be confusing for the user, but should be more accessible and far cheaper than large touch-enabled monitors or table-top touch devices. Stand-alone touch monitors can be awkward to use for long periods, as the user has to hold their arms up to interact with the display.

Gesture control via forearm muscle sensors

Gesture control (see [TechNews 06/09](#)) is generally mediated through touch, although camera-based motion controllers are also looking to enter the mainstream. (For example, Microsoft's [Project Natal](#).) Another approach being [investigated](#) by a team (which includes researchers from Microsoft) senses muscular contractions.

Every hand or finger gesture is accompanied by muscle moment in the upper forearm, the pattern of which is unique to each gesture. The user wears a set of six electromyographic (EMG) sensors - mounted on a band around the right arm - that measure changing electrical potentials in the muscles as they contract and relax. (Two sensors are also mounted on the left arm to detect hand squeezes as an additional control.)

Software is used to analyse data from the sensors, as they cannot distinguish individual muscles. This requires the system to be trained (in a way similar to that used by speech recognition systems in the past). The researchers are now testing a wireless version of the armband and a rapid training system. [This video](#) shows the system at work, in conjunction with Microsoft's Surface touch table.

The team envisage people with normal motor abilities using their system, perhaps to supplement existing input devices or for 'hands-free' control. There may be some applications for users with limited mobility, but those missing fingers or with more significant amputations may not be able to use it, since it is the actual movement of a finger that triggers the response in the arm muscles.

'Keyboard' without the keys helps autistic and others

[Project Blue Skies](#) is seeking to give learners with autism a better way to communicate using the [OrbiTouch](#) 'keyboard'. [Launched by](#) the US National Science Foundation (NSF), the [teaching materials link](#) learning objectives, communication approaches and assistive hardware to try to help people with autism communicate better in a digital world.

The NSF contends that 'the distraction and complexity of a keyboard can be an insurmountable obstacle' to autistic learners, so they selected OrbiTouch as a superior alternative. The user manipulates two handgrips by sliding them in the direction of the next letter to be typed; each control is mapped to the eight main points of the compass, which are colour coded to help the user associate the direction with the required symbol. For example, moving both controls 'north' produces an 'm', whereas moving the left 'south' and the right 'southeast' deletes selected text. In principle, this permits only 64 symbols (8x8) to be typed, but sequences involving control characters can be used to extend the range of outputs. A mouse mode can also be engaged, removing the need for a separate mouse. The keyboard uses standard connectors and drivers for both Apple and Windows PCs. It is priced at \$399 (about £245), although no indication is given of UK availability.

The makers of OrbiTouch suggest that it is also suited to people with existing physical problems due to repetitive strain injury and to those with poor motor skills.

Software and internet

Analysis: URL shortening services

At a glance

- Long URLs, often generated by database driven websites, can create problems for users.
- URL shortening services, such as used by micro-blogging sites, are becoming increasingly popular.
- Shortening services generate a 'key' using a mathematical algorithm. A combination of letters, numbers and other characters may be produced.
- The precise nature of the algorithm used will affect the number of URLs that can be shortened by the system.
- URL shorteners add 'value' to their services by providing statistics and history on how a link has been used.
- Shortened URLs have a range of disadvantages, including hiding undesirable content, questions over the reliability of services and suitability for users of assistive technology.

The lengthening URL

Resources on the internet are referenced by a URL (uniform resource locator), more commonly called the 'web address'. The URL contains information about where the resource can be found and how it is to be loaded. Due to the quantity of data held by many reference sites, pages often sit within a complex hierarchy defined by the designer, so a recent BBC News story on cricket is referred to as:

Example website:<http://news.bbc.co.uk/sport1/hi/cricket/england/8264360.stm>

Many large websites (such as online shopping services) now use database technology to retrieve the information required, adding complex search strings and user information into the URL that references a product. These URLs can be very difficult to type accurately from a printed text and are very hard to remember.

