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BRITISH TELECOMMUNICATIONS ENGINEERING

Included in this Issue

Start of New Series:

Internet and Multimedia

36th European Telecommunications Congress

The Journal of The Institution of British Telecommunications Engineers

BRITISH TELECOMMUNICATIONS ENGINEERING

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Rupert Gavin

Internet and Multimedia Services

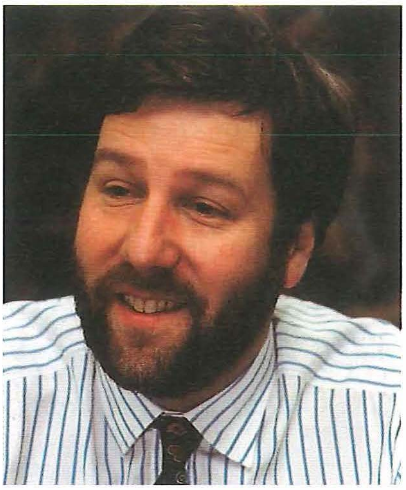
In the last few years, interest in Internet and multimedia services has grown dramatically, fuelled by advances in digital processing, network and compression technology, the exponential expansion of the World Wide Web and the rapidly increasing awareness of the potential benefits to individuals and companies. By the next millennium, Internet traffic from an estimated 300 million users could surpass voice traffic. New services made possible by the convergence of computing, communications and audio-visual media will create a $250 billion global market. BT cannot ignore this sea change in its business and is working to establish a leading position in this new arena.

BT's approach has been to pick likely winners from the multitude of possible service opportunities, run whatever trials are necessary to understand the technology and the market, and launch them as quickly as possible. This is a fast-moving, high-risk business in the most exhilarating part of our helter-skelter industry. It often requires the right deals with the right partners to assemble a jigsaw of commercial and technical components. In some cases, a service will fail and the company will withdraw, assimilate the lessons learnt and use them as the basis of future success. In many cases, services are already establishing BT and its joint ventures as leading-edge, world-class players in the Internet and multimedia game—the most exciting game in town.

This edition of *British Telecommunications Engineering* contains the first of a series of papers describing some of these services. BT launched CampusWorld in September 1995 and has introduced a new service every few months since then. The portfolio now includes:

- *CampusWorld, HomeCampus* and *CampusConnect* on-line educational services;
- the *LineOne* on-line information service for the whole family provided by Springboard, a joint venture between BT and News International;
- the *WebWorld* suite of web-hosting products allowing companies to publish and do business via the Internet;
- the *Wireplay* PC games network from BT being adopted by MCI and others;
- the *BT Internet* mass market product offering dial-up access to the full range of Internet services;
- *Touchpoint* interactive multimedia kiosks providing a selection of mostly free information and merchant services;
- *BTNet* Internet access services designed to connect business customers' networks to the global Internet;
- the *Dial IP* service providing dial access to host sites using Internet technology;
- the *HealthNet* secure data communication service for the National Health Service;
- *HealthNet WebWorld* offering organisations World Wide Web publishing on the National Health Service secure network and optionally on the Internet;
- *Intranet Complete* developed by BT, MCI, Concert and by Microsoft for secure electronic solutions to replace inefficient manual and paper-based intra-company processes;
- the *BT Network for Lotus Notes* portfolio of services managed by BT and tailored to the requirements of the Lotus Notes user community.

One of the difficulties with such a dynamic field is keeping up to date. In the time taken to prepare a single issue of this journal for publication, BT may have taken an initial service concept, researched market requirements, engineered a platform for a serious trial, established relationships with technology and business partners and announced an addition to its portfolio. In this environment, writing papers has to take lower priority than service delivery. However, I believe that increasing the awareness of Internet and multimedia services will help you understand their importance to the business and the benefits that they could provide to current and future customers. I hope that you will find the descriptions of them interesting and informative.



This is a fast-moving, high-risk business in the most exhilarating part of our helter-skelter industry.

Rupert Gavin
Managing Director BT Consumer Division

Phil Leveridge and Ian Webster

CampusWorld—Two Years On

BT's CampusWorld has now been running as a live Internet service for the past two years. Launched at the beginning of September 1995 it has steadily grown its user base to nearly 11 000 users. This article looks at what CampusWorld currently offers, the technology behind it, the experience of both those that run the service and those that use it, plus a brief look at where Campus is heading.

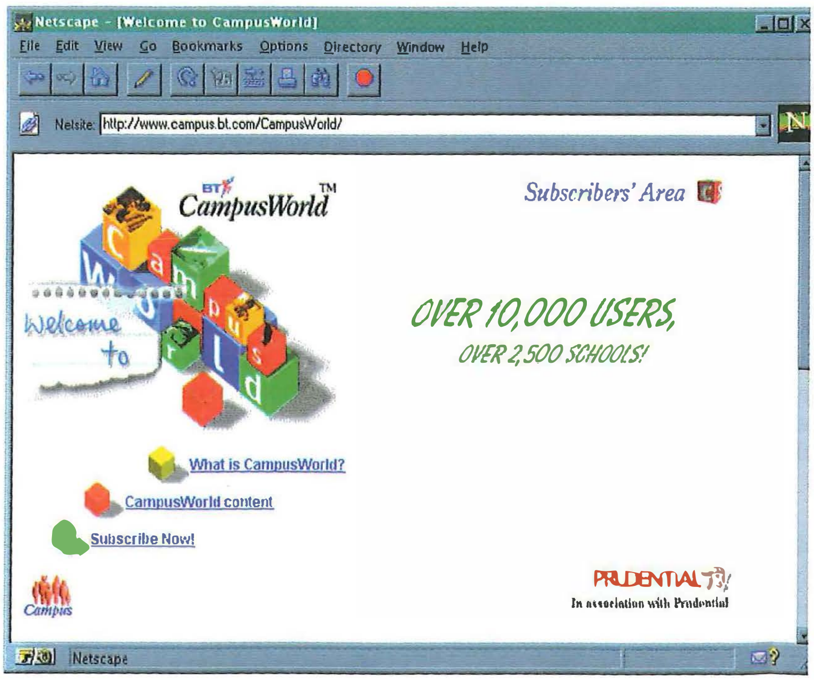
Background

CampusWorld (http://www.campus.bt.com/) is targeted at schools and colleges of further education and provides exclusive resources for teaching and learning, e-mail, file transfer and access to information databases. The service is one of BT's on-line products and uses BT's access infrastructure: BTnet and Internet Dial Access. The service allows access to all the benefits of the Internet, the first real artefact of the much-heralded 'information age' and 'super highway'. It allows schools to access the benefits already being discovered by commercial companies and universities—discussion and collaboration in a range of ways, either one-to-one, via mail messages, or one-to-many via discussion groups. The benefits of the Internet can be tempered by some less attractive features, some of which have been explored in the media to the exclusion of all else! CampusWorld, and the other products in the Campus family, have tackled this problem by providing a feature rich 'walled garden' for schools to roam in, without allowing access to more undesirable information. Time is also an important factor when looking for useful resources on the Internet, especially for busy classroom teachers, who simply cannot afford to spend several hours hunting for teaching and learning materials. CampusWorld provides the one-stop shop—a tremendously valuable mixture of access, specially designed resources and selected links to other useful sites.

The information within the 'walled garden' has been carefully created and checked for its suitability for schools. The schools can choose to keep within the walled garden protected area, or venture out (by special password) onto the full Internet.

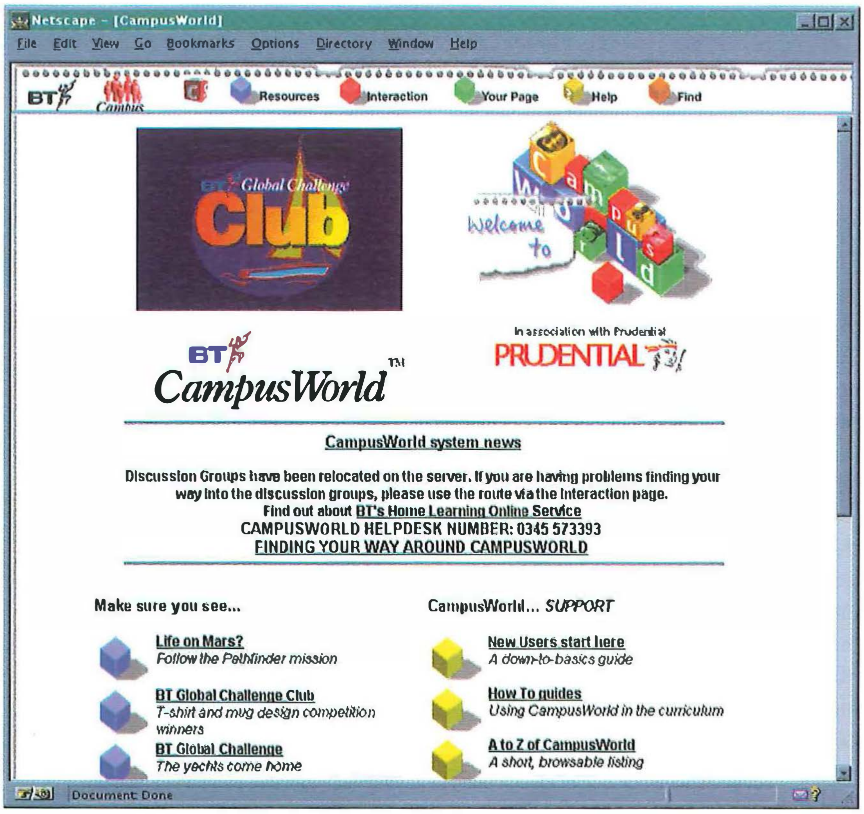
CampusWorld went live on the 8 September 1995 after three months of live trials with 20 schools situated all over the country.

The live service was an instant success and now has over 2500 schools and colleges using it. It offers these schools a number of facilities including:



- *Electronic mail* Schools can communicate using electronic mail. Facilities allow for the creation of circulation lists, aliases and other Internet standard mail features. This allows schools to correspond with other schools or pupils to individually correspond with 'pen-friends' across the world.

- *Discussion groups* Discussion groups can be set up so that topics can be open to a wide range of users. The software is very flexible and allows the organiser of a discussion group to set a number of parameters, such as access and editing rights. Each group is mediated and carefully focused in order to promote effective use of the facililty.



- *Internet access* The service is split into a free corner, accessible by all, which gives a sample of CampusWorld features, and a 'walled garden' available only through subscription. In addition to providing exclusive resources for subscribers, the walled garden approach allows for the maintenance of a 'white list' of external web sites. If BT access routes are used, this allows a school to create users with different access levels. Three levels are typically used: exclusive content only; exclusive content plus the whitelisted sites; or exclusive content and full, proxied web access.

- *School curriculae on-line* Curriculum material produced exclusively for CampusWorld by education specialists is available to be used by teachers in the classroom. This is augmented by the white-listed external web sites, which are embedded throughout CampusWorld. These sites are also listed in a section managed by curriculum specialists, who constantly check the sites for their suitability and annotate the links, providing teachers and pupils with guidance on what the site is all about together with its relevance to the learning situation.

- *Live news feed from an agency* Schools have access to the latest news by a news feed supplied by PA News. This provides a wealth of current information on politics, human interest, sport and so on, which is building into a useful searchable archive of information. The information can also be 'cut out' and used by schools to make their own newspapers—a very popular activity.

- *Web publishing* Schools are provided with unlimited Web space on CampusWorld to publish curriculum work on the Internet. Simple-to-use tools enable them to upload their Web pages. A standard FTP mechanism is also available for experienced users. Hundreds of schools have taken up this opportunity to publish on a global stage.

- *Minitel* Access to the France Telecom Minitel Service is by terminal software provided by a specialist French company. This enables schools to access the full range of its services including its telephone directory services.

Description

Features

Once users have logged in they are presented with a menu of options that take them deeper into the functions and information offered by CampusWorld. The top menu bar quickly takes them to the core features of CampusWorld:

- *Resources* Background information for teachers to use in lessons.

- *Interaction* Projects designed to get teachers, pupils and schools communicating and involved—such as the X project (see later).

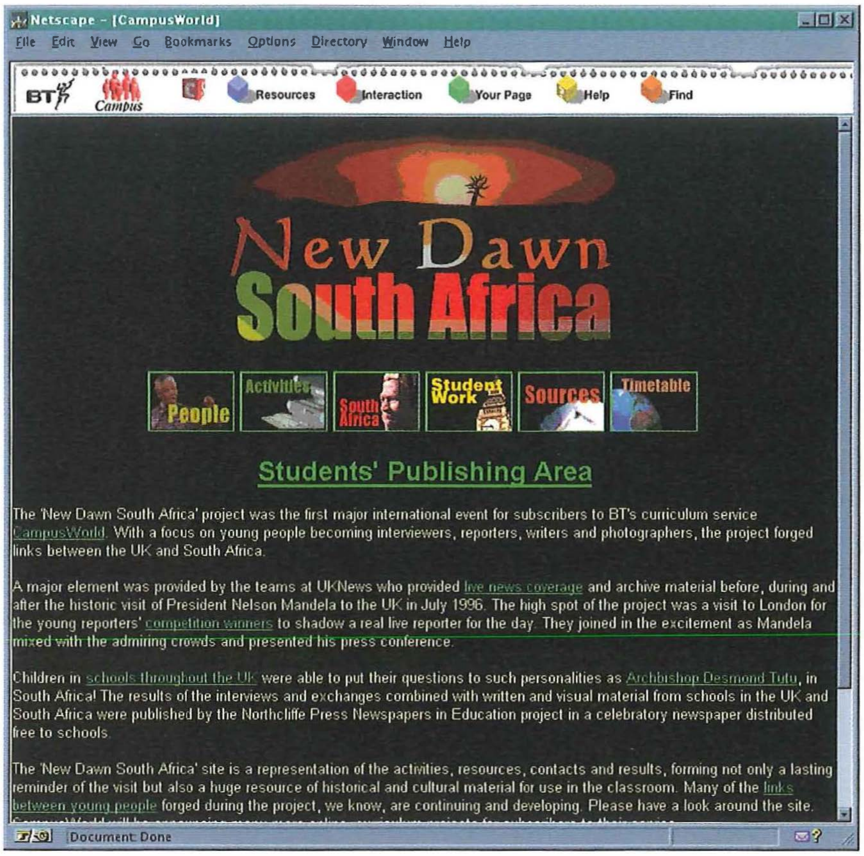
- *Your page* A page about and for the user. This provides links to enable additional user accounts to be created, e-mail to be read and even Web pages to be created and modified.

- *Help* An on-line guide to CampusWorld and the Internet for the novice user. The guide also acts as an invaluable IT resource for those wishing to develop their own IT capability.

- *Find* Powerful search engine to locate information on the Campus web site and the school's own Web pages.

Projects

CampusWorld prides itself on the quality and relevance of the interactive projects it runs—one of the many things that makes it unique among education web sites. Two examples of this are New Dawn South Africa and The 'X' Project—a schools on-line election site. Both are wonderful examples of how Campus is not just an electronic version of paper-based information: it is a dynamic, interactive resource for teachers and pupils which harnesses the real power of the Internet and encourages communication, collaboration and interaction.



New Dawn South Africa

The New Dawn South Africa project was the first major international event for subscribers to CampusWorld. With a focus on young people becoming interviewers, reporters, writers and photographers, the project forged links between the UK and South Africa.

A major element was provided by the teams at UKNews, who provided live news coverage and archive material before, during and after the historic visit of President Nelson Mandela to the UK in July 1996. The high spot of the project was a visit to London for the winners of the young reporters competition to shadow a real live reporter for the day. They joined in the excitement as Mandela mixed with the admiring crowds and presented his press conference.

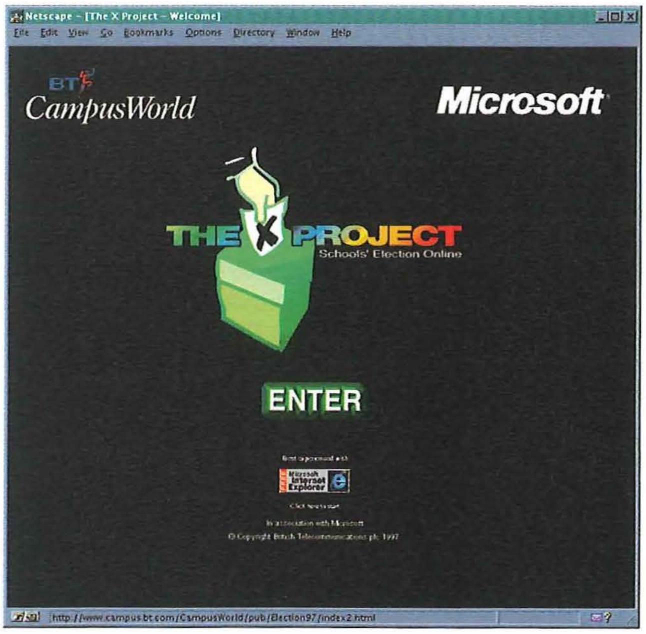
Children in schools throughout the UK were able to put their questions to such personalities as Archbishop Desmond Tutu, in South Africa! The results of the interviews and exchanges, combined with written and visual material from schools in the UK and South Africa, were published by the Northcliffe Press Newspapers in Education project in a celebratory newspaper distributed free to schools.

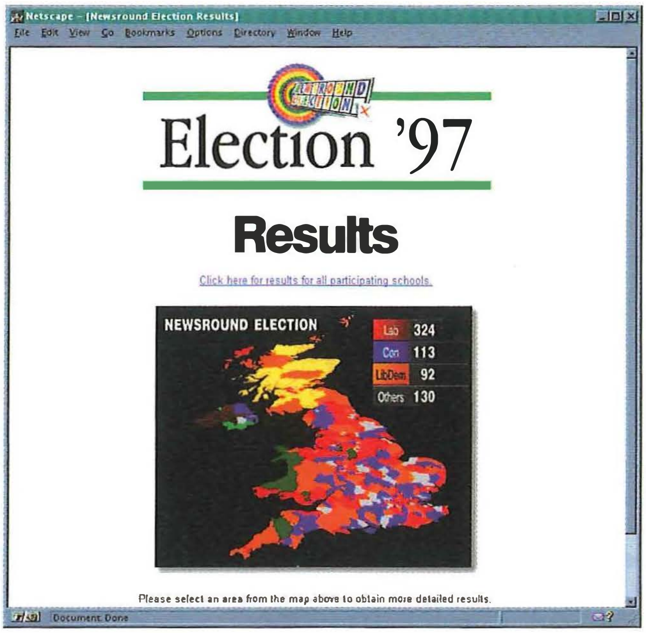
General Election—Project X

BT, in collaboration with several partners including Microsoft and the Hansard Society and BBC Newsround, put together a major Web resource to coincide with the 1997 General Election. The site gave background information on all the parties.

CampusWorld users were able to vote for the party they wanted during the election. While their parents were preparing to put an X on ballot slips, children with access to CampusWorld were able to go on-line, find out the latest election news and then register their vote electronically.

The week before the election, children on CampusWorld made their opinions known by voting and the results were published both on the CampusWorld site, on Newsround and in the *Daily Mail*. The result was a Labour landslide. (see the copy of the result screen below).





The actual general election results and CampusWorld results are compared in the following table:

Party	General Election	CampusWorld 'Election'
Labour	419	324
Conservatives	165	113
Liberal Democrates	46	92
Others	29	130

The major difference appears to be that support for 'Other' parties was much higher with school children. This may be due to a greater interest in environment and ecology based groups.

New Services

CampusConnect

CampusConnect (http://www.connect.bt.com) is another educational service but is targeted at school administrators and bursars and local education authorities (LEAs). This service, launched in July 1996, enables the school to send examination entries, receive examination results from the examination boards and exchange information with their local education authority all in a fully encrypted secure manner. CampusConnect has an additional security feature which enables the examination results files to be doubly encrypted. The second level of decryption is achieved by the use of a special decryption phrase that users can be given at a pre-defined time. This phrase enables them to 'unlock' or decrypt their results files. By using this delayed decryption, examination result files can be delivered to the schools (examination centres) up to 48 hours prior to the time of official publication. All BT has to do is to publish the decryption phrase ('Open Sesame' or similar!) at the pre-defined time.

A previous electronic delivery system had to cater for most examination centres trying to download the examination results at the same time. The double encryption approach adopted for CampusConnect has cured the excessive simultaneous access requirements and added an extra level of security. This delayed decryption feature is available to all Connect administrators.

This service has built on the security features within CampusWorld, adding secure file transfer and bespoke mail. It will also provide a shopping mall for schools to purchase goods and an information service for central bodies such as the Department for Education to disseminate information to schools. Very clearly CampusConnect is an Intranet: it enables closed user groups of communities of interest, such as LEAs, to share information among their closed community with complete confidence in the information integrity and security.

HomeCampus

CampusWorld is targeted at schools but the question has often been asked 'when can we have this at home?' The answer is BT's HomeCampus was launched in January 1997, offering some of the CampusWorld functionality and content with additional 'fun' material suitable for the home user.

The home system produced several interesting design challenges. Firstly the number of potential customers was much larger than with the academic service. Secondly, the customers required on-line registration with payment by credit card. Lastly the product had to be simple to use and provide controlled access to the less desirable aspects of the Internet.

To handle the larger customer base a number of the areas of the system were streamlined. Increasing use of LiveWire (Netscape server side scripting language based on Java) was made to improve system performance. On-line registration was provided using BT Shop—a Web based shopping service. In fact HomeCampus became the first on-line service to be purchasable through this new medium.

To make the system easier to use several of the Campus facilities were redesigned to make use of new hypertext markup language (HTML) features such as frames. This was possible partly because HomeCampus expects users to have higher specification PCs than are typical within schools.

Now that the home service is up and running, a number of projects are being designed which will encourage home learners, both adults and children, to participate in activities alongside school users of CampusWorld. We are now beginning to see how communications technologies can promote the idea of 'lifelong learning'.

CampusProfessional

CampusProfessional is an on-line training service aimed at meeting the training needs of the corporate and small and medium enterprises (SMEs).

Product Line View

From pre-school to continuing adult education and training, at home, school, college or work, BT is providing a suite of on-line content products which will play their part in developing the concept and practice of lifelong learning.

Using Internet and intranet technologies, these content products will work with virtually all Internet access providers (including BT Internet).

With over 10 years' experience in this area working closely with education and training professionals, we already have a growing range of Campus products. They go beyond pure reference into the exciting world of interactive multimedia learning.

These products are designed to deliver choice, convenience and control. Learning should be a stimulating adventure.

Don Tricker

It will bring CD-ROM type material to the student's desk both at work and at home. To assist the student in selecting course material the service content will be arranged in academies—management, technology, finance and so on.

Further, by a series of intelligent questions and answers, the user will be able to navigate to the content that most meets his/her learning style and current ability or competence in that subject.

The service has been trialled with users from several BT divisions having access from all over the country, both from their desktop and their home. The trial used a mixture of educational material: some was static Web pages, but in addition there was Real Audio™ recordings of lectures (some including video). There were also some special courses that required software to be downloaded onto the user PC. These were supplied by third-party specialist producers keen to participate in BT's trial.

Technical Details

All the live Campus services run on four Unix machines—Sun Sparc 1000s with mirrored disks (Figure 1). Two are used to support the Web servers, and a third for the X.25 gateways and for supporting mail. These machines run SQL*NET which gives them access to the fourth machine that provides the customer database and operational support functions. This machine resides on a private network only accessible from terminals on BT's intranet. The hardware is located in Telehouse in London, the Spaghetti Junction of the super highway. Schools access the service over the telephony network from a suitably equipped PC, MAC or Acorn computer. Modems on the PC connect to the dial Internet protocol (IP) modems to provide data transfers at up to 33 kbit/s over the public switched telephone network (PSTN) and 128 kbit/s over the integrated services digital network (ISDN) (for local area network (LAN) users).

Client software

Campus is currently offering Netscape 3.0 browser software as the core of its software for all users of PC and Macs. In addition for Acorn users, which represent a significant portion of the education market, BT provides the Fresco browser from ANT software.

The next release of the client software will use Microsoft's Internet

A user's story

Last year, two friends and I embarked on the task of representing our school on the World Wide Web.

The first task was to learn hypertext markup language, or HTML—the language that pages on the Internet are written in. This turned out to be easier than we at first thought.

We then had to design the pages so that they would be appealing to others outside the school, and encourage them to look at the site. This and the contents of the pages turned out to be the most difficult part. With help from our Headmistress, we were able to complete the site, so it would be informative to prospective parents, but also interesting and fun for their daughters.

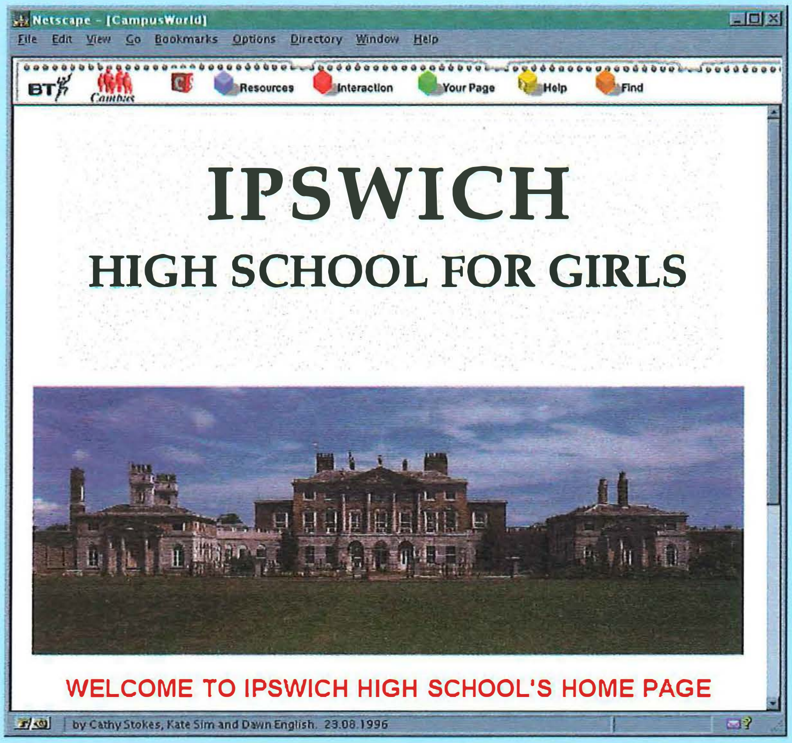
Photographs of the school were scanned into the computer, and pictures for the links were drawn. These were then positioned on the pages using HTML code, along with the text.