Long URLs can break across two lines in plain text message systems that use a limited line length (including some fairly widely used email clients), confusing recipients who fail to realise that they did not copy the complete address into their browser. Online texts generally put the URL behind a hyperlink, such as [cricket story](#), so the user only need to click the link rather than type the address, but this is entirely unhelpful in print publications. In micro-blogging services (see [TechNews 03/09](#)) like Twitter, long URLs may take up most of the characters permitted in a 'tweet' (single message).

URL shortening

URL shortening is a process that replaces a more direct reference to a resource with an 'intermediate' web address formed from as few characters as possible. When a user types in the shortened address, the browser looks this page up and tries to load it, but (commonly) the server for that address detects a '301 redirect' and passes the browser on to the location of original resource that the user wanted to view. (A 301 redirect, which is implemented in a variety of ways on different types of server, contains information to show that the page has been 'permanently moved' to a new address.)

One of the earliest services was [TinyURL.com](#), but a whole generation of contenders has emerged with even shorter domain names, like [Bit.ly](#), [Br.st](#), [Ow.ly](#) and [Tiny.cc](#). (Some of these domain names are only five characters long, compared with TinyURL's 11 characters, leaving as many as six more characters for the micro-blogger to use in a comment related to the shortened URL.) [SplashURL](#) uses [ls.gd](#) to quickly 'publish' shortened URLs in a large size during presentations.

The length of the shortened URL is determined by the shortening algorithm, as well as the length of the domain name. The part of the address after the domain name should be a unique key that the service associates with the original address. The short URL <http://bit.ly/lupcX> links to the cricket story above, using 'lupcX' as the key.

A range of algorithms using sequential references, 'hash' functions and random characters can produce the key. The choice of characters used affects the complexity of the key: a key of six characters selected from 26 lower case letters produces almost 309 million possibilities, whereas including capitals and numerals as well yields nearly 57 billion. (26^6 compared to 62^6 .) Changing the number of characters in the key will also have a dramatic effect on the total URLs that can be shortened. Services (for example [Tinyarro.ws](#)) utilising Unicode, which introduces characters from a wide range of international scripts, could provide 65,536

possibilities (or more) for each character in the key, but this may both confuse users and create incompatibility with some software.

The short domain names used often relate to countries that are less economically developed, or which some may consider less secure. For example, .cc refers to the Cocos Islands, .gd is Grenada and .ly is Libya. (County codes from domain names can be looked up using the official Internet Assigned Numbers Authority (IANA) [Root Zone Database](#).)

There are a number of open source scripts that web masters can install on their own servers to shorten URLs - Brian Cray, a Web 2.0 developer, provides an example [on his blog](#). One developer [has stated](#) his intention to put his [Tr.im](#) service into the public domain as an open source project, although how it will be managed [remains unclear](#).

A number of social bookmarking and other web 2.0 services, such as [Digg](#), [FriendFeed](#) and the virtual world Second Life, now offer their own embedded shortening functions when users opt to 'share' content over social networks. New picture and video hosting services are also springing up that provide short URLs for content, often posting addresses as messages in Twitter.

Adding value to shortened URLs

Most of the popular shortening services provide simple plug-ins that can be added to the 'links' or 'bookmarks' bar in most widely-used browsers, so that users can click an icon and have the URL of the current page shortened. The websites for URL shorteners often provide statistics and a 'history' of how a particular URL has been used, although they may require users to be logged in to the service first. A number of third party applications now take advantage of this: before displaying the destination URL, they provide further information to users to help them decide whether to follow a link. Appending '+' to the URLs of some services generates this information directly. (For the cricket story: <http://bit.ly/lupcX+>.)

Many services now include an option for the user to define a key word rather than the automatically generated key, so <http://bit.ly/cricketstory> should also lead to the BBC cricket page. These links may not be as short as the default key, but convey more information (if defined sensibly) and are less likely to be mistyped. They also tend to be offered via the service's website, encouraging traffic to the site, which may form a potential income stream where advertising is displayed.