Our Headmistress was delighted with the result, and was keen that people should see the pages and take full advantage of them.

We were very pleased to have the opportunity to carry out the project as it was very beneficial to all of us. We now have the ability to write HTML and design our own Web pages if we ever need to in the future.

Catherine Stokes

Ipswich High School's global Internet page



Explorer 3.0, with Microsoft's Internet Mail client providing the mail reader.

Server Software

Campus is based on Netscape Enterprise 2.0 server and proxy server products. This high performance web technology has been augmented with Campus's own authentication and authorisation software to provide enhanced security and fine control over what universal resource locations (URLs) users can access. This has been achieved by writing server-side plug-ins using the NSAPI interface. This gives a high degree of flexibility over the response to the incoming request, while maximising speed and performance.

Until recently the server side software was written in a combination of C, Perl and Unix scripting language Ksh. With the move to Netscape products, some software has been written in Livewire, Netscape's server-side Javascript language. This considerably enhances performance by enabling faster database access.

The software caters for two types of user, an administrator who can set up accounts and a user who has a set of access privileges. This enables the schools to be able to manage accounts as they want to, changing users, or passwords, allowing web page modification, access to e-mail etc. Schools thus only need to contact BT when they have a problem with their account.

Operational support systems

Campus support systems are also Web based; this means that the support people only require a Web browser to support the service. The operational support system (OSS) provides operators with facilities such as account creation, modification and deletion. All aspects of a user's account can be modified and viewed. By basing the OSS on Web technology it has enabled many of the user facilities to share common code with OSS facilities and hence reduce development costs and time-scales.

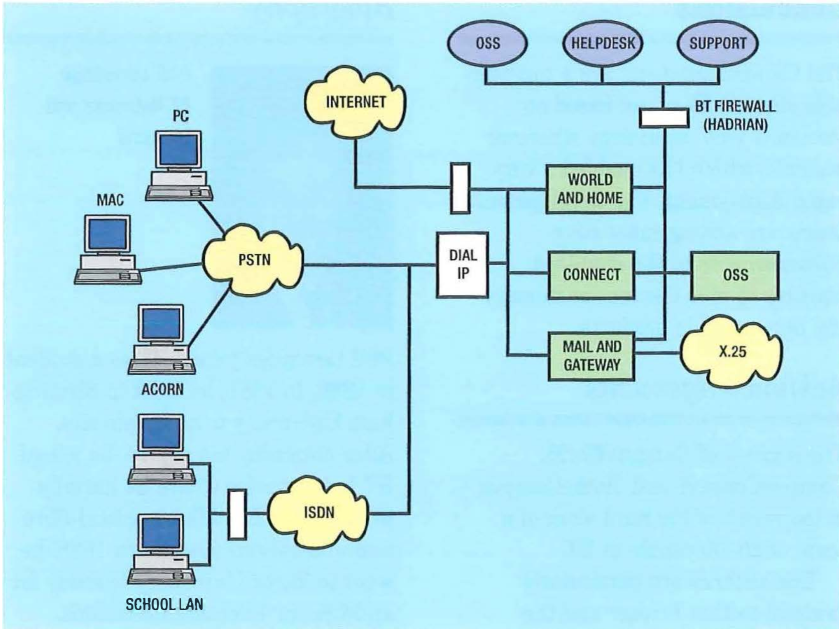


Figure 1—Hardware for CampusWorld

Dial IP platform

BT's dial IP platform provide the dial-up connection for both PSTN and ISDN users. A single 0345 number provides national coverage at local call rates to schools. In addition, Campus now offers a LAN access product, enabling schools with suitable routers to connect their entire network to Campus.

A Campus user accessing the system is restricted to accessing only the campus web servers and the proxy. The proxy provides access out to the Internet, but only to those users which have been given access privileges to do so. This enables Campus to provide both full and filtered Internet access controlled by the server—and thus requiring no special software on the user's PC.

Statistics

The server is currently responding to an average of 100 000 Web requests per day Monday–Friday, producing over 2 million hits/month during term time. The site has over 20 000 pages of unique educational material. Campus has nearly 11 000 users from 2500 schools.

The Future

The Campus products have become the Web site of choice for a large proportion of today's secondary schools and a growing number of primary schools, most of which are accessing using POTS (plain old telephony system) technology. A key improvement will be the move to ISDN technology to enable higher bandwidth access, and hence the support of richer types of content, including audio and video. This should prove an interesting challenge to provide the bandwidth to the PCs at the school, and the PC computing power to make use of it. The Internet must become an interactive and dynamic environment, allowing teachers and pupils to communicate easily around the globe. Above all the technology must be a useful tool for teachers and a positive experience for pupils.

No one can be sure where the technology will lead, but it seems certain that the Internet will play a major role in education in the next century. The Campus family of products is well positioned to provide schools with the technology they need to get the best out of that future.

Conclusions

The Campus products are a considerable success. They are based on standard Web technology wherever possible, which has enabled a very rapid deployment. The development teams are adding innovative enhancements to the standard features to give Campus customers the best possible products.

Acknowledgements

The success of CampusWorld, CampusConnect and HomeCampus is the result of the hard work of a team of 20–30 people in BT.

The authors are particularly grateful to Don Tricker and the Campus Office team for support in producing this article; a special thank you goes to Cathy Stokes from Ipswich High School for her contribution to this article.

Biography

Phil Leveridge
BT Networks and Systems

Phil Leveridge joined BT as a student in 1980. In 1981, he went to Birmingham University to study physics. After obtaining his degree, he joined BT Laboratories where he initially worked on a 565 Mbit/s optical-fibre communications system. In 1986, he went to Essex University to study for an M.Sc. in Telecommunications. After obtaining his M.Sc., he returned to BT Laboratories to work on Work Manager, a work allocation system for field engineers. He then became project leader for an automated directory enquiry system using speech recognition. He is currently working in the On-line Services Unit on a number of Internet projects, including the design of the Campus products, while coordinating design across the unit.

Ian Webster
BT Internet and Multimedia Services

Ian Webster joined BT as content manager for CampusWorld in September 1995. Previously, he spent several years working in education, first as a primary school teacher, then as an advisory teacher for IT with Derbyshire LEA. From the mid-1980s onwards, he was involved in several important classroom projects, which made use of a variety of communications technologies. For two years, Ian was national coordinator of Project Gemini—managed by the National Council for Educational Technology and funded by BT—a UK-wide project which promoted the use of combinations of communication technologies in the curriculum. Before joining the company, he was a freelance education consultant and worked with BT on a wide variety of projects.

Brian Cross and Nigel Golfin

Adding Value to a Groupware Service: BT Network for Lotus Notes

This article provides an overview of the BT's service offering of a managed service platform for Lotus Notes and Domino. It positions the service in terms of groupware in general, and explains how it supports Notes in particular. Included are key features of the service and their implications to the customer. The convergence of groupware with the Internet is considered as is the future potential for network applications.

Introduction

On 22 January 1996, BT announced the launch of its new service 'BT Network for Lotus Notes (BT NLN)', integrating Lotus Notes with the global reach of BT's public networks. Mobile executives, office-based staff and remote users are able to transact business through a variety of access methods from local dial-up to high-speed switched multi-megabit data service (SMDS) connections. The service relieves customers of the large cost burden of setting up and supporting their own DIY Notes networks and servers. In August 1997, a Domino service was introduced giving Internet and intranet users access to groupware applications with greater convenience and lower costs. Notes users can now also interact with Internet and intranet users via Domino. This article describes how BT has worked with suppliers to develop and launch its managed Notes service. In particular, it identifies and explains key features which add value to the service from the customer's perspective. It also considers how groupware is being extended to exploit the potential for network-based groupware applications on private networks (intranets) and the Internet.

Overview of Groupware

Groupware is the generic name given to a type of software which enables users to work together and share information, irrespective of their physical location. Groupware is more than a well integrated office automation tool. It provides the means by which organisations can radically re-engineer and automate their business processes, leading to greatly increased efficiency, effectiveness and cost reduction.

The global market for groupware products and services was estimated to be worth $2 billion in 1996, and to be growing at 50 per cent per annum[1]. Only 40 per cent of the value of the groupware market is made up from sales of groupware software; the remainder of the market is for support and management services such as consultancy and training.

Extension of groupware applications to the Internet via solutions such as Domino is expected to hasten growth significantly, particularly in the area of provision and support of applications.

Lotus Notes

Lotus Notes is the leading groupware computing environment[2], having over 12 million users worldwide and this figure is doubling year on year[1]. Notes enables people to work together regardless of platform, technical, organisational, or geographical boundaries. Notes-based information (text, graphics, images, sound and video) can be shared across any distance and at any time.

Notes integrates three technologies: messaging, a distributed object store, and a powerful fourth generation applications development environment. It also offers very secure client–server and server–

The groupware service operator is able to share the costs of support across a number of customers, and benefits from the use of its existing communications infrastructure.

server authentication with data encryption for transmission and storage. It is easily accessible to users of a variety of desktop and server environments, because of close integration with leading PC software. A rich set of application programming interfaces (APIs) is provided for developers who wish to build Notes applications. This has stimulated the growth of a wide variety of independent software vendors, systems integrators, application developers and consultants based on Notes.

Three main sorts of applications can be developed using Notes:

- interactive applications, such as discussions and tracking systems;
- applications for disseminating information, such as news and reference materials; and
- routing applications, including mail, forms, and work-flow applications.

Organisations can gain significant business benefits from Notes, including improved competitive responsiveness, increased quality, and cost reductions. Independent consultants estimate returns on investment (ROI) from using Notes to frequently be from 100 per cent to 200 per cent[4]. Notes is increasingly used to support the extended enterprise, by facilitating group working between the organisation and its suppliers, distributors, customers and partners.

Domino

Domino allows users to access Notes databases and applications without requiring Notes client software on their PC. The same web browser supplied with most PC software can be used to access Domino servers. In fact, several World Wide Web (WWW) servers accessible on the Internet today are actually Domino servers. Much of the user access control and security features available in Notes can be extended to Domino so it is possible to set up closed user groups in addition to public access. This gives tremendous possibilities for interactive applications ranging from publishing of information through to collaborating on projects and interactive shopping.

On the service side, BT NLN can offer flexibility and speed in setting up and supporting a web site because Domino reduces or eliminates the need for manual HTML coding, web authoring tools and separate HTTP servers.

Most of the WWW sites on the Internet are data publishing sites offering little more than a source of information, perhaps with the ability to mail requests for further information. To do much more normally requires a high-level skill in web site authoring, the use of expensive tools and knowledge of HTML etc.

Domino can publish information, but much more exciting is the ability to 'publish' an interactive application that people can use, there and then, on the web or intranets. However, it is more than a web authoring tool or an alternative web server. Many of the applications that will appear on the Internet in the future already exist now, in other forms, perhaps as a business process waiting to exploit the web. Notes has been turning business processes into groupware applications for some time. Domino now extends this to the web while still retaining highly secure access to the 'back end' of applications through Notes.

Opportunity for a Managed Service

Organisations find Notes to be a very powerful tool to automate the sharing and distribution of business information, and the number of users and the variety of applications tend to increase rapidly. Notes provides a key IT backbone for organisations who use it to share important mission critical applications and corporate mail systems. Frequently there is a need to coordinate the information across a number of sites, located both nationally and internationally. Setting up and managing the Notes systems and supporting communications becomes an increasing overhead for an organisation. Organisations need to consider the risks that can be involved in deployment such as:

- *speed of implementation*—by trying to get a Notes infrastructure rolled-out quickly problems and additional cost implications can arise through lack of planning of requirements;
- *resource issues*—skilled Notes personnel are costly due to market shortage and are frequently head-hunted; and
- *cost*—organisations may find themselves paying more than initially planned for Notes implementation with additional costs for support of the Notes infrastructure, consultancy fees and application development.

Add the increasing need for companies to add an Internet or intranet dimension to their business and the task appears daunting.

Consequently there is an opportunity for a company with a proven track record in communications and managing services to offer to provide and support Notes and groupware infrastructure for these organisations. This leaves the organisation free to design its Notes and Domino applications, secure in the knowledge they can be made available as required throughout the organisation. The groupware service operator is able to share the costs of support across a number of customers, and benefits from the use of its existing communications infrastructure.

BT Network for Lotus Notes

BT Network for Lotus Notes (BT NLN) hosts customers' Notes and Domino applications as part of its managed service platform, leaving

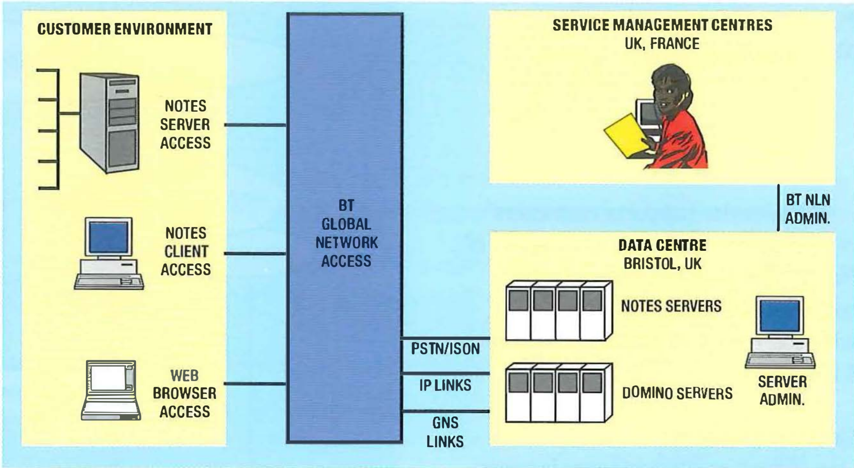


Figure 1 – The BT Network for Lotus Notes managed platform and access communications

customers free to concentrate on their own business objectives. BT's groupware experts work with the customer, providing support and helping plan for future growth and additional facilities. The service combines BT's extensive communications network with Lotus's leading groupware product and Hewlett Packard's advanced server computing platform.

Service description

The BT Network for Lotus Notes was launched in early 1996 based on the industry groupware standard—Lotus Notes—and has been further developed to include Domino services. The BT NLN service builds on the capabilities and strengths of Lotus Notes R.3 and R.4x to offer customers a cost-effective secure infrastructure with flexible access and full network management facilities.

Modular service

A new 'modular' version of the BT NLN service was launched at Lotusphere '97. The modular service encourages organisations to take the BT NLN by reducing the initial price barrier, and by offering greater flexibility to meet their specific needs. Customers are able to select one or more of a number of independent service modules:

- *Notes Publishing*—publishes customers' databases to Notes subscribers;
- *Interactive Notes*—supports interactive Notes applications;
- *Notes Mail* —provides mail routing and mail box hosting;
- *Mail Gateways*—enables access to and from other messaging systems;
- *Domino*—publishing and interactive web access to Notes databases from the Internet or intranets.

Each module is charged separately. Modules can be selected in almost any combination. New modules will be added to meet customers' requirements.

Benefits of a public Notes network to an organisation

A public Notes network offering such as the BT Network for Lotus Notes can aid an organisation to realise the full potential of implementation of a groupware solution by providing:

- a pre-built infrastructure for faster deployment of Lotus Notes/ Domino;
- expertise and skills saving an organisation the expense of hiring contractors and the pain of taking existing staff through the learning curve;
- extra flexibility since BT NLN can adapt to suit an organisation's requirements and provide a wide range of access methods available on the network (For example, the solution provided to the Labour Party met tight deadlines for full implementation and gave the bandwidth required during the intensive pre-election campaign. This was then scaled down to meet requirements after the election. Access included remote workers and connections from the headquarters to regional offices.);
- the ability to manage Notes cost-effectively, securely and reliably, using leading edge technologies and the global reach of a public network rather than having to set up expensive DIY networks and servers;
- extended customers' Notes connectivity allowing them to share pre-defined information with partners, suppliers and customers, ensuring confidentiality of information is retained;
- help with setting up with Internet web sites and intranets easily; and
- a means of easily piloting Lotus Notes/Domino without an organisation having the burden of setting up its own infrastructure.

Key features

Managed platform

The main components of the managed platform and access are shown in Figure 1.

The overall service is managed by a dedicated team of experts based at the BT NLN service management centres. Currently these are located in UK and France with further regional support centres and platforms planned for global service. BT country offices work with the SMCs to provide first-line customer support, including initial contact for orders, enquiries and fault reporting. The platform is operated by Hewlett Packard at their secure data centre. The platform management team provide management and configuration of the platform servers in the Notes and Domino environment, as well as more detailed second-line support for the service.

The capacity and capability of the Notes platform and access communications are reviewed regularly to ensure that they will continue to meet planned future customer requirements.

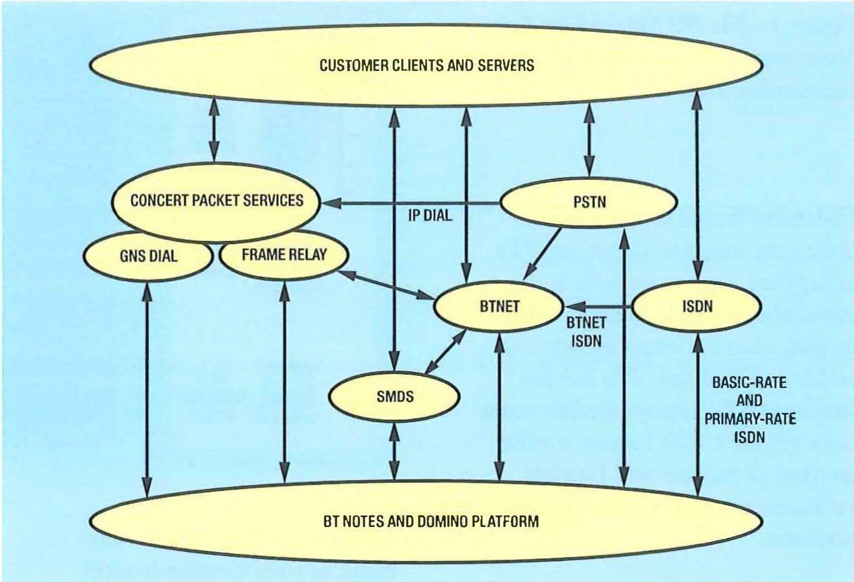


Figure 2 – BT Network for Lotus Notes communications overview

BT's service supports customers' requirements for different versions of Notes. The platform fully supports both Notes 3 and Notes 4 servers, with the recent addition of Domino 4.5 servers.

Communications

One of the key differentiators between BT's managed Notes service and its competitors' is that BT supports access to the service using the customer's preferred communications method. BT is able to offer this because of the wide range of access methods supported, as shown in Figure 2.

Service management system

Lotus Notes and Domino makes demanding challenges on service management, especially in the complexity of possible configurations. Yet good service management is critical to the successful operation of the service. The service management facilities enable BT to provide customers with a high quality and professional service, while allowing BT to operate the service at an economical cost.

Customers can call the helpdesk for support, or can use their Notes systems to connect directly to the service management system (SMS). Once they are authenticated as a registered user of the service, customers can use a suite of customer-oriented Notes forms to enable them to register new clients, services or applications, to make changes to their existing configuration on the service, to make enquiries or to register faults. The information from the customer's Notes system is replicated to the BT SMS, enabling the BT helpdesk to process any requests and to assist the customer. The BT helpdesk is also connected using Notes to the HP team managing the service platform, using secure links. This enables them quickly and easily to progress requested changes to the platform, or to pass on enquiries which require the assistance of the service platform team. The helpdesk personnel also have visibility of the current status of the platform, including alarms and server availability, enabling them to warn customers of problems with the service.

Mail and extended workforce

The basic mail service provides routing between mail boxes hosted on the customers' own servers through the BT managed domain. BT manages this on behalf of customers, providing routing between members of their organisation and to their business partners.

To support an extended workforce, customers' personnel can have their individual mail boxes hosted on the BT managed servers. The advantage to customers is that their people can connect to the managed server from any location and retrieve their mail. A typical use for this service might involve a travelling salesman collecting orders on a portable PC, and logging into the service either from a hotel bedroom or over a digital, mobile link to update a central sales database, and to collect and send mail.

Domino adds support for POP3 mailboxes, SMTP and SSL2 secure access for web browser users. Imminent enhancements to Domino servers include SSL3 and support for certificate-based security for safer commercial use of the Internet. This brings the level of Domino security on the web closer to that available through Notes.

Messaging gateways

The service enables customers to send and receive messages and documents between Notes and existing messaging systems. This enables customers to communicate with people who use alternative messaging systems; for example, Microsoft Mail, cc:Mail, X.400.

Billing

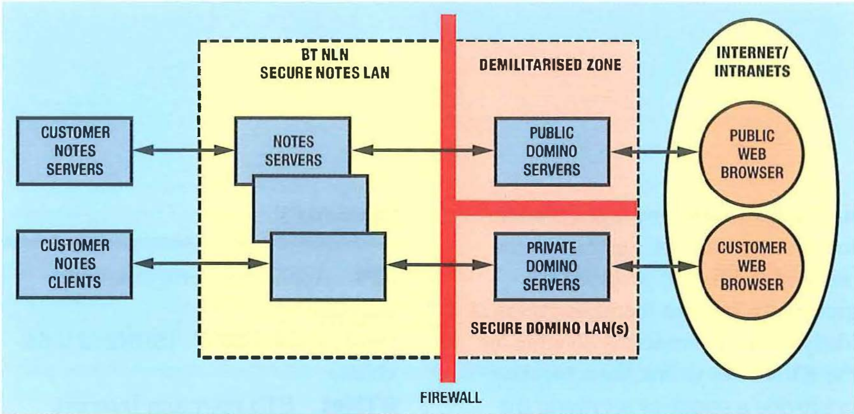
BT's service is charged on a predefined flat-rate structure based on the service type, and the options chosen. The service is priced on the number of connections and storage. Customers agree their capacity requirements with the helpdesk in advance to enable BT to plan the provision of their capacity. BT monitors the service to ensure customers operate within their agreed limits. Customers can agree with the Helpdesk to increase the number of connections, servers, and/or hosted mail boxes as their Notes usage expands.

Billing on a predefined flat-rate structure is particularly attractive to organisations who want to determine in advance the cost of using the service. This is not possible for services which charge for data transferred or time connected.

Domino – making groupware accessible to the web

Users are now able to contact BT NLN via their web browser and request Domino-based services or applications. Groups who wish to collaborate on a project, or companies who wish to set up their own web-based applications are able to download application templates and configure them either for their own

Figure 3 – BT NLN's Domino service



secure use, or for access by the estimated 20 million Internet users worldwide. Figure 3 shows how BT NLN meets the demand for Notes, Domino Intranet and Domino Internet services.

The main BT NLN platform is protected from Internet access by a firewall. Domino servers intended for public web access sit in the demilitarized zone on the Internet side of the firewall. Domino servers for Intranet customers sit on a separate secure local area network (LAN). Domino servers are maintained by providing secure Notes access via the Notes part of the platform. Data from Domino servers can also replicated to customers' Notes servers for processing; for example, order handling.

Future services

The continuing development of the BT Network for Lotus Notes service includes:

Network applications

The BT NLN will soon be able to provide a complete Notes/Domino solution to customers by adding low-risk rental applications to its existing portfolio of services. The BT NLN provides a valuable channel for Lotus Business Partners and independent software vendors to distribute the business applications they have developed for Lotus Notes/Domino. Enhanced 'network aware' applications, accessible by both Notes clients and web browsers, can benefit from being hosted on and managed by BT's network platform. The wide distribution provided by BT NLN ensures that the applications can be used by all members of an organisation's extended enterprise, including suppliers, distributors and customers.

Targeted primarily at inter- and intra-company communication, where activity extends across dispersed sites and/or involves mobile users, the service seeks to maximise Notes/Domino capabilities to support customers' business processes and offer them a proposition that is better value for money than their current business methods. By using rental applications, organisations are able to budget effectively and test the validity of the software for their needs, upgrading or changing as required, with no major cost outlay. Figure 4 shows how network applications are supported by Domino, and BT billing and service management.

Globalisation

The initial focus of the global BT NLN service is in Europe. Offices in each country support customers for the global service. The service is managed by the BT Europe Applications Support Team in Paris. Currently, all communications are routed back to the platform in the Hewlett Packard data centre in the UK. In the medium-to- longer term, BT and its partners may choose to offer access to regional service centres located at strategic positions around the world.

Additional features

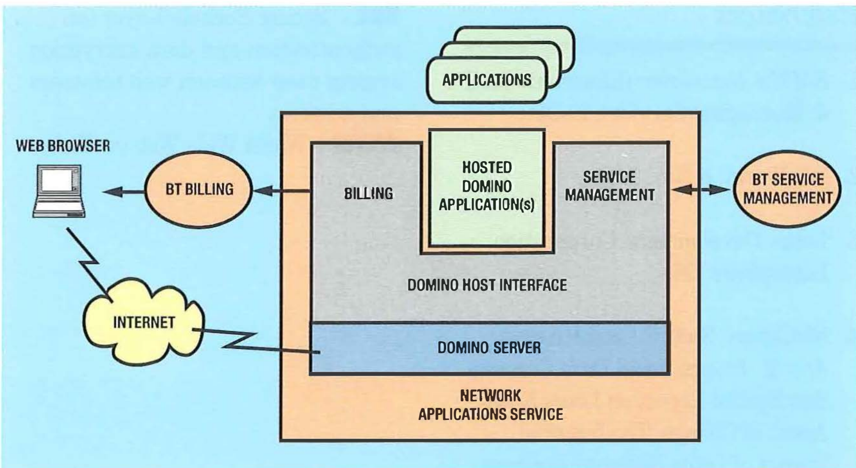
The BT service will support the features its customers need to make full use of Notes. Features which may be added to the service include the following:

- *Voice and multi-media imaging* Existing applications can be enhanced and new applications designed based on the integration of voice and multi-media imaging with Notes.
- *Video* Offering support for real-time video widens the scope of possible Notes applications still further.