Issues for educators

Short URLs seem attractive, but raise a large number of issues for staff and learners:

- The destination domain and content produced by a shortened link are generally unclear - although links created by databases can be equally obscure
- The combination of characters used for a short URL is hard to remember

- Short URLs are not appropriate in many forms of writing, especially where links need to be given as references to an assignment or in official publications
- Some style guides specifically forbid the use of shortened URLs
- Multiple short links may be generated by different users for the same resource
- Resolving short URLs doubles domain lookups and adds to network traffic
- URL shorteners can act as 'proxy anonymisers', hiding undesirable content from web filtering systems and overseeing eyes
- Shortened URLs can pose security risks, being used (for example) by spammers as intermediate vectors for a phishing attack
- The servers hosting the URL shortening service can themselves become infected by malware. (For example, [Cli.gs in June 2009](#).)
- When resources referring to information on the internet are shared, varying institutional and authority filtering policies may render short links unusable for other users
- Users may be concerned about privacy, especially as the destinations viewed by logged-in users can be tracked
- Reliability and long term viability of the services need to be considered (including those provided in-house). Many services remain in a semi-permanent 'beta' (experimental) phase and 'linkrot' may be generated when a service provider closes or chooses to re-use existing links.
- Most services are currently offered for free, but investors may demand a return for their money by insisting on advertising (some of which could be inappropriate) or moving attractive parts of the service into paid-for 'premium' accounts
- The 'jumble' of letters can cause difficulties for users of assistive technologies, such as screen readers.

QR codes (see [TechNews 06/09](#)) could be a better alternative to URL shortening in some contexts, such as on slides used for a presentation.

Addressing the future

Some sites use so-called 'blacklists' of URLs known to host malicious or undesirable content. When a request to shorten a URL is passed to the server, it first compares to (for example) Google's [Safe Browsing](#) list, before shortening the URL. Shortened URLs can be expanded and the contents viewed through some of the shortening services, as well as third party applications. It is often possible to set an option (stored in a browser cookie) so that the server responsible for expanding the URL automatically previews the destination address or content. However, this intermediate step may be a hindrance to frequent users, deterring them from regularly using previews.

Using services that embed precautions of these types can make the experience more secure. Some institutional or regional broadband consortium (RBC) filters may be configured to perform the same types of checks on redirected links before content is passed back to users. Web designers and educators managing web projects need

to consider carefully how URLs are created: where an in-house database is used, an appropriate length of 'native' URL should be considered to avoid the temptation for users to shorten URLs as a matter of course.

The number of shortened links encountered is liable to increase and teachers and researchers are more likely to find shortened URLs used in publications and assignments, as well as in Web 2.0 environments. User education regarding appropriate contexts in which shortened URLs are appropriate and how they work may be appreciated by both staff and students. This guidance could be formalised in some institutional policies, especially guides to 'house style'.

Please note: although Bit.ly has been used extensively in this article, no specific endorsement or guarantee of service should be implied. It has been used as an example of one of the many services available.

Software and internet news

Mobile operating systems update 11/09

Considerable development and innovation has been occurring in mobile operating systems recently; [TechNews 09/08](#) gave an overview, which was updated in [TechNews 03/09](#).

The operating system (OS) gives application developers access to hardware (such as the main modem, memory, GPS or a camera) and built-in services (for example, contacts or text messaging), without having to write their own code. Each OS developer makes decisions about the level of access to these resources and the degree that optional services (such as GPS) are supported as standard OS features. Further, they may provide common functions, such as an address book, within the OS code. There have been recent moves to reduce the number of mobile operating systems available, so that application developers can support more phones without rewriting code. This may be advantageous for educational application developers - both for standalone tasks and for access to resources on learning platforms and other portals - as fewer OSs will need to be considered to support the great majority of users.

Some operating systems, such as the iPhone OS, Palm's web OS and Windows Mobile, remain proprietary. Apple has [shown the benefit](#) of maintaining tight control of the hardware and operating system with the success of its App Store, which now has over 100,000 applications and has served more than two billion application downloads. (Many of the applications are either free or available as limited trial editions.) Other developers are seeking to emulate the App Store's success.

The alternative approach has been to "open source" code, making it available to as many handset manufacturers and carriers as possible. Open source code can be used and modified freely, although there may be some license restrictions - for example, to ensure that changes are made in a transparent way - while some OS developers have maintained proprietary portions of code to protect existing patents.

LiMo and Google's Android have been open source from inception, while Symbian (which runs on most Nokia phones) was made open source earlier this year.

LiMo [announced](#) the release of version 2 (R2) of its platform with the launch of a new Samsung H1 handset, available through Vodafone in the UK and elsewhere. Vodafone has 'skinned' LiMo R2 with a custom touch interface to work with its new [360](#) service. Vodafone 360 integrates a number of social networking feeds, as well as providing online backup for the phone's content and synchronising contacts and appointments across other devices, such as desktop PCs. The Samsung H1 is [available](#) in the UK and Vodafone plans to bring 360 to other new devices, including many non-LiMo phones.

[Version 2](#) of Google's Android platform (codenamed 'Eclair') has also come to market with the [announcement](#) of the Motorola Droid handset. Google shocked the market by introducing free, native support for SatNav applications built on Google's Streetview and Maps services in Android 2.0, as well as other enhancements like multi-touch gestures. This does not mean that these features will be supported on all handsets, or that all existing handsets will be capable of the Android 2.0 upgrade. In addition to hardware capabilities, the upgrade process will be affected by custom designs, such as HTC's 'Sense' user interface, that have been overlain on the main Android platform. UK availability of the Droid's European equivalent ('Milestone') and the precise feature set have yet to be announced.

The Symbian foundation [announced](#) in October that it was 'nine months ahead of schedule' with the open source release of its main microkernel and development kit. Further, it [launched](#) a new developer publishing programme, known as Symbian Horizon; new applications will be tested, listed in an online directory and 'signed' for distribution through its partner's application stores. Existing 'signed' applications (for the current, proprietary version of Symbian) would be added to the listing. It is [reported](#) that the first handsets using the open source version 2 of Symbian (S^2) will be available during the first half of next year, while further updates (S^3 and S^4) are expected during 2010.

Nokia has [launched](#) the new N900 handset in the UK, as expected, based on its most recent Maemo 5 open source OS. In the past, Nokia's Maemo devices had been larger 'mobile internet devices' (MIDs) - as Intel might call them - designed as small, tablet-form, touch-screen, internet-browsing devices. (The N900 actually uses an ARM-d main processor.) Maemo, like LiMo and Android, is founded on Linux, so it is both feature-rich and power-hungry, suiting it to smartphones and larger mobile devices with fast processors and better batteries. Silicon.com [reports](#) a Nokia spokesperson stating that Maemo would be used in innovative new products "unencumbered from any kind of legacy" (unlike Symbian).

There has been an interesting debate in the media and on blogs (for example these articles from [Ars Technica](#) and [CNET News](#)) regarding the merits of the various open source offerings and the degree of access to system code available to developers. The CNET article argues that the issue does not really reside in the openness of the operating system, but in the openness of 'cloud' services brokered by the phone -

there is little advantage in having an open phone if your data is locked into a proprietary service on the internet.

Microsoft released version 6.5 of its Windows Mobile platform in October, as expected. (See 'Mobile OS update' in [TechNews 03/09](#) and the Microsoft [press release](#).)

Windows Embedded Standard 2011 available as developer preview

Microsoft [announced](#) a 'community technology preview' for its forthcoming Windows Embedded Standard 2011 operating system at the start of September. Embedded operating systems are used to control many specialised devices, from medical equipment, through manufacturing robots, set-top boxes and car navigation systems, to classroom sensing and control equipment.