Groupware Service Futures

Although the current BT service is based on the leading groupware software in the world, Lotus Notes and Domino, the direction of future services will be guided by the need to support the groupware systems used by its customers. There are many other groupware offerings which address different target markets, with varying degrees of success. As customers choose to make use of these systems, there is a significant poten-

Figure 4 – Supporting network applications with Domino



tial for BT to offer managed services to meet these needs. Further, as the number of different proprietary groupware systems increases, there is likely to be an increasing demand for the BT service to link them together to provide a seamless service to the end user. BT will also move up the value chain to make network applications available to customers.

Links between groupware and the Internet are likely to continue to develop and grow stronger. This trend has already started with Domino 4.5. As further enhancements are added, it is likely that users will cease to perceive the boundary between groupware, intranets and the Internet. In its place they will experience a well integrated, information environment, which enables them to structure their interaction with the information to gain the most benefit from it. A continuum of access tools is likely to exist, ranging from unstructured, unrestricted lightweight browsers for individual use, to groupware application development tools enabling powerful, directed use of information by corporate users. BT's service will continue to evolve to meet the changing needs of its customers.

Acknowledgements

Extensive use is made of the documentation and figures produced by the members of the service development and launch team. Their contributions are gratefully acknowledged.

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Glossary

API Application programming interface
Basic-rate ISDN ISDN2 (2 × 64 kbit/s)
BTNet BT's premium Internet connection service
BT NLN BT Network for Lotus Notes, BT's Notes service
Domain A group of Notes servers which share common access rights
Frame relay A high-speed packet data service, using virtual circuits
GNS Global Network Services (BT)
HTML Hypertext markup language
HTTP Hypertext transport protocol
IP Internet protocol
ISDN Integrated services digital network
LAN Local area network—high-speed link between computers and peripherals within a building or site
Platform BT's service platform consists of all the BT servers and associated infrastructure
POP3 Post Office Protocol 3—a mailbox protocol used by most Internet access software or browsers
Primary-Rate ISDN ISDN30 (6–30 × 64 kbit/s)
PSTN Public switched telephony network
Replication Makes all copies of databases essentially identical, over time, by transferring the changes between them
SMS Service management system
SMDS Switched multi-megabit data service, a connectionless, high speed packet data service
SSL Secure Sockets Layer (an authentication and data encryption system used between web browsers and servers)
WWW World Wide Web (or Web)

Biographies

Brian Cross
BT Networks and Systems

Brian Cross manages the team delivering the new Modular BT Network for Lotus Notes service. He led the team which developed the original BT NLN service, launched in February 1996. Previous work has included project management and requirements capture for BT's multimedia services, including video on demand. He was responsible for part of an ISO standard for interchanging multimedia documents. He has been developing value-added services for BT since 1983.

Nigel Golfin
BT Networks and Systems

Nigel Golfin is the Groupware Design Authority for BT's external groupware services. He was responsible for much of the early detailed design and trial of BT's Lotus Notes systems and services and is currently responsible for the overall design of the BT NLN service. Previous work included consultancy in the use of groupware tools, multimedia applications and satellite delivery of analogue/digital TV, audio and data networks. He has been designing and helping to develop new service opportunities and solutions for BT since 1975.

Alwyn Lewis and Fred Westall

Whither Speech?— Bakelite Mindsets and the Urge to be Three

This is the last in a series of three articles[3,4] exploring technical factors in the convergence of communications, computing and entertainment. The articles have looked forwards, backwards, sideways and around to discuss the potential cultural and organisational consequences for the future of telephony. This article focuses on the important, potentially controversial and intangible aspects in the preconceptions and mental attitudes of engineers, executives, competitors and customers.

Introduction

By common consent, we are in the middle of a revolution in the accessibility and use of information technology that can be summed up in a single word—*convergence*. The word might conjure up uncertainty, trepidation, excitement or disbelief, depending on your viewpoint. But it is sobering to discover that the latest Internet Protocol (IPv6) provides more than 10^{28} unique addresses for every human being alive today. What might toasters, key fobs or children's toys do with an Internet address?

Plotting A Course

How do we navigate in this new world? So many things have changed in all sorts of ways. The global future of telephony is increasingly dominated by energetic competition and multinational companies. Younger industries, with a different way of thinking and a more flamboyant business style than has been usual in communications, stare hungrily at the potential profits[1]. The situation is stunningly unlike that which applied over most of the 120-year history of the telephone.

To survive and prosper in such a changed world, a multitude of factors, some new and some old, need fresh examination or reappraisal. Bell and Riezenman, senior editors with the IEEE, recently wrote about communications technology[2], saying, 'the conventional wisdom that has guided the industry for decades must be largely discarded, or at least carefully examined'.

Reprise

Key points from the previous two articles[3,4] are summarised below:

- Telephones have seen little fundamental change this century, but radical changes in shape and performance now await—including wideband sound, a speech-driven interface, video, PSTN-like conferencing, handset alternatives and closer integration with computer or television equipment.
- These changes imply a plural mixture of technical specifications for telephony, that might originate from any of the convergent industries.
- The evolution of telephony is likely to humanize the evolution of the Internet.
- Signal processing is likely to become a central battleground of the convergence debate, an important differentiator of added value and an integrated part of future networks.
- These radical and turbulent changes are akin to electronic puberty.

Changing Expectations

Communication products are now used in places and in ways that the

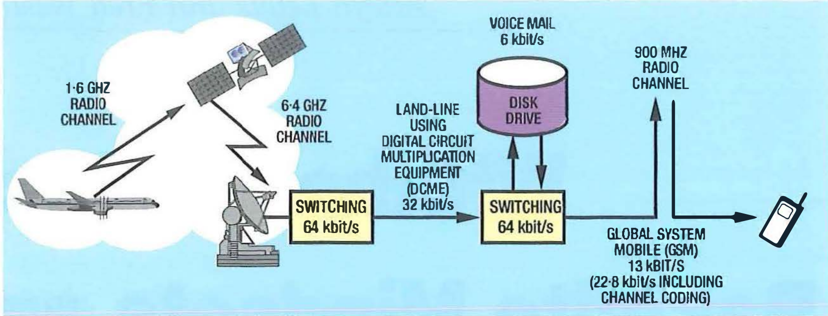

Figure 1 – Cascaded speech codecs in a mobile-to-mobile call via voice mail

original designers did not consider. High-speed data modems and fax machines are commonplace today, but did not exist when the first national networks were developed. Telephones are now used casually in any room of the house, rather than reverentially in the hall. Public payphones are expected to work well in the noisiest of bars and public places. Yet the electro-acoustic characteristics of telephones are largely unchanged from those laid down generations ago. The Internet is an outstanding example of an idea serving a very different purpose than was originally intended.

One of the authors can remember his intense frustration as a child, on opening a plastic 'Meccano-type' construction set. There were lots of straight, flat bits suitable for building houses, cars and bridges—but no curved pieces at all, which made it hard to build a really good chicken. Children take technology and use it in ways parents don't imagine. Past predictions of the future of telephony have often been haunted by the 'Meccano chicken' scenario.

A Change of Mind?

The business of telecommunications was traditionally seen as the assembly of essentially linear components upon the two firmly-set foundations of transmission and switching technology. This outlook was tested, and found true, by generations of engineers and executives in telecommunications all over the world, so becoming an accepted mindset. Although some see things differently, this mindset is not uncommon today across the industry and in parts of the technical press. Current evidence suggests it is quickly becoming less and less true.

An apt, though blunt, description of the characteristics of this mindset can be found in Bakelite, a material that formed many millions of telephones. This famous thermosetting plastic still seems firm and strong and undoubtedly remains useful. But it is a brittle relic of the past and liable to shatter unexpectedly under pressure. The Bakelite kind of mindset is coming under pressure from the consequences of digital technology.

The foundations of transmission and switching were transformed by digitisation during the 1980s—providing economic solutions to problems that had dominated telecommunication engineering for decades. But in the 1990s, digital technology enabled further changes, in a wealth of novel and non-linear components that gave birth to a third foundation for telecommunications—affordable signal processing[5]. The convergence debate is much enlivened by the computing and entertainment industries vigorously claiming that signal processing technology is their territory.

Digital signal processing has, for the first time, made a plural future for telephony economically possible. Instead of solely transporting and routeing bits, networks could manipulate them, processing signals to meet customer requirements for new services and interoperability. Such a radical change in network function would have major repercussions on the planning, design and implementation of transmission and switching equipment. The potential effects are illustrated in the two examples that follow. Similar effects, called *feature interactions*, have already been widely observed in the early trials of networked multimedia services[6].

A Mobile Expedient

A proposal has been made, within the standards body ETSI, to improve the speech quality of mobile-to-mobile GSM calls by avoiding a connection through cascaded speech codecs. The method would create a relatively unobtrusive in-band signalling channel, using a noise-like signal coded in the 'stolen' least-significant bit of all conventional GSM speech traffic. If the call should connect to another GSM mobile, the speech codecs could use this in-band signalling channel, during the call, to switch to an alternative format. This would allow the codecs to exchange coded data at 16 or 8 kbit/s, padded with dummy data in a 64 kbit/s stream. The technique would avoid the loss of speech quality associated with transcoding to and from the conventional 64 kbit/s format used for network transmission and switching.

This expedient, though ingenious and potentially effective, might be seen as a retrograde step that undermines the widely-recognised technical and operational advantages of common channel signalling. Speech codecs occur in cascade in other services[7] (Figure 1), so mutually incompatible bit-stealing signalling schemes might arise in future. In the GSM example, the desired feature is the removal of unnecessary signal processing, illustrating one of many potential reasons why signal processing issues are likely to become a routine part of call routeing and network configuration decisions.

Building With Blocks

During the development of Skyphone™ [8], the authors learnt that the whole can sometimes be more than the sum of its parts, not only in the language of advertising but in engineering too. Yet with linear and time-invariant systems, the principle of superposition applies[9] so the whole is always precisely equal to the sum of its parts.

The history of telephony has been dominated by the engineering of linear systems, making it possible to

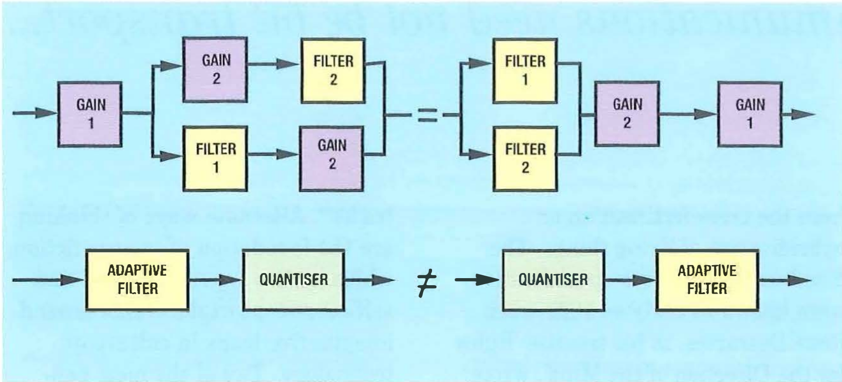

Figure 2 – Cascading linear and non-linear systems.

assemble a global telecommunications machine from separate blocks of transmission, switching and customer equipment. Any one block could be amended or rearranged, independently of the rest, with predictable results. This linear-systems outlook has been so successful for so long that it threatens to exclude any other outlook[10]. Yet in business, as in cooking, everyone intuitively seems to understand that the order in which you do things might change the outcome. Such non-commutative behaviour is a hallmark of non-linearity (Figure 2).

Affordable signal processing technology has opened a breathtaking panorama of both linear and non-linear design opportunities. Speech codecs, widely used for mobile and international telephony as well as in message services such as Callminder™, are often strongly non-linear[11]. New transmission and switching technologies, using asynchronous transfer mode (ATM) or frame-relay techniques, also show significant non-linear effects[12].

A linear-systems outlook is a serious handicap when dealing with non-linear technology. Those previously independent building blocks become uncomfortably interdependent or confusingly less distinct[13, 14]. If one part is amended or rearranged, the results may not be predictable. Delivering good service to customers might become considerably more complicated and expensive.

Signalling a Change

In such cases, end-to-end management of the particular building blocks used to deliver each particular service would become a new but unavoidable aspect of telecommunications. This change would probably have the greatest impact in the fields of network signalling and switching. New bit-fields and protocols might be needed to manage the configuration of signal processing and non-linear network components, during both routeing and call set-up functions. The authors suspect it would be prudent to make such bit-fields variable in length, since the number of functions they might serve is hard to foresee in detail yet likely to grow.

The reconfiguration of mobile-to-mobile telephony connections (as described earlier in the section on 'A Mobile Expedient') could be achieved with a greater degree of future-proof transparency by changes to the network signalling and switching software that determines call set-up and routeing. If, in future, telephony is tripartite—founded on three disciplines not two, then extensive software revisions to signalling, switching and network management mechanisms will be needed. This would imply significant additional investment.

Primacy of Purpose

Many communication engineers naturally tend to think about connections in a hard and mechanistic or low-level sense, as is typified by the very name given to that little box on the wall—the *network terminating point*. In the view of some engineers, once that box is reached then communication is complete. In contrast, customers tend to think of communications in a softer and more abstract way, focusing on the purpose of a connection that might stretch from one mind to another. This softer viewpoint is the one taken by almost all large-scale advertising of telecommunication services.

In the past, this disparity hardly mattered. But in a plural and tripartite future for telephony, it will. Effective configuration of engineering resources, in both customer and network equipment, would be dictated by the purpose of the communication—especially when signal processing or non-linear resources are involved. Purpose would then become prime, unifying the hard and soft viewpoints of engineers and customers.

Innards of the Internet

Some observers have said that the essence of telecommunications is the management of complexity in information transport and routeing. The great success of the Internet has made those same observers question whether transport and routeing are really such complex tasks after all. With inexpensive network routers and simple control protocols, the Internet has given the impression of lower operating costs and greater flexibility than conventional telecommunications—even though the widely different traffic volumes make this comparison misleading.

Yet buried deep inside the Internet, hidden from most users, is an enduring claim to fame. The global spread of computer networking has seriously questioned the fundamental method of operation of the largest and most commercially successful machine on the planet—the telephone network.

The telephone is a connection-oriented machine, with a communication overhead only at the start of a call. This requires overall management of network resources, specific to each and every call. The Internet is a connectionless machine, that imposes a continuous, though invisible, overhead in communication. This avoids the need for any call-specific, overall management whatsoever.

This difference in method is akin to sending someone a book, either by express motorcycle courier (telephone network) or page-by-page in individually-addressed envelopes through the mail (Internet). The

The destiny of telecommunications need not be bit transport...

courier method can be sensitive to the purpose of sending the book, has the least delay and the best guarantee of arrival of the whole book. The mail method ignores the purpose of each envelope and can have a much greater and variable delay, with pages that might arrive out of order or not at all (also known as *non-linearity*)—but the transport is by regular schedule so that running the service can be easier and cheaper.

Internet telephony might become integrated with the conventional kind, in a mainstream service called Internet CTI or CTI/I[15,16] that Frost and Sullivan recently estimated could be worth US$40 billion by 2002. Sincoskie goes further, predicting that POTS (plain old telephone service) will be replaced by 'Internet dialling tone', saying: 'The impact of this on telecommunications companies is breath-taking. It's evolve-or-die time'[17].

For time-critical services, such as speech and video calls, the connection-oriented method of conventional telephony is superior. But recent developments are blurring the differences between these two methods. Purpose-specific alternatives to the purpose-independent transmission control protocol/ Internet protocol (TCP/IP) claim improved Internet performance for speech, audio and video transfers. Conventional connection-oriented links have been proposed as a high-speed backbone within the Internet. The development of ATM technology can exploit the connectionless method for telephony. Telecommunication networks might become a hybrid mixture of connection-oriented and connectionless techniques[15].

Hybrid Vigour

Someone who studies several disciplines, rather than specialising in one, is sometimes described as a 'Jack of all trades and Master of none'. Yet the world of horticulture values the vigour that can result from the cross-fertilisation or hybridisation of living things. The disadvantages of over-specialisation were known as early as 1629 when René Descartes, in his treatise 'Rules for the Direction of the Mind', wrote: 'If, therefore, anyone wishes to search out the truth of things in serious earnest, he ought not to select one special science, for all the sciences are co-joined with each other and interdependent.'

A tripartite future for telecommunications engineering, with connective purpose made prime, would mean the integration and hybridisation of previously separate disciplines—in speech, video, signalling, network design, switch design, terminal design, human factors, information visualisation and more. The growing importance of such multi-disciplinary technology, in engineering in general and communications in particular, might change the way that aspects of the subject are taught[18]. Should it even alter the classification and subdivision of the relevant academic disciplines?

Ways of Thinking

'Empires of the future are empires of the mind'—Winston Churchill

Such sweeping and powerful challenges to formerly immutable fundamentals should not surprise us, because all revolutions inspire chaos. Science concerns the pursuit of knowledge, but engineering makes a business of accommodating uncertainty. That is why good engineering is an art as well as a science. If electronic puberty is a good description of the situation, then perhaps we should examine how adolescents cope with the real thing. Is it foolish to suggest that the subjectivity of a 'hang loose' or 'let the force be with you' outlook could sometimes be valuable?

In letting go and embracing subjectivism, the world of science-fiction can teach hard-bitten, analytic technologists a few useful tricks[19]. Alternate ways of thinking are the foundation of science fiction, which makes logical, rational and self-consistent explorations around imaginative leaps in culture or technology. Two of the most penetratingly accurate pieces of foresight this century came from the best of science fiction writers—H. G. Wells about the start of World War II and A. C. Clarke about the possibility of geostationary communication satellites. The discussion of Star Trek technology in the previous article was not meant to be frivolous.

When IBM executives first saw the ENIAC computer, they were quite blind to its potential. Their thoughts were dominated by the physical embodiment of the machine they saw all around them—a huge room crammed full with heavy, hot and expensive equipment. They could not separate the form of the device from its function and thereby missed an opportunity. They thought of the current mechanism instead of the underlying metaphor.

The destiny of telecommunications need not be bit transport, with most of the value added within the customer's equipment. Telephony can have a rich future, if we can learn how best to exploit convergence and embrace the potential of signal processing technology. But more gravely, we will need to re-examine, or even relearn, some of our fundamental ways of thinking—focusing on the metaphor not the mechanism. Vogt, writing in a special issue of *Telecommunications*[20], said: 'While convergent technologies show significant promise in supporting a radical rethinking of traditional concepts and processes, the effort must begin with our thinking, not with the seductive technologies'. That will be part of the process of successfully coping with the turbulence of electronic puberty and becoming a worthy adult. The unambitious alternative is equivalent to rejecting adolescence and looking for the stability, comfort and

A dramatic mindshift in telecommunication engineering will be needed...

familiarity of childhood in the bit transport business.

In Conclusion

The early years of telephony were a time of cautious but progressive growth on reliable foundations, with strict parental control by government monopolies. The child was well taught, but adolescence has now arrived—with its rapid, chaotic, miserable, exciting and sometimes frightening but potent changes. It is already hard to tell where the former child is going or quite how things will turn out. Strict parental control is counter-productive[21] and stronger external influences abound.

In the face of these developments, the authors hope that these articles have challenged the reader's preconceptions and stimulated fresh thinking about the form and function of the telephone. It is impossible to over-emphasize the scale of the potential changes and almost as difficult to grasp their speed of impact. Imagine a medieval knight trying to understand the effect of a machine gun by thinking of it as a new sort of sword. Logic and prudent judgment are no help here—a leap of imagination is needed, and quickly.

The original purpose of telephony, 'far speech', has become so linked to the current form of the telephone that the fundamental metaphor is obscured. The authors have tried to restore that metaphor to its prime place. Telephony is about the abolition of distance, between one person and another or between people and machines. Its true intention is to satisfy the subtle and richly varied needs of human communication—in speech, pictures and information.

Communications is at the forefront of the all-embracing changes of the information technology revolution. Predicting the future is usually fraught with failure, but it seems safe to say that telephones with the appearance of less will accomplish more. Layer upon layer of complex but increasingly affordable signal processing will offer a simple and progressively human-centred interface to an expanding range of services. Meeting and matching the true needs of customers, and of society as a whole, will be recognised as a force stronger than any commercial deal, seductive technology or regulatory restriction.

But this revolution will not stop at better information management. It will reach to the very roots of our humanity, affecting how we individually and collectively learn, think, work and grow. It will change our concepts of community, culture and society.

Adopting both the fervour and the bias of the evangelist, the authors are confident that speech and signal processing technology will be the most powerful engines of widespread embrace in this revolution. The authors also believe that signal processing will become just as commercially significant as transmission and switching are today, no matter which convergent industry provides the new technology. Telephony would then no longer stand on two foundations but on three, in a plural future where connective purpose is prime. A dramatic mindshift in telecommunication engineering will be needed to achieve success in such a future, rapidly revising many of the fundamental assumptions and attitudes that worked so very well in the past.

The telephone is on the threshold of multiple transformations—in user-friendliness and convenience, in sound quality and naturalness, and in shape and appearance. These transformations will lead to the largest and most radical shift in the educational, commercial and cultural impact of telecommunications since the telephone was born.

The emotional scale of this prophesy is encapsulated by a landmark episode from cinema history. 'The Jazz Singer' was the first commercial talking feature film. There had been short films with fragments of sound before, also using manually-synchronised gramophone records but to little effect. It was the sentimental content of Jolson's songs, closely woven into the plot, that grabbed the audience by the heart-strings and made people flock to see an otherwise unremarkable film—demonstrating the power of two appropriately-converged technologies.

Between those songs, Al Jolson ad libbed with scraps of his stage patter, chancing to say something prophetic about the future of cinema sound. Warner Brothers dared to leave those snippets of speech in the film they released. Seventy years ago, in cinemas everywhere, people sat open-mouthed in astonishment or dewy-eyed with emotion as Jolson's image waved its arms and shouted, bouncing on its toes[22]: 'Wait a minute. Wait a minute. You ain't heard nothin' yet!' The authors doubt there could be a shorter way to sum up the power and potential of a converged future for telephony.

Acknowledgments

The authors express grateful thanks to colleagues in the Speech Technology and Advanced Perception units, for stimulating and stretching debate, and to colleagues in the Martlesham Library and the BT Museum and Archive, for their expert and willing help. Our perspectives would be limited and our understanding much less without you.

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Biographies

Alwyn Lewis
BT Networks and Systems

Alwyn Lewis is an advisor in Advanced Applications and Technologies, BT Networks and Systems. He gained a B.A. from Cambridge University in 1971, and an M.Sc. from Essex University in 1972. After a spell with Plessey on formant-tracking vocoders, he joined BT Laboratories to work on acoustics, telephonometry and telephone design. In 1984, he became head of a team developing a duplex hands-free telephone with a custom VSLI chip-set and a DSP microprocessor. He then led the speech coding team, helping develop and test DSP software for CallMinder and for Skyphone facsimile and data services. His interests include beam steering microphones, speech coding and enhancement, adaptive audio signal processing and the social impact of electro-technology. He is a Chartered Engineer and a Member of the IEE and IEEE.

Fred Westall
Brite Voice Systems

Fred Westall is the Engineering Director of Brite Voice Systems, formerly a manager with Advanced Applications and Technologies, BT Networks and Systems. He gained a B.Sc. (Eng.) from University College, London in 1973 and an M.Sc. from the University of Manchester Institute of Science and Technology in 1975. After a spell in microwave development, he joined BT Laboratories to design speech-band modems and has been closely associated with digital signal processing ever since. In 1982, he became head of speech coding, developing novel speech-and-data multiplexers, and became manager of data products development in 1987, responsible for packet terminals and high-speed modems. Recently he was manager of the speech technology unit, downstreaming applications in the fields of speech coding, analysis, recognition and synthesis. He is a European Engineer, a Fellow of the IEE and a Senior Member of the IEEE.

Peter Cochrane

Banking a Bit at a Time

Over the past 20 years or so, information technology and telecommunications networks have considerably changed the face of banking. But in the 21st century, banks will have to change even more radically, to become proactive service-orientated angels.

Prologue

While visiting a living museum recently I stepped into a reconstructed Victorian bank. In the musty gloom of dark stained wood was a huge metal safe, ledgers, scales, coinage, and the manager in starched collar. It all had that unmistakable air of fossilised stability I remember from my childhood. I began to reflect on the changes in banking over the past decades. On the surface, most perhaps see only the change to lighter wood, friendlier staff and more customer-focused services, but there has been much more.

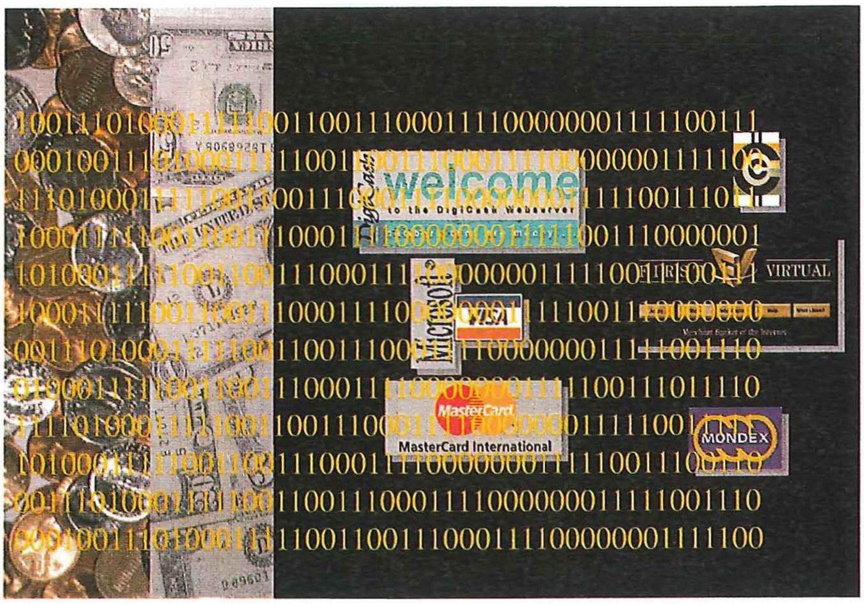
I cannot remember the last time I saw anyone depositing a blue bag in a night safe, or having coins weighed; I presume it still happens. But then I no longer visit my bank every week; in fact I positively avoid the inconvenience. For many, life is extremely busy with telephone banking and automatic teller machines (ATMs) vital in managing their affairs. Like other sectors, banking has changed more in the last 20 years than in the previous 100, and the pace of technology will accelerate the process. So the next 10 years looks even more exciting. Just consider the changes, with: mortgages, pensions, insurance, share dealing, direct debit, standing orders, special accounts, financial management, plastic and IT.