Windows Embedded Standard 2011 will be based on the same Windows 7 core as its forthcoming desktop operating system, enabling developers to create code using the same tools for both environments and easily port it from one to the other. The embedded environment will be more modular than the standard editions, allowing developers to integrate only those components required for a particular application. Major options are expected to include Microsoft's touch interface, Internet Explorer, Windows Media Player and the latest Remote Desktop Protocol for thin client systems. This version is not a finished product, but will enable developers to start writing code, while giving Microsoft feedback on any issues that may be found. The 'release to manufacturing' version is expected in the second half of 2010. Further details will be given at the Embedded Systems Conference later in September.

The preview is available to registered users from Microsoft's Windows Embedded Standard ['Connect'](#) website. A wide range of alternative embedded operating systems, including open source Linux variants, is available from mobile and other developers.

Microsoft research identifies factors that lead to bugs

Large software applications are difficult to test, so programmers must make decisions about how testing will be performed and the degree to which each component will be tested. Software errors can range from those that are a nuisance to users, to issues that put the security of individual computers and complete networks at risk.

A Microsoft researcher, Nachi Nagappan, has been working with the Windows development team for a year to identify some of the critical factors that lead to (relatively) fault-free code. The Windows code base contains many tens of thousands of lines of instructions, developed by several international teams operating within the same organisational structure. Among Nagappan's [conclusions](#) were the following:

- Increasing the level of testing does not necessarily increase the reliability of the software. In terms of the faults experienced by Microsoft's end-users, it is

more important to focus testing on the parts of the code used most frequently and those that are most complex.

- Test-driven development (TDD) produces better code. The normal practice of programmers is to write the source code first and then test code that will subject that source code to the appropriate inputs and other conditions that it should handle. In TDD, the test code is written first and then the source code is written to 'match' it. Although teams using TDD can take 15 to 35 per cent longer to write code, the 'defect density' is 60 to 90 per cent less than code developed in the normal way. This creates a trade-off between development time and both the aggravation produced for users and time taken to trace bugs after the event.
- Inserting 'assertions' produces better code. Assertions are generally text comments in the source code that describe what each section of the program is intended to achieve. However, this correlation also mapped to the greater experience of engineers that regularly used assertions.
- The accuracy of the code reflects the complexity of the structure within which programmers work.
- The output from geographically distributed teams is only marginally more prone to errors than components developed by collocated teams.

These conclusions were drawn from data that could be said to reflect Microsoft's particular practices, so Nagappan would like to extend his studies to other environments. Nevertheless, there are lessons here both for educational developers and for those teaching programming in colleges and sixth forms.

Google to launch online book store in 2010

Many book retailers already operate entirely online or have an online presence, but the entry of Google into this market is a significant step. The company has already been scanning a large number of books in US libraries, making those otherwise out of print available through its book service, alongside samples of those still available. Google reached a copyright agreement with US publishers, which has since been challenged legally and is [due to be amended](#) for a November court hearing. [Google says](#) that it has already scanned over a million public domain books (those out of copyright) which it has made available in the EPUB standard. (EPUB, previously known as Open e-Book or OEB, is an open standard for distributing books for use on a variety of devices and standard PC applications. It was covered in the article on E-books in [TechNews 03/08](#).)

The new project is to be known as Google Editions, through which Google [will operate](#) as an electronic wholesaler for digital versions of books that are in print. Due to be rolled out in 2010, the company says that around half a million books will be available for purchase through a browser-based interface. This will make all the books accessible to devices running a suitable browser, including desktops, netbooks and many mobile phones. Google has not said which book format would

be used or whether owners will be able to transfer titles between devices, but they will be available to read offline after they have first been accessed. Google will be working with a variety of retailers and directly with publishers.

The EU is engaged in a review of copyright for published works across Europe and has [specifically referred](#) to the issues raised by the Google scanning projects. In particular, it wants to address the issues of 'orphan works' (where details of the copyright holder cannot be identified or located) and accessibility for blind and other disabled people to digital versions of books. The EU has also [been scanning](#) its own publications, to be made available through the [EU Bookshop](#) and the [Europeana](#) archive.

In related news, the Internet Archive, which also operates the Wayback Machine of archived versions of websites, has [announced](#) a new [BookServer](#) project. The aim is to produce a server architecture suited to books (in the same way that a web server delivers web pages) and common indexing system that would allow users to search millions of digitised books. Publications would be available for lending, purchase or both. The timescale and practical details (including funding) for this project remain unclear.

Several new e-book readers have been launched or are about to come to market, including Barnes and Noble's [Nook](#) in the US, Spring Design's [Alex](#), the [Que](#) from Plastic Logic and the international version of Amazon's [Kindle](#).

Tool released for improve mobile web design and accessibility

Many people are posting their own web content and acting as web masters, whether on their own site or using hosted services like blogs and wikis. Many web pages follow a commonly accepted visual structure of menus, headings and content that users quickly navigate to find information that interests them. However, the underlying code (whether in HTML, CSS, XML or a scripting language) may not order content in anything like the same manner, especially where there are embedded images, tables or advertisements. This becomes a major problem for both screen readers (used by visually impaired people) and for all users of mobile devices with small screens - when 'reformatted' for use by these, the content may be presented in an illogical, non-sequential order.

IBM has developed a visual tool that allows content authors to review reading order on their web sites and employ a 'drag and drop' approach to reorder it appropriately. The current flow is shown by arrows, with nodes that can be dragged around the screen to ensure that text will appear in the intended order on mobile devices and through screen readers. IBM says that the same tool can be used to check PDF documents, presentations and Flash content. The [press release](#) contains a video that shows the tool in operation, but gives no name to the software or details about availability. PC Advisor [reports](#) that it may be part of the Lotus suite or released as an open source tool. The same article points out the issues that would still be faced by developers of large database driven systems, where resulting pages cannot be manually reviewed in this way, and the need to alter some content for better presentation on mobile devices.

This project is a good example of where starting to make a particular technology more accessible can also of real benefit to every user. (Google's T V Raman has demonstrated other instances - see Accessible interfaces, [TechNews 01/09](#).)

Exploring virtual maps to make sense of the real world

People with significant visual impairment will often explore new neighbourhoods in the company of a sighted person in order to learn routes and understand key risks. [New software](#), BlindAid, aims to use virtual reality for the same purposes. The software links to a joystick with force feedback and other haptics capabilities, providing the user with a sense of touch, so they are able to feel the texture of asphalt or the edge of a pavement.

BlindAid needs a detailed map of any new environment, whether that is the route to a campus, the layout of a library or the outlets in a shopping centre. This Sounds can be associated with locations, so a telephone may ring when passing a reception desk or flowing water be heard when approaching a brook. Dr. Orly Lahav's intention is that blind users will be able to explore environments and plan routes before going out, helping to raise their confidence and giving greater independence.

New audio tags to provide information for blind people

Information tags, such as QR codes and other types of bar code (see [TechNews 06/09](#)), are often used to mark items in a machine-readable way. Working with Mantra Lingua, the RNIB has developed a new system for the visually impaired, enabling them to create their own custom audio tags that can be attached to any object. The [PenFriend](#) (see [YouTube video](#)) should help blind people identify food in their cupboards, pick up the correct documents to take to a lesson or appointment, remember which medicines to take, or label the controls on a new device.

The system is based on a set of cheap labels 'pre-printed' with microdot barcodes, each of which has a unique coding. (The labels, which cost £9.99 per set, are only unique within a pack, so different users may use the 'same' labels for different purposes.) When labelling a new item, the user scans the label using the battery-powered 'pen' and records a voice memo, which is then played back when the item is scanned in the future. The pen can store about 70 hours of audio and costs £54.95 (excluding VAT) from the RNIB. The pen can be interfaced with a computer via USB, permitting MP3 audio files to be transferred in either direction.