As an outsider to, but active customer of, the banking sector I see the embodiment of change in the progression from coins, paper and cheques to cards, and soon, e-cash. This would be impossible without IT and telecommunication networks. But IT is also allowing many newcomers to enter banking: building societies, retail chains, motor manufacturers and telephone companies. Because there is no money anymore, just bits in a database, anyone can become a bank. So the traditional banking sector finds itself under siege. The $64 000 question is: what happens next?

Basic Questions

For the most part, the core business of banking is managing complexity and providing trust services. Banks

Money = Bits



deal in secure information and data transfers at the speed of light across the planet. People trust banks, and banks manage the lubrication of commerce and society—money—furnishing confidence, surety and security. However, the very rocket science to do all this is now available on a PC. Just get on-line and open your own bank; it is happening. So what should banks be doing?

Opinion

Ask most small-business people what they think of their bank and most likely you will get a rude reply. The reason? Simple—banks take no real risks, they sit on the hillside with binoculars watching the small-to-medium enterprise (SME) crash and burn. They then rush in at the last moment to pick over the bones and recover their investment.

Ask most individuals what they think of their bank and most likely they will be kinder, but they will probably moan about charges, interest rates, and the perception of practices of instantly debiting accounts, while delaying the credit process, so the difference can be traded.

For banks to survive and progress all of this has to change and move on.

A Sample of the Future

In the new millennium, banks will have to change radically to become proactive service-oriented angels. Here are some examples:

Individual professionals

Thirty years ago a professional might have expected to work for one, two or three employers in a lifetime. Today the number is in excess of seven, and in 20 years it will be in excess of 25. Managing the tax, pension, insurance and stability of such a life will be a nightmare; people will want to outsource the problem.

Looking around for a real example, I found a young lady who graduated as a pharmacist, worked for 18 months for a large pharmacy chain in the UK, and then became a freelance locum. She currently works in a hospital during the week, and as a supermarket pharmacist at the weekend. By the end of a year, she typically has had over 35 employers!

Who should she turn to for assistance and the management of her affairs—the banks? After all they have access to all the data and could reduce the problem to a software package. More importantly, has her bank been proactive and spotted her dilemma? Are they chasing her with solutions to her financial management problems? No, they are not even aware she exists and have not even approached her to set up a pension fund. What an opportunity missed; and how many more are there in this new and growing sector?

Corporate professionals

People are working harder as companies downsize and de-layer—no time for decorating, gardening, or cleaning the car. Here is another banking opportunity at the micro-level. Managers are paying more attention to their company accounts than their domestic situation. They need to outsource their personal finance management, make provision for job changes, and insure against the unforeseen. They are moving toward a more complex world of rapidly changing fortunes and, for some, multiple simultaneous employers. Who should they turn to for financial advice and management if not the banks?

Small businesses

The business-angels concept is only just migrating across the Atlantic, and it could radically change the funding of SMEs. The concepts are simple but effective. A club of intelligent and interested funding companies and individuals is formed with a vested interest in the success of a new venture. Typically the funders are active in the same or related areas so they can advise and support with market experience and contacts to minimise failures. They assume a low percentage return (typically 10–15 percent), and work to make the enterprise a winner.

The founding principles are simple and essential:

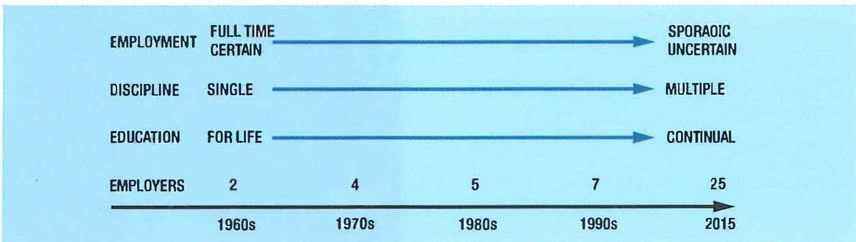
- *OPEOM*—Other PEOples Money;
- *commitment*—everyone involved is an investor;
- *reward*—everyone stands to gain;
- *self help*—all involved work toward the overall success of each venture;
- *propagation*—the successful start-ups then become angels too.

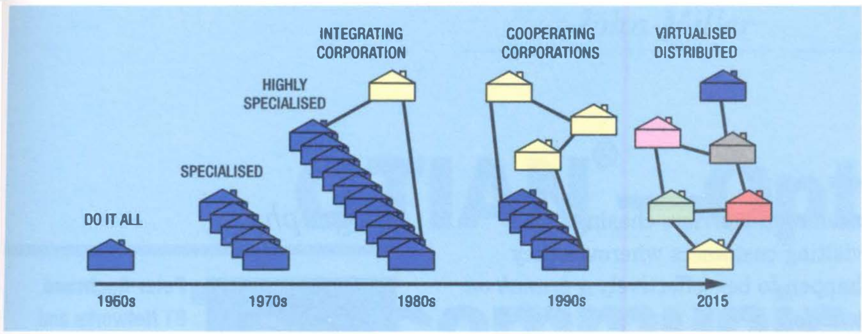
How simple, and how different to the traditional approach. This is both a threat to, and an opportunity for, banking. But to enter this new sector and mode means acquiring new expertise and skills. This is probably best done by virtualisation—and banks then become more ethereal, less solid, and distributed.

Big businesses

Outsourcing is more than a management fad. No company can do it all, no matter how large. Most large players have already got rid of the motor pool, estate management, IT networks, catering and more. Soon they will have outsourced desk-top support, printing,

The development of employment





The future of companies

design, and turned their focus to their core business. This is very evident in automobile and aircraft manufacture. The major players have become system integrators—they just assemble the piece parts manufactured by others. So if outsourcing has reached such a peak, why do they still have a finance department and why do they still collect money?

Information

Trading in information products will see vast new markets of a form difficult for the old ways of thinking to conceive. Certainly any bank with a technologically ignorant CEO and board members is in trouble. They are unlikely to be able to make the right strategic decisions and investments to cope with a world dominated by bits and not atoms. Already there are more microprocessors than people, more conversations between machines every day than humankind ever had in total, and an exponential growth in bit trading.

There is money in information, but, more importantly, there is more money in the information about information. In a bit world, people will pay more to find the location of what they are looking for than the item itself. This is both deep and subtle, and a key to making money. Banks have access to a lot of information!

Common currencies

It is difficult to imagine anything more futile than the striving for common currencies. Why bother? There is no money—just bits! As coinage and paper disappear, and plastic takes over, the conversion of currencies occurs in less than a millionth of a second inside a database. It is hard to see how banks can continue to charge significantly for this luxury when it literally costs nothing.

Politicians should be encouraged to stop talking and thinking monetary union—it is the wrong problem. They need to start talking bit union. Without the networked ability to move information rapidly and transparently across Europe, we will see this 350 million people trading block outclassed and sidelined by 250 million in the USA.

Data banking

We have already reached the point where: Money = Information = Bits. That being the case, there is a direct analogy with the blue bag and the night safe. Banks have networks, databases, reliability and security. Businesses are at risk because their data is at risk. A stolen PC, fire damage, or a disc crash can debilitate an SME or even a large business if the data is not backed up. Who better to provide the back up service if not a bank?

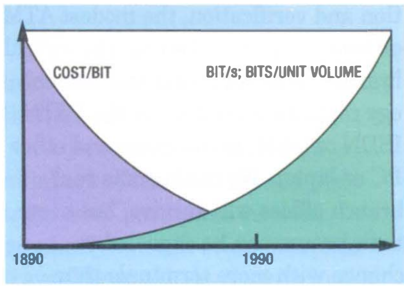
E-cash

How do you purchase something for 0·1p? Not coinage! How do you buy something for 1p or 10p? Coinage, but not plastic and not a cheque! In a world of electronic commerce the old transaction processes will not work. The reason? In a large part we will see transaction costs greater than price, or a significant percentage of price.

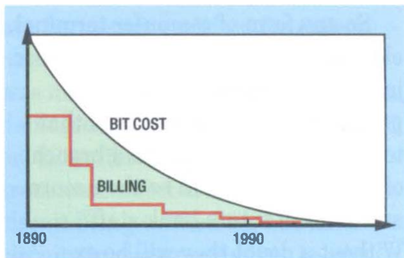
Buy a music CD and you are buying someone else's choice of bits and paying for the storage medium and packaging (~50p), plus advertising, distribution and retail. On the Net it is now possible to select the content you would like and download it to hard disc and/or onto your own CD. This bypasses the distributor and retailer, accesses a vast market and changes the economics.

Buy a book from a store and the inconvenience, publishing, distribution and retail costs are huge. The electronic equivalent is significantly cheaper and more convenient. I no longer buy books in the UK. I go to the USA on-line, purchase by AMEX and have a delivery to my home within four days by FEDEX at a lower price than a UK book store.

Buy a video, photographs, computer CD, and any on-line services of any kind, and the same is true. Transaction costs are the killer. This is a business opportunity for the provision of a new and secure system that transcends money. It will also transcend the geographical boundaries of nations and taxation systems. E-cash, like networks, is a global opportunity.



Bit cost and capacity/volume—exponentially more for exponentially less



Costs of bits versus billing

Chaos

The big bang experienced by the City of London marked a fundamental change with people (traders) being displaced by machines, and a speed up of the trading process. Increasingly, computer trading systems based on artificial intelligence (AI) will take over markets in the same way that Deeper Blue took out Gary Kasparov.

This change highlights a rapid and general move from a reasonably slow, linear, well-behaved world to a non-linear and chaotic period that is difficult for humans to rationalise. For managers this is manifest in the 'mean time between decisions' now being longer than the 'mean time between surprises'. Fortunately, people are good at identifying long-term trends, while machines can predict short-term chaotic change. Managers need AI and timely information to help them make the right decisions.

Who has access to a lot of information?—banks!

Virtual Branches and People

With the addition of videoconferencing, iris scanning customer identification and verification, the modest ATM of today could well become the virtual branch in the wall. And this technology could be extended via the PSTN, ISDN or GSM, to the home and office PC or laptop. No doubt some real branch offices will survive, but even their nature can be expected to change with more terminals than staff. Their function—real people contact when it is vital, when situations are just too complex to fix over the telephone, keyboard or conference call.

So any form of computer terminal, electronic kiosk, on-line organiser, or just a telephone will potentially provide many of the functions that today necessitate a trip to a branch office. What then will be the nature and skills of future bank staff? Without a doubt they will be extremely IT capable, with good customer-handling skills, entrepreneurial, and in many cases specialised in market sectors. Teams of advisors, experts and mentors on-line will have to deal with an increasingly sophisticated customer base living more complex lives. Banks may also need *road warriors* chasing and visiting customers wherever they happen to be—effectively *a branch on wheels*.

Millennium Banks

From the selected examples cited in the limited space available here, we can perhaps conceive the primary features of successful banks in the new millennium, as follows:

- trust services—virtualised, on-line and global;
- business angels, advisers and partners;
- providers of corporate and personal financial support and services;
- secure data warehouses, storehouses, traders;
- supporters of new electronic trading environments;
- currency translators; and
- information brokers and traders.

And then bankers will be down from the hillside, on the pitch, and a part of the game of building new and successful futures, far removed from the gloom of rosewood and staid stability.

Even More

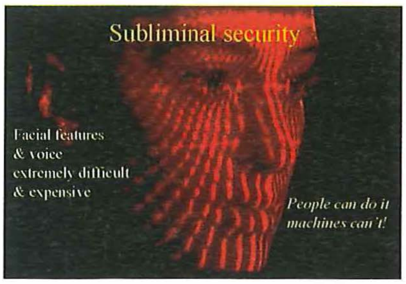
The technology, business, and people issues related to this article can be found on: http://www.labs.bt.com/people/cochrap/

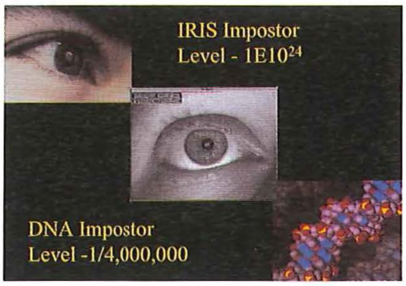
Biography

Peter Cochrane
BT Networks and Systems

Peter Cochrane joined the British Post Office in 1962 and is a graduate of Trent Polytechnic and Essex University. He is a fellow of the IEE, IEEE, and Royal Academy of Engineeering, a visiting professor to Essex and Kent Universities and University College London. He joined BT Laboratories in 1973 and has worked on a variety of analogue and digital switching and transmission studies. He has been a consultant to numerous international companies on projects concerned with systems, networks and test equipment developments. In 1978, he became manager of the Long Lines Division and directed the development of optical-fibre systems, photonic amplifiers and wavelength-routed networks for terrestrial and undersea applications. His team received the Queen's Award for Technology in 1990 for the production of optical receivers for the TAT-8 and PTAT-1 undersea cable systems. In 1991, he was appointed to head the Systems Research Division of BT Laboratories, which is concerned with future computing and communications developments. He was further promoted in 1993 to head BT Research Department with 660 staff.

Iris recognition—possible security technology for the virtual bank





John Miller

OTIAN®—Optical Telecommunications Infrastructure for the Access Network

This article describes BT's external optical plant designed for introduction into the local access network for provision between exchanges and customers.

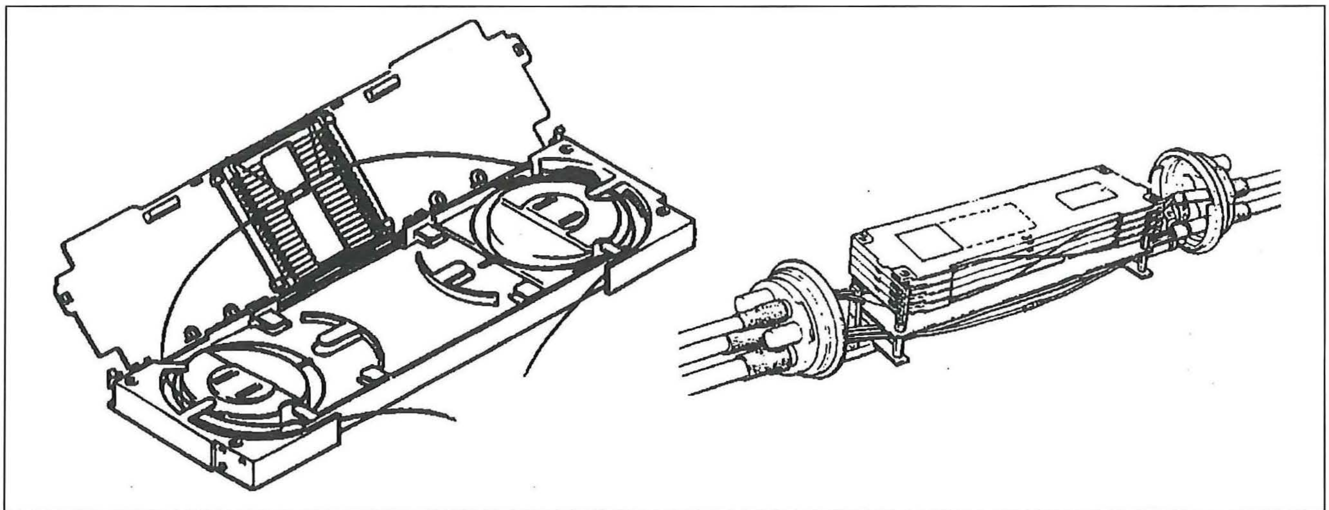
Introduction

Optical-fibre cables have many well-published advantages over copper cables; for example, higher transmission capacity, physically smaller and lighter, etc. However, they have their own disadvantages some of which necessitate the use of different plant and practices from those traditionally used for copper. One major difficulty when handling optical-fibre cables is the restriction on the degree of bend that can be tolerated before damage is caused to the fibre; for handling purposes this is a radius of 30 mm. For this reason a new range of fibre management plant was developed prior to the launch of optical-fibre cables into the main trunk network during the late-1970s to early-1980s.

At jointing positions, large numbers of fibre splices (24 per tray) were positioned in close proximity to each other on splice trays (Figure 1). As circuits in the main trunk network are not often disturbed, fibres in close proximity to each other did not highlight any problems.

In the local network, where fibres are frequently revisited for maintenance, reconfiguration or growth, it was discovered that fibres were often damaged or transients[1] were induced on those fibres disturbed. These transients affected not only the circuit being worked on, but other circuits in close proximity, thereby

Figure 1 – Traditional fibre tray (left) and configuration of joint (right)



affecting customers' service. Therefore, a new range of plant to accommodate optical-fibre cables was required.

This article outlines the philosophies, development and benefits of the fibre management system known as *OTIAN*®—Optical Telecommunications Infrastructure for the Access Network.

History

Existing plant used for fibre cables in the main trunk network has limited element and fibre management, does not offer adequate protection against frequent fibre handling, causing transients, and cannot accommodate optical devices (splitters).

In the early-1990s, it was planned to introduce fibres into the local network; that is, from exchange to customer. Customers to be offered provision were to be small businesses of five or more public switched telephone network (PSTN) lines. It was realised that conventional single-mode optical fibre would be more vulnerable and therefore more likely to suffer from transients at flexibility points. The decision was therefore taken to conduct a trial using off-the-shelf plant. This trial, know as the *local line optical-fibre trial* (LLOFT), was run by BT Laboratories and took place at Bishop's Stortford. Results from the trial confirmed the need to provide a new range of plant and associated work practices to meet the requirements of the local network.

Philosophies

The following philosophies were adopted when documenting the requirements for the new plant:

- an end-to-end fibre network solution (from exchange to customer end) (traditionally individual plant items are specified);
- a system-independent and future-proof solution;
- non-service affecting network growth, reconfiguration and network flexibility (accommodated by specifying 'single circuit management');
- common parts that are modular in design wherever possible, and, no matter how complex in design, are simple to use;
- the opportunity for turnkey solutions; and
- specification of function and performance, not detailed design.

Development

From the above philosophies, results from LLOFT and experience from plant used in the main trunk network, specifications were prepared and sent to industry in the form of requests for information (RFIs).

It was of no surprise that industry had few off-the-shelf items to offer and did not understand BT's network and its requirements. In the past, industry provided individual plant items, and therefore did not appreciate where in the network plant items are used and the skills needed to use them.

After several presentations from companies, it was decided to work closely with two—BICC and Raychem. Both companies developed and produced plant acceptable for pilot trials.

Other companies were sought, not only to provide further competition but also to meet the large quantities required for launch in the UK. One additional company, Pirelli Cables, provided plant to an acceptable standard.

With some minor amendments and full technical backup from BT, systems from these three companies were launched for use in the network in November 1995.

After major rationalisation of the number of plant items and with some redesigns, more cost-effective plant and quicker installation times were achieved.

BT is currently building its network using plant supplied by Pirelli.

The Building Blocks

The individual items of plant which make up the OTIAN system, known as *building blocks* (Figure 2), are discussed below:

Sub-Assemblies

Sub-assemblies (Figure 3) are the basic building blocks of the OTIAN plant and can be located in all parts of the network. They are a series of trays arranged in modular blocks and the trays may have apertures that allow for the attachment of clip-on[2] optical power meter maintenance tools. There are three kinds of sub-assembly:

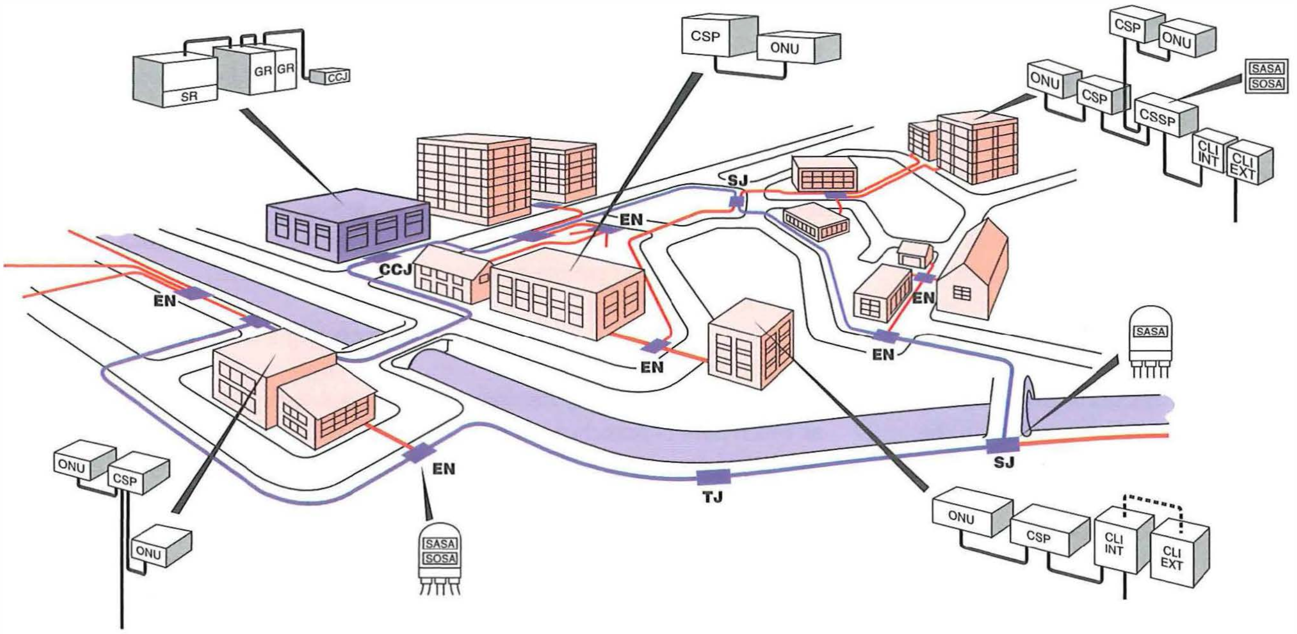
Splitter array sub-assembly

The splitter array sub-assembly (SASA) is located at points in the network where an optical split is needed and provides a housing for storage, splicing and splitting. SASAs manage fibre on a single-circuit basis. Each tray within a SASA holds two spliced fibres, the go and return fibres for specific customers.

SASAs come in a range of different split levels (2 × 2, 2 × 4, 2 × 8, 2 × 16 and 2 × 32) where the first figure (2) refers to the number of input trays, main and standby, and the second figure (2, 4, 8, 16 and 32) the output trays. The splitter section (that is, where the optical splitting devices are housed) of the SASA module is completely separate from the section for splicing. In the event of a fault, SASAs can be reaccessed and tested with clip-on maintenance tools. SASAs are found in nodes, but can also be placed in a customer premises box unit. SASAs are therefore used in point-to-point and point-to-multipoint systems.

Single-element splice-only sub-assemblies

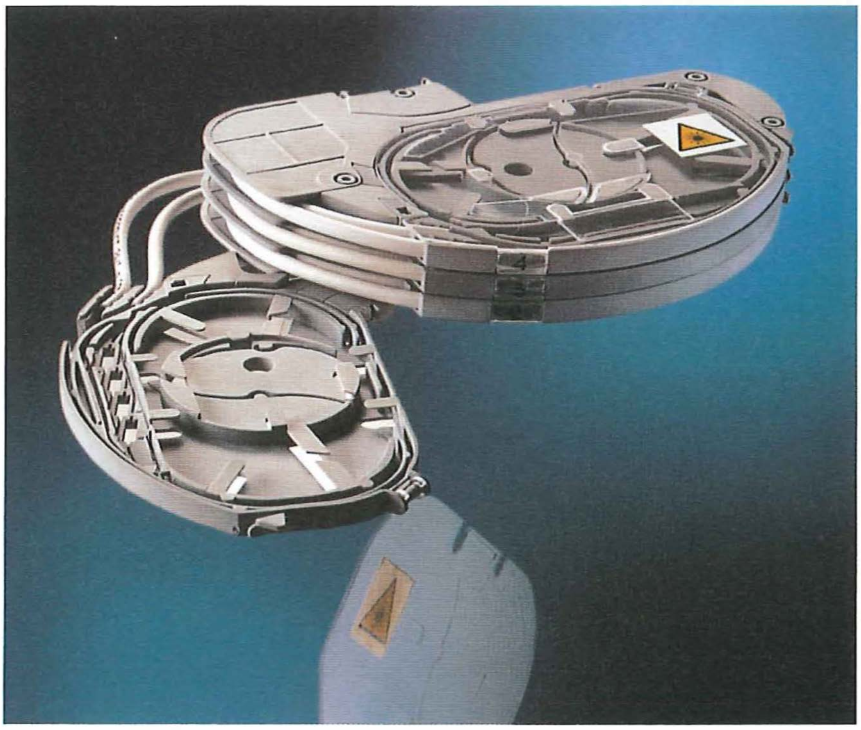
Single-element splice-only sub-assemblies (SE SOSAs) are modules



CCJ - Cable Chamber Joint	**EN** - External Nodes	**SJ** - Spur Joint
CLI EXT - Customer Lead-In External	**GR** - Generic Rack	**SOSA** - Splice Only Sub-Assembly
CLI INT - Customer Lead-In Internal	**ONU** - Optical Network Unit	**SR** - Sub Rack
CSP - Customer Splicing Point	**SASA** - Splitter Array Sub-Assembly	**TJ** - Track Joint
CSSP - Customer Splicing and Splitting Point		

Figure 2—Fibre ring showing the various items of OTIAN plant from exchange to customers' premises (BT is also using OTIAN for building tree-and-branch and point-to-point/multipoint networks)

Figure 3—Sub-assembly



designed to splice fibre elements together. Elements are groups of eight fibres in a tube, as used in BT's optical cable designs. One splice tray caters for one element; that is, eight spliced fibres.

SE SOSA trays are not designed to be reaccessed or tested. SE SOSAs are used predominantly in cable chamber joints and track joints.

Single-circuit splice-only sub-assemblies

Single-circuit splice-only sub-assemblies (SC SOSA) store two spliced fibres on a single-circuit basis. This means individual circuits and customers are managed separately. Each tray contains four apertures for the use of the clip-on maintenance tool. Single-circuit SOSAs are used in point-to-point and point-to-multipoint systems.

External building blocks

Generic joint

A generic joint (Figure 4) is a heatshrink/mechanical cap-ended closure which is supplied empty and is configured to provide the following:

- *External node (EN)* External nodes are the key to configuring the network. They are the strategic points at which levels of split are planned. They can accommodate either SASAs or SOSAs. Depending on their location (in the primary or secondary network), external nodes are referred to as either *primary* or *secondary* nodes. A Junction Box 4 can house one node and a Junction Box 6 can accommodate four nodes. External nodes have an oval entry and six circular cable ports. Typically they have a capacity for 48 single-circuit splice trays and are compatible with cables of up to 144 fibres and blown fibre[3].

- *Track joint (TJ)* Track joints join in-line lengths of fibre cable. They use splice-only sub-assemblies. Splicing is performed cable element to cable element. Once made, track joints are not designed to be re-entered unless a damaged cable needs to be reinstated (although track joints may be converted into nodes at a later date). Track joints have a maximum capacity of 240 spliced fibres, when spliced on SE SOSAs, and are compatible with blown fibre and cables.

- *Spur joint (SJ)* Spur joints are the points in the primary network at which fibre is branched out into the secondary network. The required fibre is spurred off by splicing and the remaining fibre can be spliced or looped through the joint. Joints have a maximum capacity of 240 spliced fibres, when spliced on SE SOSAs, and are compatible with blown fibre and cables. Installation of this joint involves using specific loop lengths of cable.

- *Cable-chamber joint (CCJ)* Cable-chamber joints are housed in an exchange. They are the point at which external and internal cables are jointed (spliced). The joint is made using SOSAs. CCJs have the capacity to manage a maximum of 144 spliced fibres. They accommodate a range of optical cables: Cable Optical Fibre 18 and 27, which are external cables, and Cable Optical Fibre 23, which is an internal cable.

Exchange building blocks

Sub rack

The sub rack (Figure 5) is located on the exchange equipment rack. It is the means of connecting the electronics onto the in-station (exchange) optical-fibre cabling. This is done by splicing the ruggedised cable tails from the electronics onto the exchange cabling.

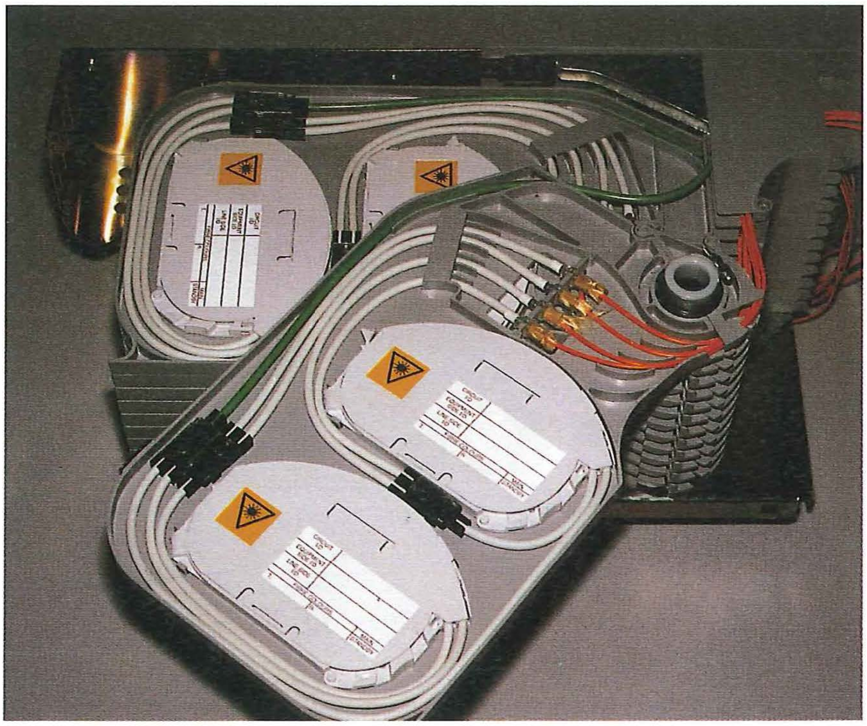
The sub rack uses single-circuit splice trays and can accommodate 48 spliced fibres (no splitters are involved).

Test access module (TAM)

Test access module assemblies (TAMs) house eight single-circuit test access modules (Figure 6). By connecting a light source to a TAM, a test wavelength (for use with clip-on

Figure 4—Generic joint with sub-assembly fitted

Figure 5—Sub rack



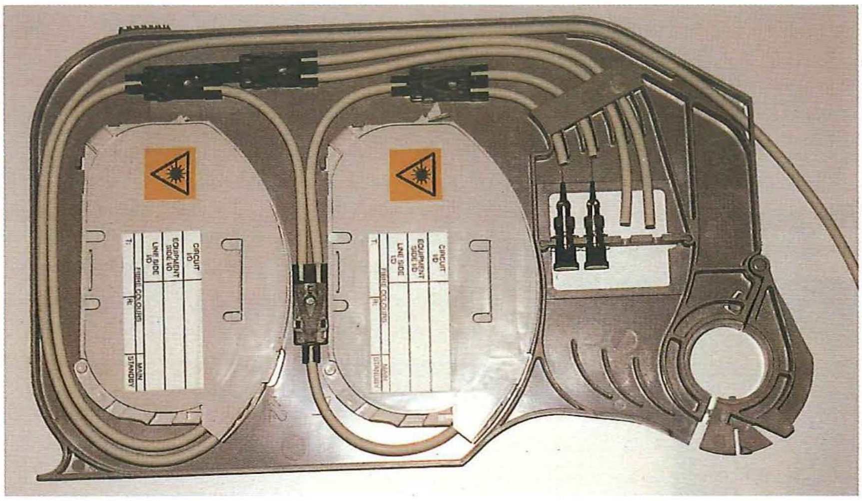


Figure 6 – Test access module

measurement techniques) can be introduced without affecting service to customers.

Generic rack

The generic rack (Figure 7) provides single-circuit jumpering between line and exchange-side cables and has a capacity to hold up to 576 fibres.

Internal building blocks

Customer lead-In

The customer lead-in (CLI) (Figures 8) manages the access of blown fibre into the customer's premises. It consists of a box unit, blown-fibre management system and gas blocking system. The method of entry is either by installing cable through a wall or by means of an underground duct.

Figure 7 – Generic rack

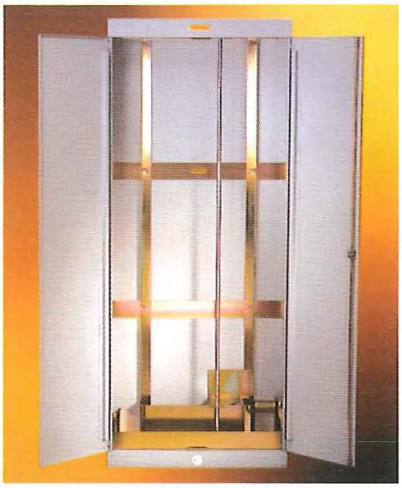
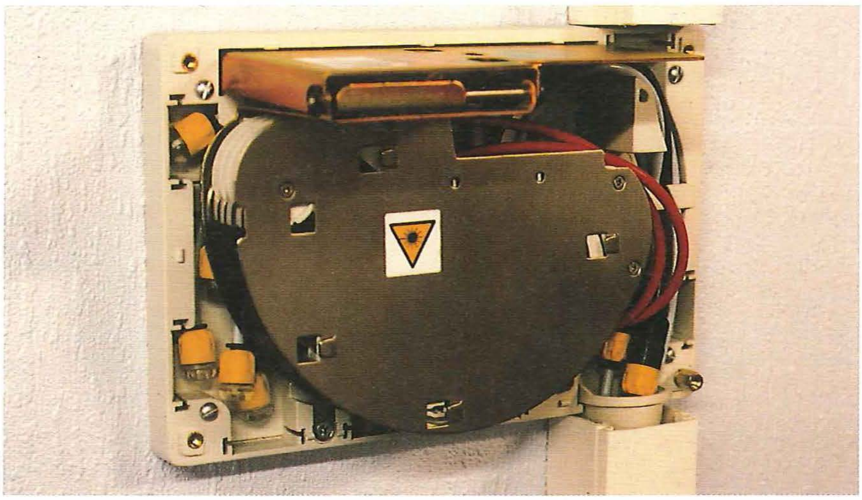


Figure 8 – External customer lead-in

Figure 9 – Customer splicing and splitting point



Customer splicing and splitting point

The customer splicing and splitting point (CSSP) (Figure 9) gives the option of splitting the signal after the fibre has been brought into the customer's premises.

CSSPs can provide either optical splitting or cable jointing using splitter array or splice-only sub-assemblies. They are wall-mounted and consist of a box unit and a fibre and tube management system. The signal can be split up to a maximum of eight ways.

Customer splicing point

Located at the customer's premises, the customer splicing point (CSP) (Figure 10) connects fibre to the ruggedised tails of the customer electronics. These electronic units are called *optical network units* (ONUs).

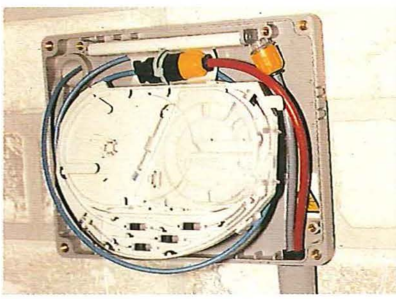
One CSP will provide a termination for two ONUs.

Conclusions

Since the introduction of OTIAN into the local network there have been no reported instances of transient interference. After the launch in November 1995, the cost of OTIAN plant has halved and have potential for reducing the installation times by two thirds.

With many of the OTIAN philosophies included in ITU-T (Recommendation L.17) and various articles published detailing OTIAN plant, there is now a lot of interest around the world in the use of OTIAN, with

Figure 10 – Customer splicing point (cover removed)



several countries now using the system, including Holland, Australia and Hungary.

Extra volumes from potential worldwide use and planned introduction into BT's main trunk network, will reduced the price of plant still further.

Acknowledgements

Thanks go to Pirelli for the use of photographs of their plant.

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Biography

John Miller
BT Networks and Systems

John Miller joined BT in 1971 as a design draughtsman. He has spent all his career in the External Engineering Division. His work has involved various aspects of copper and fibre jointing, terminations, sheath closures and test equipment development. He leads the Fibre Infrastructure Team, in Networks and Service Operations, whose responsibilities include the specification, evaluation and approval of fibre infrastructure plant and installation practices used by BT.

Paul Townsend and Simon Phoenix

Quantum Cryptography: Secure Communications Using Quantum Physics

Recently, researchers have begun to look beyond the limits imposed by classical physics on information processing and communication in an attempt to design and build systems with radically new functionalities that are intrinsically quantum-mechanical in nature. Quantum cryptography is an example of such a system. The technique exploits the fundamental quantum properties of single photons of light to provide certifiably-secure communications on optical-fibre networks.

Introduction

The information revolution of the latter half of the twentieth century has been driven by rapid technological developments in the fields of digital communications and digital data processing. A defining feature of today's digital information systems is that they operate within the domain of classical (that is, non-quantum) physics. Each bit of information can be fully described by a classical variable such as, for example, the voltage level at the input to a transistor or microprocessor. However, information can also be processed and transported quantum-mechanically, leading to a range of radically new functionalities[1]. These new features occur because the properties of quantum and classical information are fundamentally different. For example, while classical bits must take on one of the two mutually exclusive values of zero or one, a bit of quantum information can have the strange property of being both zero and one simultaneously. Furthermore, it is always possible, in principle, to read classical information and make a perfect copy of it without changing it. In contrast, quantum systems can be used to carry information coded in such a way that it is impossible to read it without changing it and impossible to make a perfect copy of it[2]. It is these properties that are directly exploited in quantum cryptography[3–5] to provide secure communications on optical-fibre systems[6–13]. The technique enables the secrecy of information transmitted over public networks to be tested in a fundamental way, since an eavesdropper will inevitably introduce readily detectable errors in the transmission. Quantum cryptography offers the intriguing prospect of certifiable levels of security that are 'guaranteed' by fundamental physical laws. This possibility arises from the quantum nature of the communication system and cannot be realised with any conventional classical system.

This article discusses the fundamental theoretical ideas that underlie quantum cryptography and reviews the results of recent experimental work carried out at BT Laboratories. These practical developments include the demonstration of quantum cryptography on a multi-user computer network and trials of the technique on fibre installed in BT's external network. These experiments show that, despite the apparent esoteric nature of the technique, practical quantum cryptography systems can in fact be built and tested in real-world applications.

Classical Cryptography

Encryption is the process of taking a message or plain text and 'scrambling' it so that it is unreadable by anyone except the authorised recipient. The process can perhaps best be described by analogy. Encryption is the mathematical analogue of taking a message and placing it inside a lockable box.

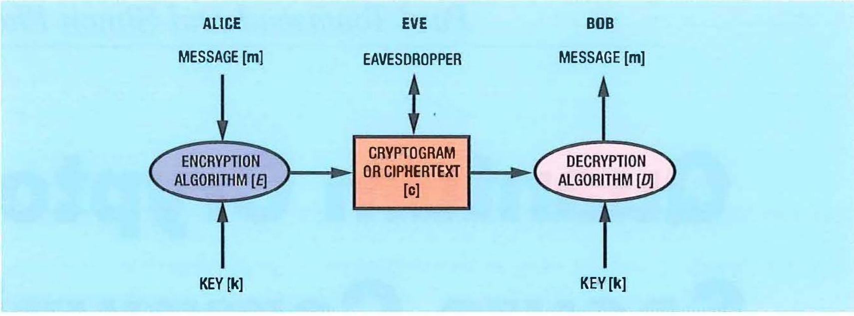


Figure 1 – Basic elements of a cipher system

The box is then locked with a key held only by the sender and the authorised recipients of the message. Any unauthorised person intercepting the locked box will be unable to retrieve the message from the box without possessing a copy of the key.

Mathematically, encryption can be described as an invertible mapping of a message **m** into a ciphertext **c**. The mapping is achieved by an encryption algorithm, E, which takes as input the secret key, **k**, and the message so that $\mathbf{c} = E(\mathbf{m}, \mathbf{k})$. The message, key and ciphertext can be expressed as binary data strings. The decryption is achieved with the use of the inverse algorithm, D, so that $\mathbf{m} = D(\mathbf{c}, \mathbf{k})$.

In terms of the lockable box analogy the algorithm is the locking mechanism which is activated by the key. As with the case of a mechanical lock it is the secrecy of the key that keeps the system secure. A well-designed lock should be difficult to open without the key even when the details of the lock are known. Similarly, a well-designed algorithm resists attempts to invert it even when its mathematical details are known. It is an accepted design principle of cryptographic algorithms that the security should not be dependent on the secrecy of the algorithm but should reside *entirely* in the secrecy of the key. Many widely-used cryptography systems, such as the Data Encryption Standard (DES)[14] use publicly-available algorithms.

The requirement that the secrecy be entirely dependent upon the key also imposes another good design principle. An eavesdropper can always attack a cryptography system simply by trying each possible key in turn. A good algorithm will be designed such that this is the *fastest* method of attack. DES, for example, uses a key length of 56 bits so that an attacker performing an exhaustive key search will have to test, on average, 2^{55} keys. Although this is a huge number, future increases in computational power may necessitate the use of longer keys.

Figure 1 shows a schematic representation of a cryptography system, where the standard terminology of Alice, Bob and Eve is used to describe the transmitter, receiver and an unauthorised eavesdropper respectively. In order to operate the scheme Alice and Bob must exchange keys and, most importantly, must ensure that these keys do not fall into Eve's hands. If the system is to remain secure Alice and Bob must regularly update their keys and this leads to a key generation, distribution and management problem that is a central issue for secure communications systems.

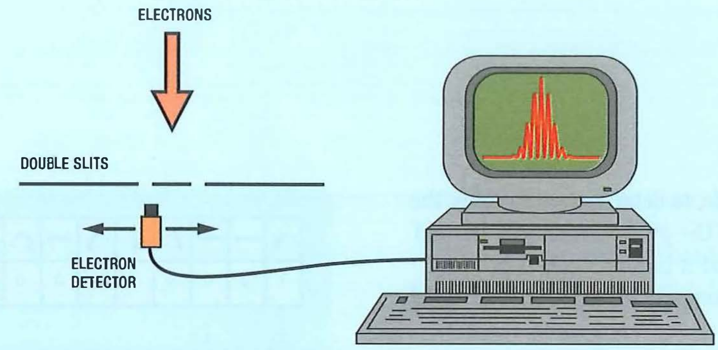
Quantum cryptography achieves the desirable goal of an automated procedure for establishing keys between two or more parties in such a way that any unauthorised interception can be discovered and dealt with. Some modern cryptography systems attempt to solve the key management problems using a technique known as *public-key cryptography*. In public-key cryptography each user has two keys: a private key, and a public key. The public key is widely distributed, the private key is kept secret. To send a confidential message using a public-key scheme, Alice obtains Bob's public key from a public directory and uses this to encrypt her message to Bob. Once this has been done only Bob can decrypt the message using his private key. In terms of the lockable box analogy this is like having a box whose lock is operated by two keys. Everyone has access to the key to lock the box but cannot unlock it. Only one key will open the box and that is the private key held by the message recipient.

Public-key cryptography requires, in general, more processing power than conventional cryptography. It's use in modern confidentiality systems is usually as a means of encrypting the shared key for use in the faster conventional cryptography. This encrypted key can then be distributed over open networks. However, this method does not really solve the overall problem. A public key is obtained from some public source and this source must be trusted. In other words how do we know the public key we use to encrypt the message belongs to who we think and not to some other party? Other techniques such as the use of trusted third parties are required to address this authentication problem[15].

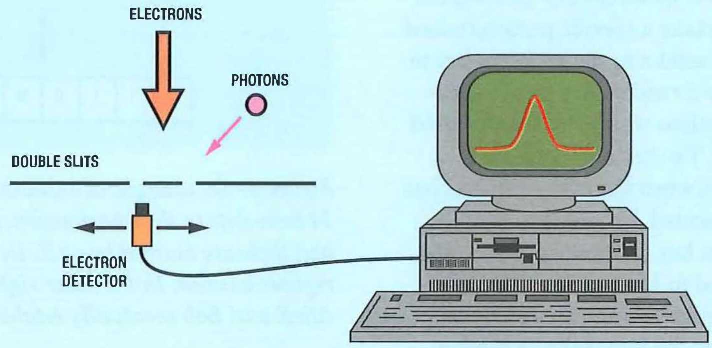
Quantum Complementarity and Photon Polarisations

In quantum cryptography[3–4] secure key distribution is achieved via an exploitation of a strange quantum property known as *complementarity*[16]. In simple terms the essence of complementarity is that measurement of a quantum system disturbs it. An experiment can be designed to probe either the particle-like or wave-like properties of a quantum system, for example, *but not both*. The particle and wave aspects are said to be complementary attributes of a quantum system. A classic example of this is Young's double-slit experiment for single electrons (Figure 2). If we try to determine through which slit an electron went, thus probing the particle-like nature of the system, we lose any interference pattern. If we choose to view the interference pattern, thus probing the wave-like nature of the system, we cannot determine through which slit the electron went. For example, we could try to determine which slit the electron went through by using a photon to 'see' the electron. However, interaction of the electron with the photon imparts a momentum kick to the electron sufficient to destroy the

Figure 2 – Is it a particle or is it a wave?



(a) The electron detector sees a periodic variation in electron intensity as it is moved in the lateral direction. This is indicative of interference – a wave-like phenomenon



(b) When photons are scattered from the electrons to identify which slit they have passed through (particle-like behaviour) the interference pattern disappears

interference pattern. If we try to use photons of a longer wavelength, thereby reducing the momentum kick imparted to the electron, we find that the interference pattern is restored when the wavelength is greater than the slit separation. However, it is then no longer possible to resolve the slits and it is therefore no longer possible to ascribe a unique trajectory to the electron. It is possible to use the existence or otherwise of the interference pattern to determine whether or not an attempt has been made to measure the trajectory of the electron. Turning the experiment on its head in this way and asking whether or not there has been an attempt to tamper with the electron (that is, to measure its trajectory) we can see the beginnings of an idea of how quantum mechanics may be used to protect information.

In order to proceed further we need to find a way of representing a random bit sequence (the key) using complementary quantum observables. Keeping in mind that the final goal is to distribute cryptographic keys over long distances, and that standard telecommunications fibre is an excellent low-loss optical transmission medium, a system based on the polarisation states of single photons of light[3,4] will be described. The polarisation of a photon indicates the direction of oscillation of the electric field. If the direction is constant in time then we say that the photon is *linearly* polarised. Another possibility is that the direction of polarisation simply rotates with time and then we say that the photon is *circularly* polarised. A photon prepared, for example, in a state of circular polarisation can be right circularly polarised or left circularly polarised. Similarly, a linearly polarised photon may be vertically or horizontally polarised. All of the photon's polarisation properties can be understood in terms of either one of these two (linear or circular) polarisation 'bases', or combinations of the states therein. These states and their

Table 1 Notation and Coding for the Circular and Linear Polarisation States of Single Photons

State	Coding
Right circularly polarised $\lvert R\rangle_{circ}$	1
Left circularly polarised $\lvert L\rangle_{circ}$	0
Vertically polarised $\lvert V\rangle_{linear}$	1
Horizontally polarised $\lvert H\rangle_{linear}$	0

associated binary values are summarised in Table 1.

Before describing the protocol in detail it is necessary to take a look at the various possible measurements of the polarisation states of a single photon and their interpretation. Suppose you were given a photon and told it was prepared in one of the four polarisation states $\lvert L\rangle_{circ}$, $\lvert R\rangle_{circ}$, $\lvert V\rangle_{linear}$, $\lvert H\rangle_{linear}$, but not which one of those states and asked to identify which particular state, which measurement would you choose? In fact there is no single measurement, or sequence of measurements, that will enable you to determine unambiguously the polarisation state of the photon. This occurs because linear polarisation and circular polarisation are complementary quantum observables and measurement of these quantities are incompatible in the same sense as the particle and wave properties of the electron as discussed above. Suppose that in fact you had been given a photon prepared in the state $\lvert R\rangle_{circ}$. If you decided to measure a circular polarisation, all well and good, you would identify the state with 100% accuracy (assuming perfect measuring apparatus). However, if you had chosen to measure a linear polarisation along the given direction, you would obtain the result $\lvert V\rangle_{linear}$ with 50% probability and the result $\lvert H\rangle_{linear}$ with 50% probability. This is because the circularly polarised state $\lvert R\rangle_{circ}$ can also be represented by a combination or 'superposition' of the two linear states $\lvert V\rangle_{linear}$ and $\lvert H\rangle_{linear}$. However, the situation is worse than it appears at first sight; not only do you obtain a random outcome with the 'wrong' measurement but also you do not know that you have obtained such an incorrect result! All that can be said after a particular measurement is that the photon is now in the polarisation state measured. It is impossible, *in* *principle*, to determine accurately the state of the photon when you are told only that it has been coded in one of two incompatible bases, but not which one[2].

Quantum Key Distribution Protocol

The aim of quantum key distribution is not to take a specific predetermined key and send it to the recipient but to generate a random key in two separate locations which can then be used as a key. The key only comes into existence when the entire protocol has been executed. The essence of the quantum key distribution protocol is contained in Figures 3 and 4. Alice begins by generating a random bit sequence; she also makes a random selection of polarisation basis (linear or circular) to be used for encoding each bit. The photons are then generated in the required state and sent on to Bob over an optical link that is not necessarily private. The photons are generated in a regular sequence so that only one photon is present in any given time-slot. Bob receives this regular sequence of photons and for each time-slot chooses, randomly and independently of Alice, a measurement basis in which to determine the photon's polarisation state. This procedure is shown in Figure 3 where an example 14 bit sequence is shown with the coding chosen by Alice. Bob's measurements are shown directly below the bits chosen by Alice. We can see that one of three things can happen:

- Bob does not receive the photon (there is loss in the system),
- Bob makes an incorrect choice of measurement basis, or
- Bob measures in the correct basis.

Alice and Bob now engage in a public discussion and exchange basis information, that is, they disclose the coding and measurement bases chosen, *but they do not disclose the actual bits which were sent and received.* Those instances where Alice and Bob chose different bases are discarded as no correlation between sent and received data is expected. Bob and Alice also discard those time-slots where no photon was received by Bob. Alice and Bob keep the remaining time-slots and should therefore now share an identical sequence of random bits which can be used to generate the final cryptographic key.