Early years teachers may also find the PenFriend useful for labelling objects, although a number of other products (such as [Talking Tins](#) and those using more expensive RFID tags) perform a similar function.

Transition to independence eased by portal for learners with disabilities

The [Click Start](#) project is working in partnership with The Rix Centre and ten local authorities (LAs) in northeast London to provide appropriate information to people with learning disabilities, to ease transition to living and working in the wider community. Content, which is created by young people involved in the project, covers areas such as independent living, finding employment and further education

in the community. Information is presented as images with short captions and optional audio narration.

The structure of the site is based on templates designed to simplify user input, prompting for appropriate titles, descriptions and files for images to be displayed. Effectively, it is built as a wiki, with sections for each LA team, but the final appearance bears little resemblance to how most people imagine a wiki to look. Content can include video files, such as diaries of people's own experiences.

The project was [launched in July](#) at an event hosted at the House of Commons by Lord Rix. It is largely funded through a grant from the European Social Fund, channelled through the Learning and Skills Council, but would need further funding to be rolled out nationally.

Children's web access - 60 per cent surf unsupervised

Ofcom [has published](#) an interim report entitled [UK children's media literacy](#), with a further report based on data collected this autumn due in spring 2010. The report contains many statistics on the media used by children, where they consume it, the hardware used, frequency of use, e-safety measures imposed by parents and data break downs by age, sex and household income. The results are based on 1,044 in-home interviews with parents and children aged 5-15 between April and May this year. Comparisons are drawn with similar surveys prepared in 2007 and 2008.

Access to media through television, the internet and other sources has increased across the board, but actual use varies. For example, in lower income households (socio-economic groups D and E), access has increased but no more children actually use the internet than in 2008. The report also finds that children have started using the internet at somewhat younger ages across the period and that their preference for television drops off with age.

Headlines have noted that more than a third of 12-15 year-olds (35%) now have internet access in their bedrooms, with one in seven (15%) of those having games consoles in their rooms (75% of the age group) playing with friends over the internet. Just under half of parents have implemented internet filtering or parental controls but a substantial majority (growing with the age of the child) say that they 'trust [their] child to use the internet safely'.

One in six users aged 5-7 (17%) are mostly left to use the internet unsupervised, but this rises to 60% for young people aged 12-15. Around three quarters of young people (depending on age) have had lessons about the internet at school. PIN access to multichannel television services, especially for satellite and cable, has increased since 2008, with a third (34%) of parents blocking content in this way. A significant minority of parents (around 13%) do not know how to set controls for access to the internet or to television content, or are unaware that such controls exist.

An important addition to the latest report has been data on parental knowledge and concerns about location-based services on mobile phones. Parental awareness of

these services remains in a slight minority (41%), but nearly three quarters of these have concerns that other people or commercial marketers might misuse awareness of a child's location.

These figures show the continuing need for e-safety education in schools. According to the [Telegraph](#), CEOP (the Child Exploitation and Online Protection Centre) has changed its advice to parents:

A spokeswoman said: "A few years ago we would have said it was important to keep the computer in the family room. But now in light of new technology, and as more children can access the internet on mobile phone and consoles, the advice is to educate yourselves and your children about what the internet can bring and keep safe."

Half of young people want personal privacy advice

[Ofcom research](#) has found that over half (54%) of young people aged 11-16 would like guidance about how to keep personal information safe online. Worryingly, nearly a quarter (23%) suggested they had never received guidance on this issue. Although only ten per cent of children aged 7-16 use mobile phones to go online, two thirds of those parents and carers are unlikely to be aware of the existence of access controls for online content. Thankfully, 'very few' children and young people have actually seen material that they consider inappropriate or which has upset them. More children (16%) who use games consoles go online but only one in twenty of those had seen inappropriate content.

The [full report](#) gives further details of young people's use of portable technologies and the level of awareness among parents and carers of the built-in content controls. Data is based on in-home interviews with 797 children and young people surveyed by Ipsos MORI.

TechNews Information

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