How is secrecy achieved? Consider what happens if Eve tries to intercept the quantum transmission. If Eve decides to read the bit encoded on any particular photon she must choose a measurement basis to do so. Because of the random coding scheme, it is quite likely that the basis she chooses will not be correct, leading her to achieve (unknowingly) a random outcome from the measurement. Furthermore, only those bits that reach Bob will form part of any eventual key so Eve must send something on to Bob if her measurement is to be useful to her. This causes Eve to generate errors, as illustrated in Figure 4 where the transmission example shown in Figure 3 is repeated with an example

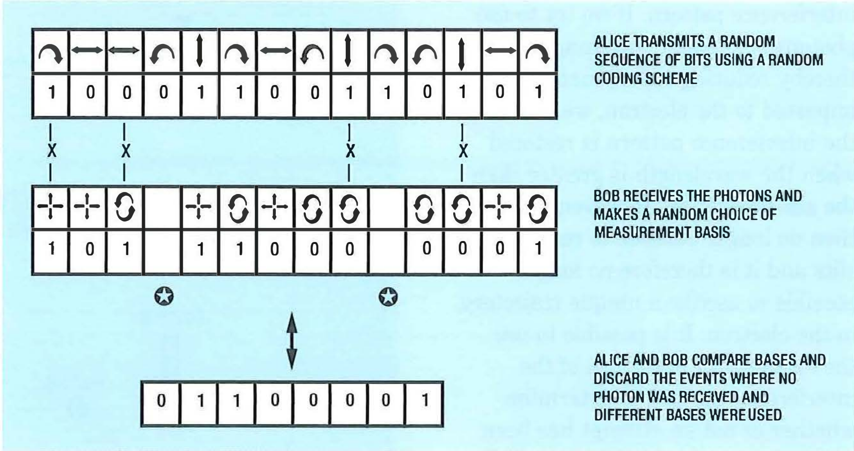


Figure 3 – An example of a quantum transmission between Alice and Bob. There are 14 time-slots in the transmission. In four of these slots Bob measures the wrong basis and these are marked by an X. In two of these slots, marked with a ✪, Bob does not register a count. In the other eight instances Bob measures the correct basis so that AlicE and Bob eventually establish an 8 bit random binary sequence as their key

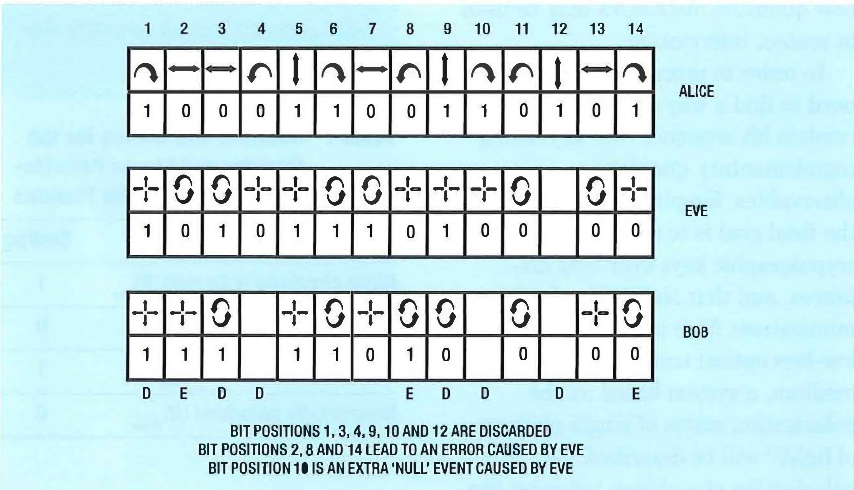


Figure 4 – The same quantum transmission shown in Figure 3 but with the presence of an eavesdropper

interception by Eve. In this figure Eve is assumed to have tried to intercept all of the photons and to have randomly chosen between the linear and circular measurement bases, retransmitting her measured state faithfully. In time-slot 1 Eve guessed incorrectly, but so did Bob, and this bit is discarded at the public discussion phase. Time-slot 2, however, is an example of a successful transmission by Alice in that both she and Bob chose the same basis. Eve guessed incorrectly in this instance and has given rise to a discrepancy between Alice's and Bob's bit strings. Time-slot 7 is a similar instance to that of time-slot 2, except that Eve's retransmission of the incorrect state has not given rise to an error. Time-slot 10 is another example of how Eve can cause a discrepancy. Here, she tries to measure the photon but receives a null result. If Eve is not careful to compensate for these instances Alice and Bob can infer her presence from an increase in null results. At the end of a public comparison of bases and rejection of incompatible data Alice is left with a subset of her transmitted bit string given by 01100001. Bob's bit string, which in the absence of Eve should be identical to this, is 11101000. If Alice and Bob now randomly choose bit positions 1, 3 and 8 to publicly compare they will note two discrepancies and can infer the presence of Eve. Of course Alice and Bob will wish to test many more bits than this to be certain, with negligibly small probability, that their communication has not been intercepted. For example, in the scheme that we have considered, Eve has a 25 per cent chance, per photon, of inducing an error in Alice and Bob's potential key data. If Alice and Bob have a sequence of N bits where they used the same basis, and therefore expect to have N identical bits, the probability that there will be no errors in this data if Eve has tried this eavesdropping strategy is $(3/4)^N$. In order to test for the presence of Eve, Alice and Bob have a further public discussion where M test bits, say, are randomly chosen from their original transmission of N bits and publicly compared. The probability that Eve escapes detection for M=100 is about 3×10^{-13}; that is, negligibly small. If they find after public comparison of the test sample that there is no detectable presence of an eavesdropper they can discard these test bits and use their remaining, undisclosed bits as a secret key.

It is the fact that any eventual key is only established from those photons *actually received* by Bob that makes a quantum key distribution scheme robust to loss. Loss does not compromise the security of the system but merely reduces the data rate of the key generation. The same is true for an attack in which Eve diverts some of the photons to herself by inserting a beamsplitter or optical coupler into the quantum channel. Photons behave like indivisible particles that cannot be split, so although Eve will obtain a subset of the bits transmitted by Alice it will be a different subset from the one established with Bob and, hence, gives no information on the key. In an ideal world the protocol described would detect the presence of an eavesdropper if just a single error was found in the test sample. However, we have to make do with imperfect detectors and noisy systems which can give rise to spurious results even in the absence of an eavesdropper. The experimental systems described later have an intrinsic error rate of a few per cent. In order to give a guaranteed level of security, Alice and Bob must assume that *all* the errors in their data are due to an eavesdropper. There is, in principle, no way to distinguish between an error caused by an active eavesdropper and a noise-induced error. Alice and Bob, of course, need to share the *same* key. It is clear, therefore, that in any practical system, environmental influences must be accommodated without compromising the security. In other words, Alice's and Bob's bit strings must be reconciled by a suitable error-correction procedure[4]. Once this public error-correcting procedure has been performed Alice and Bob will share an identical sequence of bits. Even if Alice and Bob believe their errors to have arisen purely from noise this cannot be proven absolutely and they must therefore assume that their reconciled bit string is only partially secret. Alice and Bob then employ a procedure known as *privacy amplification*[17] to distil a smaller body of certifiably secret data from their partially secret shared bit sequence. This final random bit sequence can then be safely used as a secret key for subsequent encrypted data transmissions.

Quantum Key Distribution Over Optical Fibre

The remainder of this article reviews a number of practical developments that have taken place recently at BT Laboratories. These developments demonstrate the potential that quantum cryptography has for applications in real optical-fibre networks and systems. Although we have so far concentrated exclusively on polarisation it is not the only property of single photons that can be exploited in a quantum cryptography system. A phase coding scheme can also be adopted where the coding is effected by changing the relative phase between the internal arms of an interferometer[6]. Over the last few years BT Laboratories has developed such a quantum interferometric system[10, 18] and has used it to transmit keys securely over optical fibre for distances of up to 50 km. These laboratory experiments used dedicated fibre solely for purposes of quantum key distribution; however, in real applications this may not be possible owing to issues of cost or lack of available fibre capacity. Consequently, a more generally applicable approach that uses wavelength-division multiplexing (WDM) to add a quantum key distribution channel to an existing installed fibre link carrying a conventional high-capacity data channel has been demonstrated[12]. In operation, the secret keys exchanged across the link could be used for

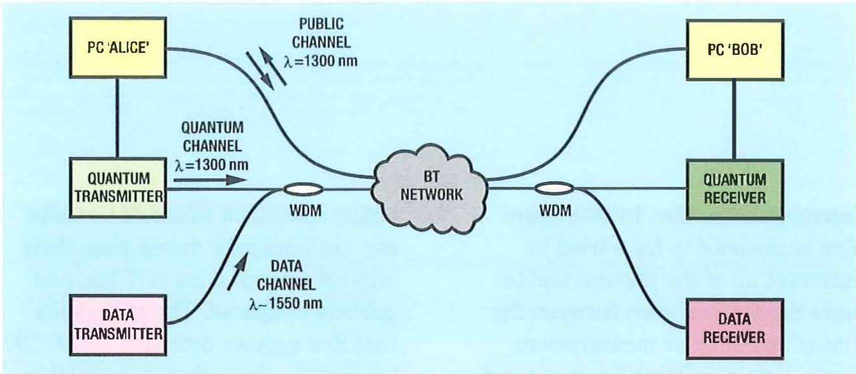


Figure 5—Experimental system for simultaneous quantum key distribution and conventional data transmission over installed fibre

encrypting some or all of the data carried by the data channel. A schematic diagram of the experiment is shown in Figure 5. The system is controlled by a pair of personal computers (Alice and Bob) that are linked via 28 km of standard telecommunication fibre installed in the Ipswich region of BT's external network. The quantum key distribution channel (wavelength λ_q = 1300 nm) and the 1·2 Gbit/s data channel (wavelength $\lambda_d \sim$ 1550 nm) are multiplexed at the transmitter onto a single fibre and then de-multiplexed at the receiver using commercial WDM couplers. In the current experiment the public discussion traffic required for the quantum cryptography protocol is carried by a physically separate 155 Mbit/s optical asynchronous transfer mode (ATM) channel operating over additional fibre in the cable, although in principle this could be carried as part of the data channel traffic.

The experiment showed that simultaneous operation of the data and quantum channels was possible with no increase in the quantum bit error rate (QBER) for the key distribution channel. This is very important since if the QBER were to increase due to crosstalk from the data channel the ability to detect eavesdroppers would be compromised.

BT has recently demonstrated[13] how quantum cryptography can also be applied to the case of a passive optical network (PON) comprising a single network controller, Alice, linked via a sequence of passive optical splitters to a multiple of network users, Bob_1–Bob_N (Figure 6). In the conventional operating regime information transmitted by Alice in the downstream direction on the PON is broadcast to all Bobs; similarly upstream transmissions by any of the Bobs are 'broadgathered' by Alice. If Alice can establish a verifiably secret and unique individual key with each Bob she can then use (for example) the i^{th} key to encrypt information intended for Bob_i. In this way the network can be operated securely, because although the encrypted information is broadcast on the network Alice and Bob_i can be confident that no other network user or external eavesdropper has obtained any information on their shared key. Quantum cryptography can be used to perform the key distribution task simply by exploiting the quantum level behaviour of the optical splitters in the PON. A single photon incident on such a node cannot split and is instead routed to one and only one of the output paths. The choice of output path for any particular photon is random and unpredictable, governed only probabilistically by the classical splitting ratios for each path. Consequently, if the conventional scheme discussed above is applied to the network then each Bob will be supplied with a unique randomly-selected subset of bits from the sequence that Alice transmits into the PON. By carrying out the post transmission public discussion with each Bob in turn, Alice can identify which photons were shared with each receiver and (via the error rate) guarantee secrecy from external eavesdroppers.

Conclusion

This article has shown how some of the most fundamental aspects of quantum physics can be harnessed in a quantum cryptography scheme to provide an exciting new approach to the practical problem of communications security. By discussing some of the state-of-the-art developments in experimental systems at BT Laboratories we hope to have convinced the reader that quantum cryptography has now progressed a long way from the original fundamental theoretical concept towards practical applications in real fibre networks and systems.

Acknowledgements

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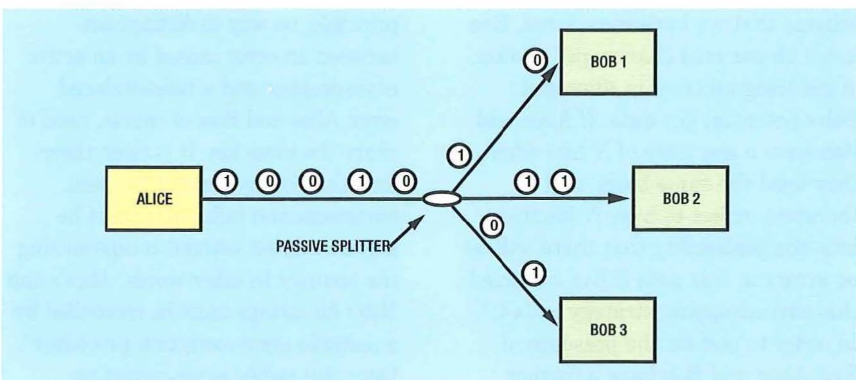
Figure 6—Schematic diagram of BT's multi-user quantum cryptography system based on a simple 1 × 3 passive optical network. Binary-encoded photons are illustrated by numbered circles. The photons do not split at the coupler but are instead randomly routed causing the random bit sequence transmitted by Alice to be randomly divided up among the three Bobs. By subsequently comparing the time periods when photons were detected Alice can secretly agree upon a shared random bit sequence (key) with each Bob in turn.



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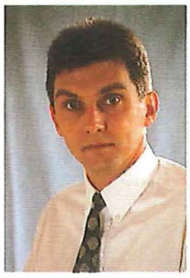
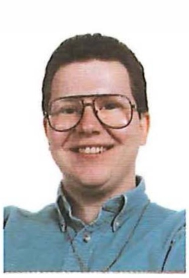


Paul Townsend
BT Networks and Systems

Paul Townsend began his research career at the University of Cambridge where he studied the physical properties of a new class of one-dimensional polymeric semiconductors. After completing his Ph.D. at Cambridge he moved to Bellcore in the USA where he worked on ultrafast switching devices for all-optical data processing. Since joining BT in 1990 his research has focused on the applications of the quantum properties of light in optical communication systems. This work has led to the development of new highly-secure communications systems based on quantum cryptography. He is currently the team leader of BT's research effort in this area.



Simon Phoenix
BT Networks and Systems

Simon Phoenix graduated from York University in 1986. He joined BT in 1989 after having completed his Ph.D. in theoretical quantum optics at Imperial College London. His research work at BT has involved fundamental investigations into the quantum nature of light and its application to telecommunications. After a period developing several new quantum cryptographic techniques and concepts he moved into the security futures team at BT Laboratories where his interests now include commercial applications of cryptographic techniques and trusted third party services.

Patricia Vargas Simón and Fiona MacKenzie

36th European Telecommunications Congress

'Emerging Opportunities in Telecommunications at the Dawn of the New Millennium' was the theme for the 1997 FITCE Congress in Thessaloniki. This article, which summarises the congress programme, serves as an introduction to a selection of articles based on papers from the congress.

Introduction

'Emerging Opportunities in Telecommunications at the Dawn of the New Millennium' was the theme for the 1997 congress of the Federation of Telecommunications Engineers of the European Community (FITCE), held in the Macedonian capital and this year's European Cultural Capital—Thessaloniki. The congress was hosted by the Hellenic Branch of FITCE and attracted some 330 delegates from around Europe.

The congress started with an opening ceremony. After a welcome address by Mr Dimitrios Kostis, President of the Organising Committee, a number of local dignitaries, including Mr Dimitrios Papoulias, President of the Board of Directors of Hellenic Telecommunications Organisation (OTE), gave addresses concerning the relationship of telecommunications with society and prosperity. This was followed by a round table discussion on 'the strategies of the telecommunication players at the dawn of the new millennium'. The members of the session discussed the key issues for the industry as we enter the new millennium, namely, deregulation, non-traditional competitors, spirals of demand and the need for innovation, globalisation, anti-pollution measures, technology as master or servant, global information society; universal service and convergence. These issues were to resurface in many of the papers throughout the congress.

Technical Sessions

Business opportunities

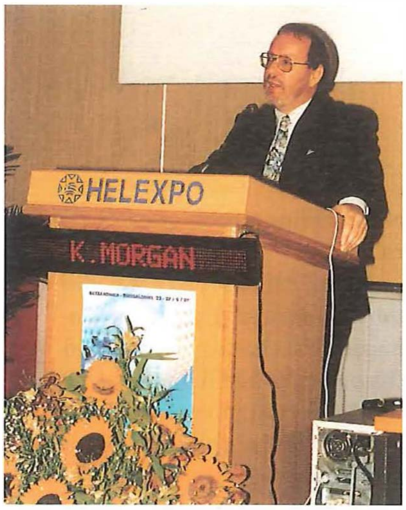
Opening the first session of the congress, chaired by Mr. M. Arbeit (France), Alcibiade Zaganiaris and Sabine Huon (France Telecom-CNET) discussed the role of small and medium enterprises as telecommunications users and specialised suppliers, showing a move towards 'just in time' knowledge and learning and an expectation of World Wide Web use for electronic data interchange applications.

Professor Keith Ward (UCL) and David Corrie (BT) discussed management development strategy and the dangers facing incumbent operators from competitors in the IT, entertainment and media sectors. The ultimate effect on the organisation was a requirement for developing key competencies and continual personal development.

Lorraine Margherita's (Coopers and Lybrand) presentation on Internet economics continued the theme of IT and telecommunications convergence. Network operation and Internet service provision are no longer independent with Internet servicc providers and telcos taking both roles, including provision of voice over Internet protocol (IP) services. Alliances were seen as key to building the necessary infrastructure. Internet is expected to become the major channel for electronic commerce, with alliances among sectors for mall and payment facilities.

Papers from Huib Ekkelenkamp and John van Oort (KPN Nepsotel) and Tom

Keith Morgan, BT, winner of the congress Best Paper Award



Savage (Telecom Eireann) discussed infrastructures in the emerging economies of Central and Eastern Europe where telcos are undergoing a transition towards competition and privatisation. Most of these countries are now using the integrated services digital network (ISDN) as an enabler for data services. The special characteristics of the region were highlighted; in particular the high education standards, low telecommunications expertise, consumer reluctance to spend money on services and political issues with cost rebalancing. The close relationship between gross domestic product per capita and demand for teleservices was stressed and had been used as a basis for demand forecasting.

Mobile and personal communications (and corporate networks)

Session 2, the first part of which was chaired by Nikos Manasis (Greece), began with a paper from M. Soellner (Lucent) on open architectures for the universal mobile telecommunications system (UMTS), describing the factors driving the new standard and its targets: infosociety; success of the global system for mobile communications (GSM); mass market public and private access; personal, terminal and service mobility; applications based on IP protocols and multimedia. The evolution of technology would be based on a common asynchronous transfer mode (ATM) backbone, IT software (Java, CORBA, IP, SNMP), client server architectures, standard application programming interfaces (APIs) for service creation and management.

George Vorvis (Panafon) discussed the evolving messaging platforms on GSM, including the use of voicemail with SMS notification, Telerat—an interactive voice response information service—and the introduction of a non-voice service for telemetry and other applications. The need to educate users about the current capabilities of the system was highlighted.

Dimitris Minas (Stet-Hellas) highlighted the obstacles faced by mobile telecommunications in terms of bad press about health risks and environmental issues and suggesting the need for government bodies to supply unbiased advice to consumers.

Returning to GSM, Joseph Franz Huber and Peter von Schau (Siemens) described the enhancements currently undergoing standardisation including: cell broadcast; dual-rate speech codecs; better security and improved roaming. UMTS was again introduced, with ATM and IP seen as the dominant 'switching' technologies.

The UMTS theme was continued by Nikos Pronios (Intracom), who considered some of the problems in forecasting service penetration given a lack of historical data and predicted that operators would have a number of strategies for introduction of third-generation systems from direct transition between analogue and UMTS to gradual evolution through enhanced GSM 2.

A paper on satellite systems and services from F-N. Pavlidou (University of Thessaloniki) introduced the current systems and next generation of services based on LEOS.

In the second part of Session 2, chaired by David Greenop (UK), G. Alfano's (Telecom Italia) paper on DECT for local mobility described the results of a trial of DECT cordless access for home and public environments supported by intelligent network features in the public switched telephone network. The trial will be followed by a commercial project, Fido, to cover 28 large cities by the end of 1997.

Fiona MacKenzie (BT) described the challenges of achieving universal personal communications using UMTS and existing technologies. Again, the emphasis was on the use of a client-server approach, with an IP- and ATM-based network. The importance of cooperation between standards bodies including ATM Forum, IETF and ETSI was stressed as key to achieving UMTS.

Manuel G. Soares (Instituto Politecnico do Porto) and Francisco J. Restivo (Universidade do Porto) explained the differential global positioning system and its uses, particularly in vehicle guidance.

G. Liggieri, A. Palamidessi, I. Pepe, and S. Tamburrini (Telecom Italia) described the complexities of the mobile network planning process and a network optimisation tool developed for this purpose.

The session concluded with a complete change of subject, the final paper being a description of corporate network technologies and their usage by Dr. Theologos Kanaropoulos (EMS). The emphasis was on virtual private networks for intranet and computer telephony integration (CTI) applications.

Human resources/universal services

The third session, chaired by B. Jacobfeuerborn (Germany) considered universal service and human aspects of the telecommunications arena. Achilleas Kemos (École Nationale Supérieure des Télécommunications de Bretagne) examined the likely definition of universal service in a European infosociety and examined the effect of market liberalisation on the obligations of the 'dominant players' and the funding of universal service obligation (USO).

Educational access to the infosociety was the theme of Keith Morgan's (BT) paper, which won the 'Best Paper Award for 1997'. This described a trial of Internet and multimedia usage in a small set of schools. The main requirements identified were total managed service; adequate teacher training and support; affordability; flexibility; ease of use, a protected environment and enabling school-to-school collaborations.

Paul Tomlinson (BT) provided a thought-provoking paper on the impact of technology on disabled customers. It highlights ways in which telecommunications products and services help or hinder disabled people and suggests ways in which the level of support provided by the telecommunications industry could be improved.

Broadband access

The first part of the fourth session, also chaired by Mr. B. Jacobfeureborn (Germany), dealt with how to make the best choice of the best access network architecture to provide the end user with broadband services.

Access network technologies for the 21st century was the theme for Heinrich Obersheidt's (Alcatel) paper. He discussed the status of both narrowband and broadband networks in Germany, and how, with the liberalisation of the market at the beginning of 1998, clients expect a greater offer of services at less price and with better quality of service. After presenting the characteristics of different existing networks (twisted pair, coaxial, optical, hybrid and wireless radio), the discussion concentrated on how the new services could be implemented, whether through changes in the existing plant, by overlaying networks or by slowly introducing new equipment.

The paper from C. Montanari and S. Omiccioli (Telecom Italia), and P. Di Martino and L. Zanetta (Sirti) presented the evolution of the Italian telecommunication network towards new broadband network architectures. It is quite clear that optical fibre in the access network is the way to carry broadband services to the end user, but the exact architecture is yet to be defined. Different technologies are possible, like hybrid coaxial/fibre for asymmetric networks, asynchronous digital subscriber loop (ADSL) through twisted pair, fibre to the building or cabinet, and finally hybrid coaxial/fibre to the building or cabinet. The paper concluded with some of the technical and market experiments being carried out by Telecom Italia.

Inma Rodriguez Serrano (Telefónica) described telco opportunities for high-speed Internet access through the use of asymetric digital subscriber line (ADSL) technology. As demand for new services increases, it is clear that current telephone networks are not able to provide the bandwidth necessary nor are they adequate for Internet traffic. A solution is to increase the potential of the twisted-copper network through ADSL, only when and where the extra capacity is needed. This technology is experiencing, however, problems in its introduction, due to cost, standardisation process and competence from cable companies.

The second half of the session, chaired by A. Como (Italy), centred on new technologies for broadband multimedia information networks.

Luigi Rocchi and Stefano Teodori (RAI, Italy) introduced the experimental use of the multipoint video-distribution system on TV broadcasts and broadband interactive services in Italy. The paper gave a theoretical approach to the technology, and then went on to describe the experiments to be carried out in different Italian cities, as well as the future applications, like educational interactive television.

Dealing now with the residential market, Heikki Sundquist (Helsinki Telephone Company) and Jari Karttunen (Omnitele Ltd.) described future residential broadband services and their impact on telecommunication infrastructures. The residential customers will use broadband on-demand, multimedia and information services in the near future if the telecommunication infrastructure is ready for them. The paper went on to analyse the existing infrastructures for access networks (fibre Ethernet, cable modems and ADSL) and how they will cope with the broadband services, and then described a practical example of a local multimedia network, Helsinki Arena 2000.

In the area of mobile/fixed networks integration, N. Blefari-Melazzi, M. Listanti and S. Salsano (University of Rome) and L. Ronchetti (Ericsson) introduced a protocol architecture for the integration of mobility in the integrated broadband communication network (IBCN). The third-generation mobile telecommunication system (UMTS) aims towards the use of common network elements between the fixed and the mobile networks, and to offer the same range of services to both network users. All of this requires a complex signalling protocol, and the presentation proposed a possible solution.

Information network/ telematics

This first part of the fifth session, chaired by A. Como (Italy), focused on the evolution of information networks.

Roger Clark (BT) explained the evolutionary path to the global information infrastructure from the Internet to the Infonet. If the global information infrastructure (also known as the *Infonet*) is to arise from the existing Internet, a series of goals must be met, such as compatibility, security, adequate censorship, a sensible billing versus quality of service plan, regulatory issues, etc. Owing to the high uncertainty of the best choice, a 'scenario analysis' was described, in which several future scenarios are set and a strategy that has success in all or most of them is developed.

R. Jochems (Telepolis Antwerp) presented the project Antwerp: An Intelligent City. It is based on an optical-fibre metropolitan area network (MAN) with ATM transmission technology, city wide, connecting 28 locations and providing all kinds of services to the public, from telemedicine, telephony, videoconferencing and telecontrol to cultural services like museum objects not in display, library catalogues, city archive documents and a central ticketing service.

David Greenop (BT) described the special characteristics of community networks, their differences with commercial networks and the difficulties they encounter because of those differences, their local scope and social-oriented objectives.

The second part of the session, chaired by Professor Dimitri Kouremenos (Greece), dealt with the evolution of telecommunications in the liberalised market. A paper from G. Garlichs and W. H. Gries (Deutsche Telekom), M. Horbat (Berkom), P. Polese (Alcatel Telecom) and F. Vagliani (Italtel) introduced project CONVAIR, which deals with strategical aspects that take into account the existing competence environment, and compares the needs of the users with the services they get from the providers. Visions and foresights, based on extensive studies of the European telecommunications market, are used to anticipate user needs.

Henrique Santos De Priamo (Portugal Telecom) talked about the role of intelligent networks in a full competitive telecommunications environment in Europe. As the connection of the networks of different service providers will be a reality, there will be a need for interworking, and a unique numbering system, as well as number portability. Intelligent networks will be needed to achieve this.

Going into a more specific market, Jos Gerrese (AT&T Unisource Services) spoke about European and global high-speed infrastructure for research communities and the information society, and in particular project TEN-34. Some of the problems information highways have been suffering in Europe is the crossing of national borders, which makes the implementation long, costly and not very efficient, as every country has its own service provider. With the liberalisation of the market, this may change. TEN-34 is part of the European IP backbone network, providing 34 Mbit/s capacity, now being migrated to ATM, linking several research communities in different countries, while having a single service provider.

Centring now on telematics, Alan Millet (Telecom Eirean) introduced Teleaction, a new service for the residential sector through the D-channel of an ISDN basic access. ISDN has a very low penetration in the residential market, being used almost exclusively in the business market, specially because of its high cost. To introduce ISDN, it is necessary to create attractive services for the home end-user. Teleaction is based on multiple virtual data links using only one D-channel, at a low cost. The possible applications are telecare, telealarms, telemeasurement, remote control, house automation, IP access from home, etc.

The paper from Tomas Kummerow (Bosh Telecom) and Pietro Polese (Alcatel Telecom) concerned deriving requirements for the future European telecommunications infrastructure from the telematics applications collaborative research and development programme of the EU, and in particular project CONCORDIA and the applied telematics projects inside it. The objective is to identify the need for telecommunications applications, adapt them to the user needs, and estimate costs to derive from such information the requirements of the network infrastructure. The means for reaching that objective is an in-depth analysis of services and their components.

Mario Capurro and Maurizio Montagna (Alcatel) described new architectures for city networks, usually based on synchronous digital hierarchy, ATM, and frame relay, and how to improve accessibility for all kinds of users, including the disabled. As an example of these highways, the paper introduced project AVANTI (adaptive and adaptable interactions for multimedia telecommunications applications) being carried out in Italy.

Submarine optical-fibre cables/regional networks

This last session, chaired by Mr. Jos Gerrese (Netherlands) dealt with submarine cables and regional networks and their interconnections to European Networks. Patricia Vargas Simón (Telefónica) introduced optical-fibre submarine cable systems and their role in communication networks. She gave a brief historical and technological introduction, explaining their particular design characteristics, followed by a study of system costs for systems with or without repeaters. She showed the network structures that could be achieved, as well as the different traffic restoration and protection schemes that can be applied, concluding with the advantages of this kind of links.

A paper by Lambros Athanatios (Aristotles University of Thessaloniki) and Mirsky Christiu (Telecommunication Association in Bulgaria) described the structure and regional allocation of electronic communication networks in Greece, and links to Balkan and European networks. The different services provided by the Hellespac and Hellascom data networks were introduced, followed by a description of a telemedicine application via Inmarsat (project MERMAID), and project North Star, the academic data network linking, through FDDI, several Greek institutions and expandable to other Balkan countries.

Parallel Sessions

The Hellenic Branch of FITCE had organised two sessions in parallel with the technical presentations. These sessions examined the evolution of the telecommunications sector of the Eastern European countries and the countries of the former Soviet Union by way of presentations from Romania, Albania and Georgia. Also the international and regional cooperation projects for Central and Eastern European countries were described.

Congress Awards

In accordance with the tradition of FITCE Congress, two awards were made at this year's congress. The award for the Best Paper 1997 went to Keith Morgan (BT) for his paper 'Education Services for Schools in the New Millennium'. The second award—the Most Promising Young Engineer 1997—was awarded to Patricia Vargas Simón (Telefónica) for her paper 'Introduction to Optical Fibre Submarine Cable Systems and Their Role in Communication Networks'.

Study Commission

The FITCE Study Commission on 'FITCE Supporting Members' Personal Development' under the chairmanship of Les Brand (UK) submitted its final report. Over the years FITCE has recognised the need to add real value to its members' personal development within the telecommunications industry. The Study Commission was created to investigate the possible areas in which FITCE could make a real difference to its members. The main conclusion of the Study Commission was that FITCE needed to be more responsive to the needs of its members and that it could do this by developing into a truly professional organisation. The Study Commission proposed several ways in which this could be achieved including the need for a clear FITCE vision, excellent communications through the use of Internet technologies and a portfolio of products and services to meet the needs of its members into the new millennium.

Congress 1998

The 37th European Telelcommunications Congress will be held in London in August 1998. The congress theme will be 'Diverging Roles in a Converging Marketplace'. (The Call for Papers is printed on the inside back covet of this issue of the *Journal*. Further information about the 1998 FITCE Congress is on http://www.btwebworld.com/fitce98/

Conclusion

As well as the technical presentations, delegates had the opportunity to enjoy a programme of technical visits and social and cultural events. The papers maintained a very high standard and the congress once again provided a platform for meeting FITCE's objectives. The congress continued the tradition of being the meeting place for European telecommunications experts and created opportunities for renewing friendships and making new acquaintances.

Biographies

Fiona MacKenzie, BT Networks and Systems, joined the Optical Research Division of BT in 1988 and authored a number of papers in the area of optical switching and waveguides before moving into mobility research. She currently leads a group, within the Mobility Research Unit, researching network architectures for UMTS. She holds a B.Sc. (Hons.) in Physics from Aberdeen University and an M.Sc. in Telecommunications Engineering from the University of London. She is a member of the IOP and IBTE.

Patricia Vargas, Telefónica de España S.A., obtained her degree in Telecommunications Engineering from the Polythecnic University of Madrid in December 1994. In November 1993 she started an internship in the International Communications Engineering Department of Telefónica de España S.A., in the field of submarine cable systems. Since December 1995, she has been working in the Outside and International Plant Engineering Department of Telefónica de España S.A., where her main function is the procurement of submarine communication systems.

Keith Morgan

Education Services for Schools in the New Millennium

The widespread availability of high-quality data network services and the emergence of powerful desktop computers make new types of educational services practicable. Telecommunications suppliers have to persuade customers to think flexibly about the benefits of radically new solutions. Also, they have to examine the way in which they structure, present and price the types of service which could be commonplace early in the next century.

This article is based on a paper presented by the author at the 36th European Telecommunications (FITCE) Congresss, 22–27 Sept. 1997, Thessaloniki, Greece.

Introduction

The last 3-4 years have seen advances in computer technology which have been significant in providing potential benefits for education. Communications links can be operated over public switched telephone network (PSTN) or integrated services digital network (ISDN) lines at a speed and quality which generally remove many of the previous obstacles and frustrations. They have enabled the widespread use of e-mail and the Internet, and the interchange of a huge variety of information. With the capabilities of Pentium computers now on sale, it is possible to process multiple media at satisfactory speeds. Images can be downloaded, manipulated and integrated into documents. Scanning systems and cameras provide a range of image inputs which can be personalised. Moving images and sound can be added, although the input devices and manipulative software are still largely out of the financial league of most schools. While it is clear that development will continue apace, information and communications technology (ICT) now offers more features than most people are competent to use, and the old inhibitors of capacity and reliability are fading.

Over recent years, there has been a large increase in the number of Internet service providers (ISPs) providing access to the Internet for home and business use. Corporate intranets are being set up by many major companies. Videoconferencing is now commonplace in industry. Why, then, is it proving so difficult for the education sector to take on board the opportunities offered by ICT? Education is high on the political agenda in most countries, and yet we have seen disappointingly little progress in ICT in schools and colleges. It seems to be very difficult to unlock the funds necessary to provide computers and communications in education. This article takes a look at the education environment, with specific examples drawn from UK schools, to try to understand the requirements and where network service providers can play a part.

The Education Marketplace

In every country there is a large number of educational establishments ranging from universities and colleges of higher education, to secondary and primary schools, and including various types of specialist and vocational institutions. In addition there is a range of adult and further-education establishments which have strong links to other community facilities. With such large national markets, which can potentially be multiplied many times if pan-European and global markets are included, there is a huge opportunity for the provision of educational services by means of telecommunications networks.

There have been various studies concerning the number of computers in schools. A recent report published by McKinsey in the UK, shows that the average number rose from around 13 per secondary school in 1985 to 85 in 1994 (Figure 1). The corresponding

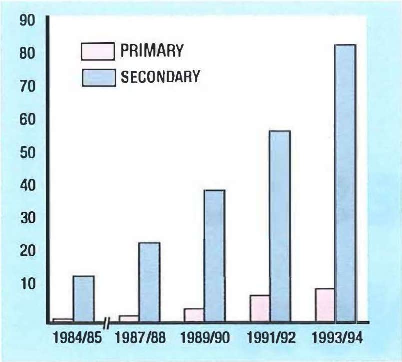


Figure 1—Average number of computers per school in England (source: McKinsey, attributed to Government Statistical Service, 1995)

figures for primary schools are two and 10. In a comparative survey, the UK appears to stand in a good position. However, the Stevenson report makes the following comment about computers in UK schools:

'It is sometimes said that the UK is ahead in the penetration of computers in schools internationally. Taking into account the long tail of obsolete or almost obsolete computers, and that figures are not a reflection of how effectively a computer is used, it is doubtful whether this is true. However, the key point is that even if it were true, this is analogous to suggesting that a runner is ahead after 500 m of the marathon.'

Perhaps the position is best summarised as follows:

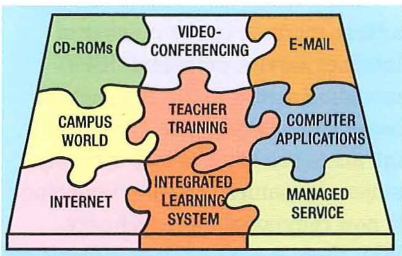
- most schools only have a few computers,
- most school computers do not use the latest technology,
- few schools have integral ICT systems, and
- no schools are fully realising the potential of ICT.

Taking a Radical Approach

Given the size and importance of the education market, and the lack of impetus in ICT despite the availability of suitable technology, BT decided that a radically different approach was needed in order to test the potential. What would happen if we were to equip a group of schools with a range of computing and telecommunications technology which was sufficiently comprehensive that it was able to have an effect on every teacher and every pupil? Would this have a major, positive effect on teaching and learning styles, and if so, could we draw conclusions as to the type of education network and services required for the future?

With this aim, BT worked with its partners to choose a suitable set of schools and to equip them with the necessary hardware, software, local area networks, telecommunications links and training. Pentium computers were provided to all schools taking part—30 to each primary and 200 to the secondary. Eleven schools took part in the trial, known as the *Bristol Education On-line Network* (BEON). A range of ICT and IT services were included in the BEON package, to permit a wide variety of curriculum applications to be undertaken. The services, summarised in Figure 2, included pc-based video-conferencing, access to the Internet from any terminal for BT CampusWorld, e-mail and other Internet services, applications run from a centrally-placed neighbourhood server, and applications run on-site. A range of technical, educational and commercial evaluation criteria were put in place as an integral part of the trial. The result was one of the largest ICT projects in the world. The trial produced valuable outputs after the first year of operation, and these will be referenced in this article. Even greater strides are expected over the next few years, as teachers and pupils enter more mature methodologies for usage.

Figure 2—The BEON services



The BEON trial has demonstrated that it is insufficient simply to supply computers and current types of communications service to schools. Unless the total service addresses their requirements, and unless they are adequately trained, there is little impact. However, if the obstacles can be overcome, and if the service can be integrated into teaching the curriculum, there is the potential for classroom benefits and educational gains.

Customer Requirements

In general, teachers are wary of computers; they appreciate the benefits which computers can bring, but are very nervous about the things which can go wrong. This perception is aggravated when telecommunications are involved; while embracing the potential for a range of up-to-date information, teachers are suspicious of the time and money which can be wasted in getting the technology to work. When considering telecommunications networks for education, therefore, it is important that the design aims to reflect the users' requirements and placate their fears from the outset.

Affordability

The first necessity for an education network is that it should be affordable and that the costs should be predictable. Affordability is a complex subject, which embraces prices, perceptions, ways of working, and other local factors, as well as government policy and educational funding at a high level. However, the current view from the education sector is that the sorts of networks which commercial companies use are way beyond the reach of schools and many colleges. In addition, where switched options are available, the variable costs, incurred through time-based charging, make the bill unpredictable; in times of budget constraint this is particularly threatening to many educational institutions.

Flexibility

Another important principle for an education network is that it should

Network providers need to respond to educational users' requirements and to design services which remove obstacles.

be flexible. Very few teachers are able to articulate clearly their ICT requirements. BT trials have shown that, even when teachers have become convinced of the advantages of ICT, it is difficult for them to forecast their future usage with accuracy. (This is a common phenomenon encountered in today's environment of rapid change; customers find it difficult to imagine new modes of usage, and the extent to which claimed advantages are real). Schools require reassurance that the service can be changed or expanded in the future (at a realistic price).

Ease of use

Ease of use is a requirement which is imperative if we are to convince computerphobes and computer-illiterates to join the Information Society. Many applications are simple to use, provided that one has an intuitive understanding of Windows—many teachers are not in this position. The situation is more difficult for applications requiring the use of telecommunications. In most ICT systems today, it is necessary to know something about the specific application or technology before it is possible to operate the system. In the classroom, teachers are focused on promoting learning and are nervous of being distracted by time-consuming innovations.

Protected environment

Another fear in the educational environment is that pupils will gain access to unsuitable material (such as pornography) or will be the targets of improper communication (such as drug dealing). There are two diametrically opposed educational approaches to this problem: to educate pupils to use their freedom wisely, or to restrict access to undesirable areas. The vast majority of teachers in the UK favour the latter approach for pupils working on their own, on the grounds of pragmatism in the current social and political environment. However, they also want the freedom to access the wider Internet for themselves, and for their pupils when under suitable supervision.

Collaboration

Collaboration is valued by educationalists both as a process and for the outcomes. Learning to collaborate is a useful life-skill and helps with other social skills such as self-confidence, speaking/listening and team working. It is further enhanced when there is an opportunity to cross social and cultural divisions. Experience in UK trials demonstrates that collaboration using telecommunications takes place most fully and effectively when there is a clear mutual goal to be achieved, to which all parties bring value.

Administration

The administrative duties of a school can be very onerous. It is necessary to record the absence of pupils, to construct files of pupils' data, to produce reports, to liaise with the authorities on financial matters and to interchange all sorts of data, to send and receive information concerning exam results, to exchange a variety of urgent information with other schools, and to forward portfolios of information for pupils in transition between schools. Much of this work currently has to be performed manually; this is time-consuming, with errors being made in transcription. Systems which can automate this work, particularly between locations, can potentially save enormous amounts of time. In addition, the need for security systems is increasing, and centrally-managed bureaux using telecommunications for alarms and video-surveillance can be cost-effective.

Overall service management

Service management is key in 'de-risking' ICT activity for schools. Interviews with many schools reveal that they have a major problem when equipment goes wrong. It interrupts the lesson and the teacher has to think quickly of an alternative, it is difficult to find the time and the expertise to diagnose the fault, it is expensive to call out the technician, and there are often long delays before fixing. Feedback has shown that the removal of these problems is valued extremely highly by teachers. It is also valuable to be able to provide support for a variety of other issues, such as inability to understand applications, location of relevant material and problems in transferring material between applications.

Implications for Network Solutions

Network providers need to respond to educational users' requirements and to design services which remove obstacles. An approach which extrapolates current practice is unlikely to yield solutions which have wide appeal to the education market. Changing the way in which the market is approached is not easy: there are always reasons why new types of solution are 'impossible'—these can involve financial strategy, regulation, technical possibilities, politics, complacency, etc. The emphases and combinations are different in each country. However, the fact that one country does not have the obstacles which another does, should engender a determination to conquer the problems, since they are clearly not insoluble!

Affordability

Several innovative approaches can be taken with regard to cost and affordability. It may be possible to treat education in a special way (subject to regulatory restrictions) and to provide the structure and the safeguards sought. Special funding may be available from government or from the EU for certain types of project; network service providers may have to structure their financial offerings in ways which make it easier for schools to obtain supplementary funding. There are opportunities in the wider community by catering for new types of information requirement, such as adult education, public libraries and communal *cybercafes*. Aggregating these and providing service via a central hub may provide a larger base over which *for the education sector, an interface must be designed which is relevant to the educational environment and to tasks which teachers need to do*

to spread the costs. It must be recognised, however, that in enlarging the base, the range of customer requirements to be satisfied is increased, and this may slow down agreement and implementation.

The question of time- or usage-related tariffs is an interesting one. Most countries are used to the principle that there is a bigger bill for bigger usage. Schools can find this difficult, where they have a number of terminals with access to communications facilities. Although in many cases access to the Internet point of presence (POP) is at local rates, the total cost is not known until the bill arrives at the end of the month/term/etc. In order to allay fears that the bill will be much higher than expected, the network providers have to find ways of making the bottom line predictable. Depending on regulatory and commercial restrictions, this may be by means of a price cap for selected services, packaging of services, improved billing, jeopardy flags, daily/weekly quotas, etc.

Flexibility

Traditionally, education and telecommunications networks have not had much in common, and consequently, there are credibility obstacles to be overcome before increased synergy and trust can be achieved. Network service providers do, however, hold a trump card with the increasing awareness of the importance of integrating telecommunications with IT. It is incumbent upon network operators to offer solutions which demonstrate:

- development paths focused on the needs of education,
- access to a broad spectrum of present and future services, and
- reassurance to users that they will not be locked in to something inappropriate.

Ease of use

The concept of ICT ought to provide a sound base for providing integrated, easy-to-use applications. The requirement for convincing sceptics is to put together a system which relates to their viewpoint; for the education sector, an interface must be designed which is relevant to the educational environment and to tasks which teachers need to do. Rather than having icons for 'CD-ROM' and 'Internet', would it not be preferable to organise resources under subject or age group headings, independent of the technology which supplies the resource? Having found a suitable piece of information, would it not be helpful if I could copy and paste with confidence, with any compatibility questions being handled by the system? ICT systems must be oriented around the user, ensuring that the telecommunications areas are integrated and are perceived by the user as adding value.

Protected environment

One of the cornerstones of the Internet has always been the freedom of information across the world, which itself has major implications on society. The risk of pupils accessing unsuitable material is therefore inbuilt in the Internet as it currently stands. Within this liberal environment, network service providers have to find a way of allowing constraints to be imposed. These must be secure enough to provide teachers with confidence, but flexible enough to allow individual preferences. Current models work on two types of approach : restriction only to defined material, and free access to everything except barred material. It is easier to provide adequate reassurance using the former concept. BT already provides services, such as CampusWorld, where a *walled garden* approach is taken. Within the permitted area (comprising core, educationally-orientated topics and additional 'white pages' submitted by users and authorised by CampusWorld), children can roam as they please, and get used to the Internet methodology of searching for information.

In addition, levels of access using passwords can define pupil, teacher, supervisor, etc scope of access. This makes it possible to go outside the walled garden if pupils use the teacher's password, but experience has shown that teachers need to be very vigilant in the use of the password, and that they need to often change it to avoid abuse. We should not underestimate the importance of this area; one or two incidents well publicised by the press could force teachers away from general network usage. Network service providers must provide the means of restricting freedoms and of monitoring activity, which provide teachers with the tools to use or ignore as they wish.

Collaboration

Telecommunications are an obvious way of enabling collaboration. Network service providers supply switched connections to anywhere, and have done so for years. Why, then, is it not common practice for pupils to pick up the telephone or use the fax? Other than preconceptions about cost, the obvious answer is that this type of methodology is not built in to schools' normal ways of working. The types of service which could catalyse collaborative activity include: suitable educational resources, e-mail to each classroom (some proponents foresee e-mail to each pupil), easy use of videoconferencing, and provision of noticeboards and discussion groups. Within the context of projects, promotion of fax and telephone may be appropriate, perhaps extending the use of authorisation facilities to telephones around the school.

Administration

ICT is ideally placed to provide the tools needed for administration. E-mail, with a set of agreed electronic forms, can substantially reduce the amount of time taken in preparation, and the number of transcription errors. Data can be passed backwards and forwards much more quickly, reducing the time taken to finalise documents. Action can be taken rapidly; for example, in the case of

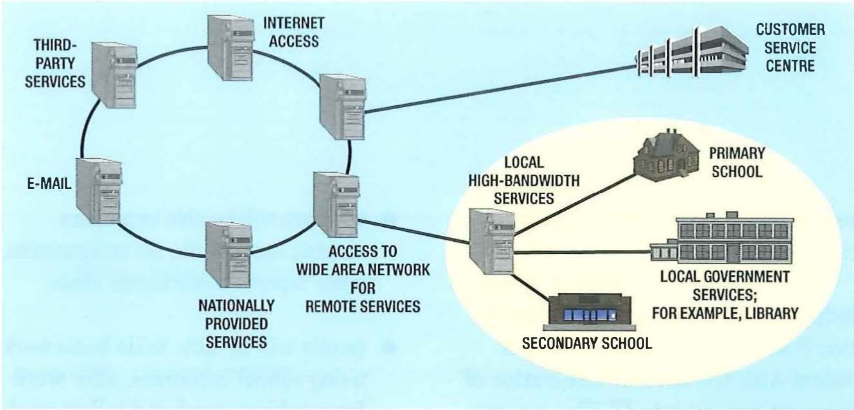


Figure 3—Notional configuration of service provision

truancy. Where security systems are necessary, these can run over the same systems used during the day for educational purposes, thus making the communications services more cost-effective. In order to realise these benefits, the network services provider must put together packages which are easy to operate and which directly reflect the systems needed and used by schools.

Overall service management

Every piece of feedback from the BEON trial has indicated that the managed service is top of the success list in terms of providing added value for teachers. Because they know that the equipment is reliable, and that any faults are quickly fixed, teachers are willing to base their lessons around ICT, having confidence that they are unlikely to encounter problems. The helpdesk has a positive attitude towards all callers, never making them feel foolish, and is able to deal with a range of enquiries including IT technology, communications, applications and educational questions. They speak in teachers' language and not in technical jargon. Faults are repaired rapidly, and the caller is provided with progress reports. The formula appears to be a winner.

Guiding Principles of the Network Infrastructure

A full appreciation of the network infrastructure is a complex study. This article can touch on only a few of the guiding principles. For network service providers, it is desirable that the network components comprise a major component of the revenue-earning value of the system, and that as much information as possible is provided using the network. The on-site model which adds telecommunications as an afterthought is unlikely to satisfy the school as an integrated ICT solution, and does not fully utilise the expertise of network service providers; however, it is not yet realistic to consider delivering broadband services to all schools in real time. The practical solution is therefore to construct a hybrid system which can be adapted over time as network computers come on to the market and as the cost of bandwidth falls (Figure 3). Digital subscriber loop (DSL) technologies now enable bandwidths of 2Mbit/s to be used locally over copper, and, in due course, asynchronous transfer mode (ATM) is likely to provide a cost-effective means of integrated access for a variety of services.

At the present time some resources have to be run locally. Multimedia CD-ROMs are optimised to be run on local PC drives. Their present format and organisation of video and sound in an environment of concurrent usage makes the bandwidth requirements for remote operation prohibitive. With more and more CDs being designed for higher-speed drives, the problem is increasing. The solution lies in providing the CD content in other ways, which are currently being researched. However, in the short term, local provision for CDs is likely to continue.

There are some applications which are best placed on a local server. These have fairly large log-on and intermediate download requirements, but do not have the huge streamed real-time characteristics of CD-ROMs. An example of such an application is the integrated learning system (ILS), where individual downloading can be accomplished in a satisfactory time, and where the local server is well-placed to enable the management and control mechanisms which can potentially assist the teacher in organising individual work programmes.

There are many services to which considerable value can be added by using network-based solutions for education, and these include the Internet, e-mail, and videoconferencing as well as telephones and fax. In addition, an increasing variety of value-added resources can be provided over the Internet or over intranets—the distinction can be made invisible to users. In education services, the curriculum relevance can be enhanced by providing access, either from Web sites or in real-time, to museums, art galleries, specialist centres and experts. The network also permits access from local applications to add-on material which can be regularly updated; for example, topics in the news, the latest figures on the stockmarket or the most recent weather-forecast charts. Network service providers need to be constantly searching for material where currency adds real value, and for means of providing increased bandwidth more cost-effectively so that a wider range of services can be provided from central sources.

The Future

Trying to speculate on the future in the rapidly developing ICT environment is not something which can be done with convincing accuracy. However, several trends are apparent. Some concepts, like the Internet, have acquired a life of their own, and could never have been predicted in advance of their emergence. In other areas, such as the development of PCs, the speed of change is evident, even if the result can not be fully described in advance, and most people would now accept that the prudent approach when purchasing a PC is to buy the best you can afford; in this way it will be out of date a little less rapidly than one with an inferior specification. Network computers will start to make an impact, particularly in markets where many machines are required and where price is a significant obstacle.

There is a trend towards distance independence as far as the Information Society is concerned, and this occurs with the natural integration of communications into IT. The concept is with us now; young people accept outputs from the Internet from across the globe without batting an eyelid, and clearly an approach which does not integrate the best affordable telecommunications technology with the best affordable computer is going to yield a rather uninteresting result.

Expectations of the quality of both sound and vision in domestic appliances have increased rapidly over the past decade. CD-ROMs now provide this level of quality for computers, and children are growing up in a multimedia world. There will be a growing expectation that all forms of material, whether run on the PC, obtained locally in the school, or downloaded across networks, will offer high levels of visual and sound quality. Two trends will enable this to happen: compression technology is enabling more data to be passed over a given bandwidth, and the price of bandwidth is falling.

Already, according to the McKinsey analysis, there is currently a 22% penetration of computers in the home in Britain (this excludes computers bought before 1989 and games machines). By extrapolation there could be computers in 44% of homes by the year 2001, and this figure could be 55% if the trend increases at the same rate as happened with video-recorders. Many computers are now sold with integral telecommunications functionality, and there is therefore the probability that around one third of the homes in Britain could be on-line by the turn of the century. The implications of this are clear: access to resources outside the home will be taken for granted, and many tasks which previously involved travelling to the resource centre will be done from the home. From an educational viewpoint, the opportunities of working remotely from the school (including from home) are considerable:

- teachers will be able to prepare lessons, mark work, set assignments, write reports, interchange ideas;
- pupils will be able to do homework using school resources, offer work for marking, send and collect work when they are sick;
- administrative tasks will be undertaken at a convenient time and place, particularly in the holidays collaboration can take place more easily, action on data can be taken quickly (for example, investigation of truancy); and
- parents and other adults can undertake retraining or study for further qualifications without the necessity to attend an outside location every day.

As with all aspects of modern life, education increasingly needs to offer more for less. There is a demand for a greater variety of specialised courses, but these specialities have to be offered against a background of decreasing budgets. Telecommunications are likely to play an increasing role in making possible such conflicting demands. Courses will be offered by specialists from a central point, and will be brought to the students by means of appropriate communications, which also allow interaction between teacher and students, and between students themselves. Several trials are currently in progress which provide an environment which more resembles a classroom situation, and which minimises the disadvantages encountered by today's more limited communications encounter.

Certain schools and colleges will set themselves up as specialist centres, and the models for these are already in place. They will build up expertise in specialist subjects and be able to offer courses in their own country and across the world by means of ICT, using their subject and presentational expertise. Such courses will be able to provide a more rounded curriculum for schools which would not otherwise have the specialist knowledge. It will be vital for schools to be positioned to take advantage of this sort of opportunity, whether on the giving or receiving end of such specialisms. Where videoconferencing, Internet access and e-mail are an integral part of the school ICT system, the only issues which arise are educational and organisational ones, and extending the curriculum into specialist areas becomes a standard part of timetable planning.

It is certain that communications-based solutions will play an ever-increasing part of everyday life, and schools will be no exception to this. We have a unique opportunity at the present time with the types of technology which are now commonly available. The extent to which network service providers gain inroads into the education market will depend heavily on their ability to listen to the users and to provide services which address the schools' environment.

Biography

Keith Morgan
BT Business Division

Keith Morgan graduated in 1971 with a degree in Physics and Electronic Engineering from the University of Manchester. He worked for Telecom Australia for 14 years, firstly in rural switching and transmission systems, and later setting up systems engineering teams for major customers in New South Wales. In 1986, he returned to England and joined BT, where he has been involved in a number of customer-facing activities including sales, customer service, training and strategy. He has a keen personal interest in European activities across language and cultural groups. He currently works in Education Marketing where he recently led the evaluation of the world-leading BEON trial of computing and communications in schools.

David Greenop and Doug Williams

Community Networks

Local Information Infrastructure for the Next Millennium

By the end of this millennium the international telecommunication industry will have radically changed as a result of technology convergence, privatisation and global competition. With these changes the industry is struggling to understand how to provide customers with an extensive all-embracing interactive information environment that will meet their needs as members of the Information Society. Recent work at BT's Research Laboratories suggests that there is an important alternative approach at the local level network, generically called community communication networks.

Introduction

In recent years there has been considerable discussion over the future of local access infrastructure, addressing issues such as: which technologies should be employed; how to exploit existing copper or cable television (CATV) infrastructures; whether fibre is technically and economically viable; whether competing local infrastructures are necessary for customer choice. To support the arguments for moving to a broadband local infrastructure many new types of services have been proposed and tested, but no so-called *killer* application has emerged. This debate has gone on while the European telecommunication industry has gone down the path of liberalisation and privatisation, with all countries opening up their communication markets to competition and a tougher commercial environment.

The much-discussed convergence of the information and communication technology (ICT) industries is underway as players within these industries re-position themselves through alliances and mergers. Information networks, or what is now often called the *information infrastructure*, are a prerequisite for the development of a converged information and communication industry. The emerging importance of the Internet and World Wide Web epitomises a trend towards far greater exchange and access to information in many different forms. However, there appears to be an increasing gulf between the commercial ambitions of the new global players and the actual requirements of ordinary people and businesses. Around the world, groups of people are not only challenging the corporate view of the information age, but also developing their own alternatives. The Internet is part of their story, but the creation of local community networks may cause a shock to the telecommunication industry as great as the emergence of the personal computer was to the mainframe computer manufacturers in the 1980s.

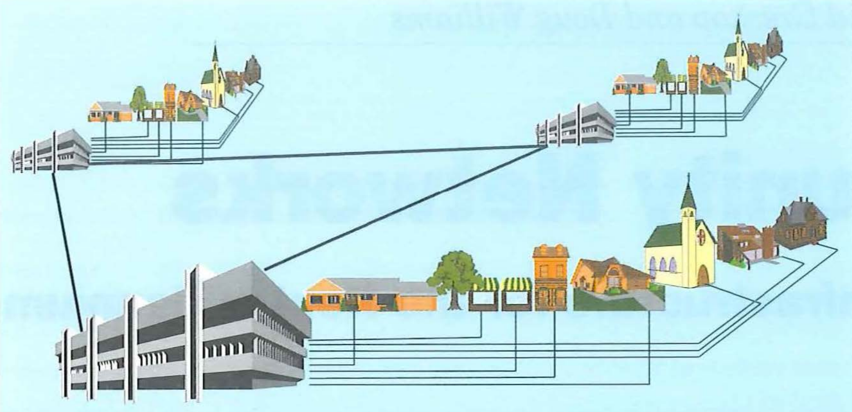
This article is based on a paper presented by the authors at the 36th European Telecommunications (FITCE) Congresss, 22–27 Sept. 1997, Thessaloniki, Greece

A New Approach to Local Information Infrastructure

Within Europe there is vigorous debate on the social implications of this new technology. Many EU initiatives encourage cross-sector dialogue and participation in the developing Information Society. In some areas of the USA and Europe dialogue has turned into action as people have realised that many aspects of the new technology, in particular the Internet, could be used in new and novel ways to support and nurture the information needs of local communities.

These local information infrastructure initiatives appear under many different names: *tele-cities, digital cities, digital sites, community networks, community resource centres and computer mediated communications*. This article uses the term *community communication networks* (C-Nets) to emphasise its important communication aspects which can easily be forgotten when discussing computer-based architectures.

Approaches vary, from the provision of dedicated community servers, accessed via dial-up modems, to locally distributed computing



'A community intranet, run, defined (and possibly owned) by the community it represents, offering high connectivity and serving the needs of the community and of communities with interest within that locality.'

Figure 1—C-Nets will embrace whole communities

platforms supported by wide area broadband networks†.

In some cases, consideration is being given to the purchase and operation of existing telecommunication infrastructure by local groups.

Examples of these initiatives can be seen in many regions of Europe; for example, Milan and Bologna in Northern Italy, and in cities such as Barceleona, Vienna, Stockholm, Berlin and Helsinki. Within the UK, various initiatives are underway from small voluntary sector activities in Grimethorpe and Newham to larger initiatives in Sheffield, Leeds and Brighton. All these activities have a common theme of providing local, city-based, or regional information infrastructures which focus upon the needs, diversity and empowerment of local people and business. In many cases, these developments involve new types of partnerships between the local network operator, local Internet service providers, ICT suppliers, local business, commercial and civic groups.

All this activity points towards one clear message: *that a significant proportion of the growth in future information interactions is likely to occur at and within local geographical areas*. In most cases these new C-Nets will offer local people features and services not available from the established corporate institutions such as the telcos.

† SCHULER, DOUGLAS. New Community Networks—Wired For Change. Seattle Community Network.

Social Drivers for Community Communication Networks

We have seen a transformation in Western society which is quite paradoxical. On the one hand, great changes have occurred this century in the social fabric of traditional communities, changes that have served to divide and isolate people socially. Former agricultural populations have shifted to urban and suburban settings as countries industrialised. This major change of settlement patterns, combined with large population growth, has led to the disintegration of many traditional communities. People are increasingly isolated and cut off from one another, even as population densities grow. On the other hand, communications systems have brought people together in unprecedented ways. It is becoming easier to find out what is happening in distant cities and countries than in one's own immediate neighbourhood.

Perhaps it has been exaggerated how new network and information technologies will force communities to extend beyond simple physical proximity and physical concourse into new global virtual communities. Our social context, including the physical environment in which we live and work, gives meaning to our actions. The traditional idea of community is typified by the high levels of communications between members of the community. Direct contact with others teaches social rules and cultural practices. There is increasing concern that information technology as used by major commercial corporations has the power to reduce social contact and social cohesion at the local level.

Therefore, a local information infrastructure offers an exciting prospect for tempering those changes dispersing traditional communities. Centred upon geographical areas it would use the new information and communication technologies to strengthen and enable local communities by promoting community awareness, encouraging involvement in local decision making, or developing new economic opportunities. For the ordinary person, local or regional information infrastructures could provide oases of form in an increasingly unstructured world.

C-Nets are developing in different regions, cities and towns of the European Union. Many are voluntary, grassroots movements whose purpose is to give the citizen, especially the less favoured ones, the opportunity to participate actively in the building of the Information Society. This movement recognises the best traditions of creativity, solidarity and cultural diversity that exist across Europe. The European Commission is developing a strategy that stresses the idea of 'people first', in order to build an authentic European way to the Global Information Society. Since 1993, the telecities initiative has been bringing together cities and towns sharing similar interests and goals for the development of telematics applications in an urban context. It is seen as essential to maintain a high profile for local authorities, as the democratic expression of user needs and demand in the urban context. The tele-cities initiative stresses the importance of universal access to the Information Society and of support for cultural and linguistic diversity at all levels.

Community networks are, therefore, more than simple computer-based services. In many cases, they are owned and operated by non-profit organisations driven by a general set of social goals, which are neither

The most important aspect of community networks is their immense potential for facilitating local participation and ownership.

strictly technological nor economic. Many of the existing community networks have been set up with the aim of improving the lot of disadvantaged communities. Areas where unemployment is high, where traditional industries have disappeared, are turning towards these newer technologies in the hope of turning the tide of unemployment and attracting new industries to their communities. Implicit in this view is the assumption that the technology should be used for collective community purposes, not solely for the private pursuits of individuals or commercial corporations. Other goals include education (computer literacy), promoting democratic ideals and ensuring that there will be some form of publicly owned resources, or a public voice, on the developing information infrastructure.

What a Local Community Communication Network Should Provide

The focus of C-Nets has been to provide access to community-oriented discussions, question-and-answer forums, electronic access to government information, access to social services, health and educational material, e-mail and, of course, Internet access. To ensure universality, public access points should be available from schools, post offices, community centres, libraries, town halls, council-run leisure facilities and public kiosks. In our vision the community network connects all parts of a community including the private and public sectors, individuals, educational establishments and the voluntary sector. It should not seek to replace the human networks that already exist but should enable them to function more efficiently. The most important aspect of community networks is their immense potential for facilitating local participation and ownership.

However, the above applications are only the beginning. Increasingly this approach has recognised the importance of providing an information infrastructure that met the commercial needs of business and the particular needs of local people.

With the availability of higher-bit-rate access technologies and low-cost Internet protocol (IP) systems and asynchronous transfer mode (ATM) switches, the provision of wide area community intranets is not difficult to envisage. Like corporate intranets they will offer telephony and high bandwidth applications including video telephony, virtual malls for local shops and local electronic trading environments for business or ordinary people (see Figure 2). Also there are likely to be intranets dedicated to specialised local activities. Examples could include a local health network which links doctors' surgeries and local hospitals, a local education network which links schools and educational facilities.

While these local intranets are logically separate for commercial or confidential reasons there is no reason why they cannot be interfaced. This allows a user on the community network to make appointments with their doctor or even undertake a virtual consultation. Similarly, the educational network could interface through the community network to the home to support home education services. It would also be expected that these local intranets would interface with other similar networks regionally or globally. These are all services which it is difficult to envisage being provided in the immediate future as discrete centralised commercial services.

In addition, many new applications will appear that civic authorities can use to manage a modern community. They would use local information collected from many sources via the local information infrastructure. We foresee that local sustainability programmes like Agenda 21 will require the collection and processing of environmental information. Examples include traffic monitoring and control, and improved information about public transport, including intelligent bus stops.

Many applications will be developed locally reflecting the diverse needs of specific areas, many others will be imported either from similar local organisations, from major software vendors or provided by government institutions as part of their programme to streamline the delivery of government services. Another major source of

Figure 2—Services offered over a C-Net

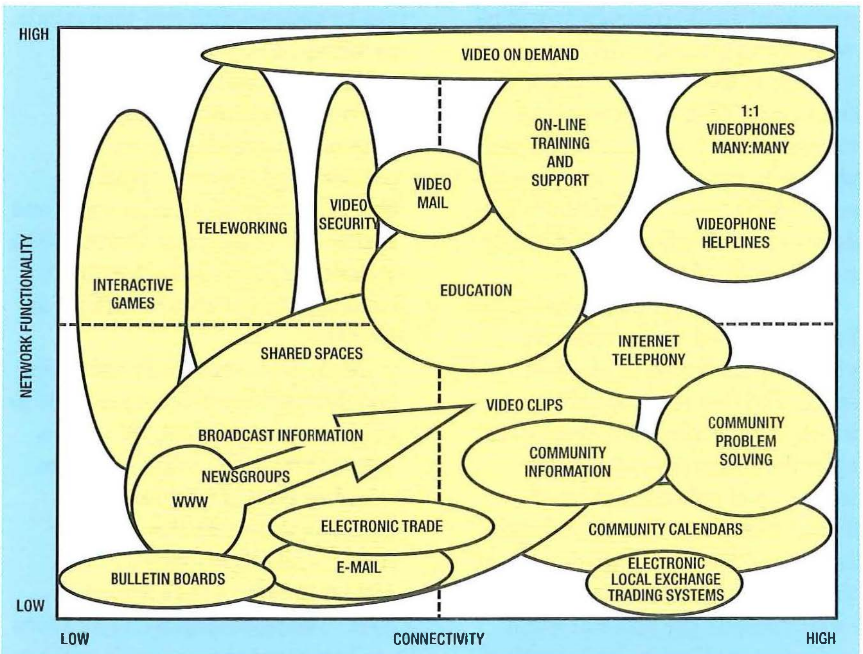
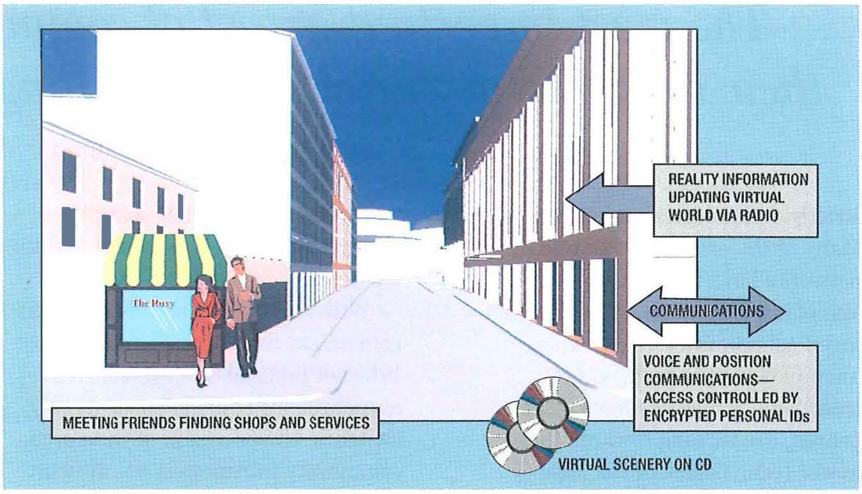


Figure 3 – Interacting in virtual towns



applications are the EU-funded research and development (R&D) activities such as the Telematics, ESPRIT and TENs programmes which have developed applications and services for many of the different commercial and public sectors.

None of the above precludes the delivery down to the customer of applications or services developed by other organisations, including telcos. Most homes will continue to have television which will receive terrestrial, cable or satellite programmes. Similarly most long-distance communications will be carried over the telco networks. In effect this means that the telcos will have to develop a service presence from which the local community network user can select services. It is also highly likely that multinational organisations will wholesale services directly to these local community networks at discount prices.

Local Virtual Territory

There is an important relationship between any local information infrastructure and cyber or virtual spaces. These spaces originate in the interaction between electronic devices, whether computers, set-top boxes, mobile telephones, traffic lights or washing machines. Tomorrow's local digital community will be very rich in electronic devices, whether in the home, at work or in the streets. With the networking together of such devices, traditionally physically separated, a new phenomena—*cyberspace*—is created. By this definition, a telephone call is simply a meeting in cyberspace.

The term *second-wave convergence* has been coined to describe how virtual space relates to physical space. The first wave of convergence, which is happening now, is focussed upon the integration of different services and industries through digital technology. The second wave focuses on how the day-to-day use of this technology will affect our relationship to the physical world and our mental attitudes towards it.

The presence of an integrated local information infrastructure can therefore be regarded as generating a local virtual space or territory. It offers the possibilities of complex virtual environments, shared spaces, where we can virtually meet others, and where real-life serendipity comes into play. These spaces could be socially divisive, trapping people in their homes and preventing them from having real human contact. On the other hand, it is possible to augment people's relationship with real-world events through such virtual environments as illustrated in Figure 3. People living in a local community would have access to a virtual representation of their real-world town or city. This could be achieved by on-line access to a virtual space server, but a more cost-effective way is to provide a digital representation of the town on CD ROM for displaying on the TV or home computer. The virtual image can be updated with real-time events by terrestrial broadcasts or data packets broadcast over the local information infrastructure. This information would include the positions and status of stationary objects, individual users, services and commercial enterprises. It would even include the status of the weather, to make the virtual world as lifelike as possible.

Many new community-enhancing possibilities may become available as people can see on their TV screens where their bus is, what roads are closed or even, if integrated with personal mobile devices, whether their friends have arrived at the restaurant where they agreed to meet. The psychological implications are important too, as people will have the opportunity to relate more closely with their physical surroundings. Needless to say, it will be possible to have different variations on the virtual town; for example a Saturday night fun town for young people. It is also very likely that people will visit other virtual towns, using avatars to move around and interact with others. All of the above is not a distant dream but is happening already; many large towns are being rendered into virtual towns; for example, San Francisco and Helsinki.

The Community Dream Versus Commercial Reality

There is a tension between the social desirability of connecting everyone to the new information infrastructures and commercial realities faced by telcos in a competitive environment. Community networks are built upon the principles of encouraging local discussions and the participation of local business and community organisations. Through being based upon partnerships they are purposely local in terms of audience, content and possibly ownership. This is in sharp contrast to most commercial services, which generally do not interest themselves in small-scale local concerns, except in the case of some major cities. One critical consequence of these commercial issues is that access to most information services today can be broken down fairly sharply on an income basis. In simple terms, the middle-class and wealthy can afford the new technology and services while many others cannot.

Community networks, driven by community development goals, are not interested in encouraging just the

Perhaps those of us in the telecommunication industry need to remind ourselves that our core business is about enabling the symmetrical flow of information between users.

wealthy to use their systems. In fact, many community nets make a strong effort to encourage the disadvantaged to sign up and become regular users. They often maintain community outreach programmes in which volunteers go out and promote their system to the community on a small-group basis. Many attempt to sponsor public access sites, frequently through local public libraries, so that users without home computers or home telephone lines can still get connected.

Community networks tend to represent a slightly wider, or at least different, range of views (and users) than those of commercial networks. Commercial on-line services are driven by marketplace demands and often put the emphasis on commodity-branded information products. Accordingly they tend to maintain an asymmetrical model of content, in which mass-market, professionally-produced and chargeable information is strongly favoured over user-produced and less-marketable content. They view the information content as a highly valuable and marketable commodity, and will aggressively defend their intellectual property. A future information infrastructure which has many of the features of today's Internet is seen by them as an undesirable commercial model.

People have little control over the content of commercial information services; we should be concerned that many services are provided by the same interests that control main-stream mass media. Commercially there is a view that people are simply passive consumers of information and media services packaged together by global media companies. Information needs to be seen as a community good, not a commodity, by encouraging people, in a real way, to become information providers in their own right, and not merely passive browsers or consumers. By casting the individual as a participant in discussions, community networks generally maintain a less unequal balance of information flow to and from the user. Perhaps those of us in the telecommunication industry need to remind ourselves that our core business is about enabling the symmetrical flow of information between users.

How can Telcos Support the Community Network Model?

Much of the recent thinking on the evolution of the access network has focused around the need for high-bandwidth applications like video on demand or entertainment TV to provide the commercial rationale for investing in local broadband infrastructure. More recently, with the growth of Internet usage, there has been an increase in demand for higher-speed access, which has been mainly satisfied through faster dial-up modems and integrated service digital network (ISDN) links provided over the traditional copper access network. The first generation of digital subscriber line units, such as asymmetric digital subscriber loop (ADSL) and very-high-rate ADSL (VDSL) are starting to be implemented over copper or on copper and fibre hybrids to provide mid-band and high-band access to new information services. With these technologies, the data streams are groomed out onto broadband data networks, either at the cabinet or telephone exchange, and the telephony component remaining connected to the existing public switched telephone network (PSTN). A similar high-bandwidth approach is being taken over CATV networks with the introduction of cable modems. However, these technologies are generally being rolled out according to market criteria reminiscent of the CATV networks with which they are perceived to be competing.

Early models of community networks are based upon Internet protocols and principles. The user accesses a dedicated community server through dial-up modem access across the PSTN. The server may or may not be connected to the wider Internet. Today the World Wide Web is seen as the most sensible platform to support the set of features and facilities that a local community may need. However, the World Wide Web is sometimes very slow. Several technologies need to be enhanced to make the community networks realisable. These include core network, Internet and access technologies. Figure 4 illustrates the direction towards which community network practitioners are moving.

Figure 4—Developing a C-Net

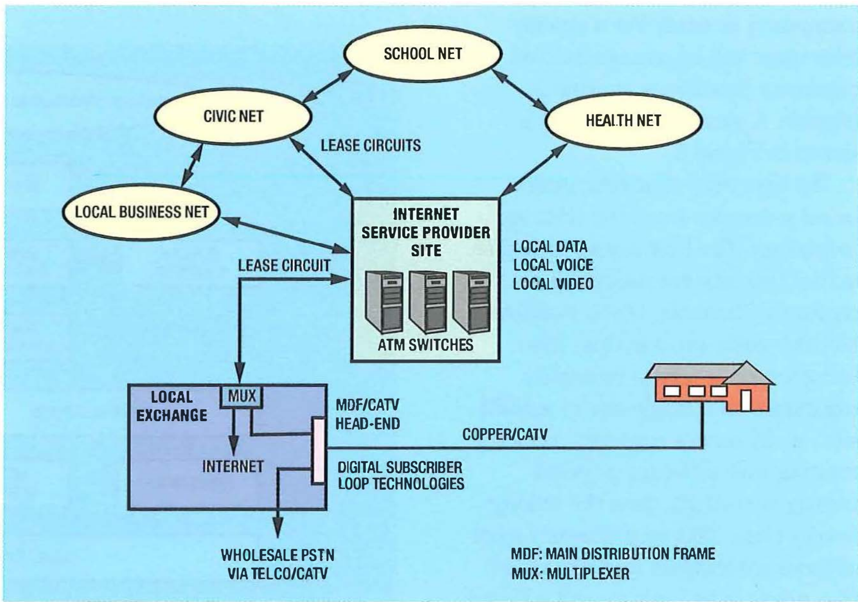
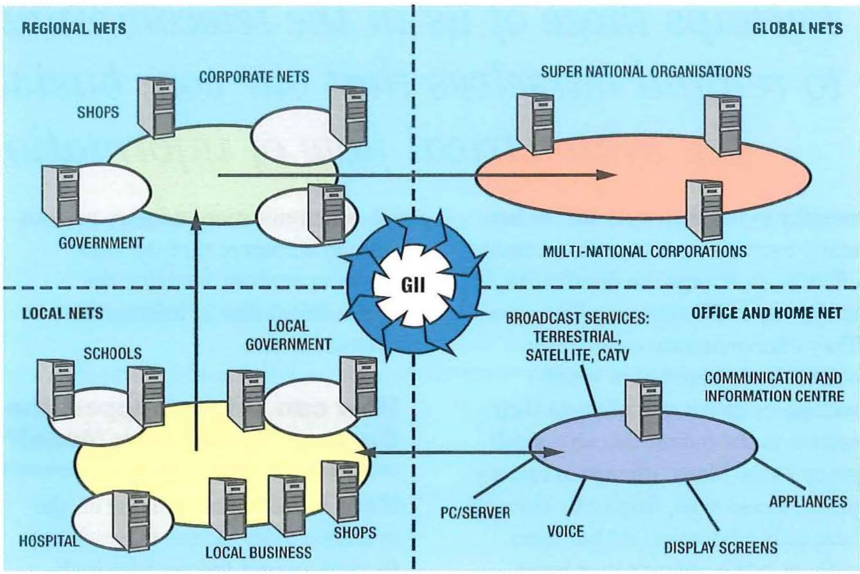


Figure 5—Local networks—a part of the global information infrastructure (GII)



The design criteria for community networks can be summarised as:

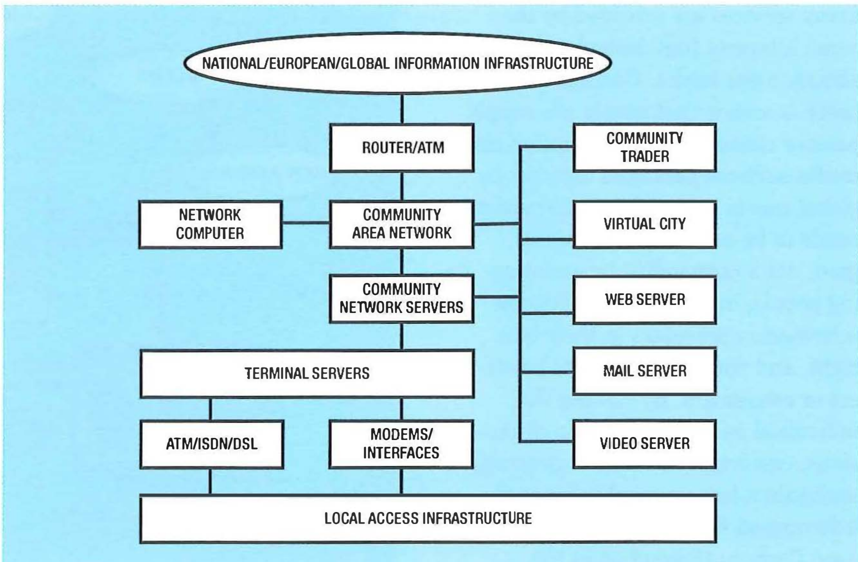
- managed locally;
- easy to use from a customer's point of view;
- easy to manage from the administrator's point of view;
- resilient, can suffer some failures without affecting service;
- should offer permanent, or instantaneous, connectivity;
- should support a mix of data services (including e-mail, bulletin boards, telephony and fax); and
- provides access to telcos service presence for value-added services and global connectivity.

Based upon these criteria, what is an ideal future local network architecture and how could we begin to migrate telcos' existing telephone networks towards a system designed to support all the needs of the community? We have to accept that there is no one simple solution. This is not a difficulty, because a very important feature of community networks is that each has to be designed and implemented with the needs of the local community in mind. For a specific telco there will be commercial and regularity limitations on what is possible. A generic architecture is shown in Figure 5.

We have seen that community-based networks are using IP-based technology. The first aspect to realise is that they are not dissimilar to corporate intranets. If you examine how intranets are evolving, from being simply a way to interwork computers on a single site to a multi-site, multi-service corporate network running over different physical transport systems, then the analogy is very close. This would satisfy most of these criteria and it is this model that needs to be built up and mapped on to the existing physical infrastructure of the access network. In terms of the access technology, the ideal partner for a community network would be a symmetrical high bandwidth service which coexists with today's telephony network; that is, symmetrial digital subscriber loop (SDSL). Technologically this is possible and costs of the related VDSL and HSDL technologies are falling; however, there are still issues of standardisation to be addressed.

Within most telcos, there is a lively debate underway concerning how to introduce the next generation of switching technology; it is likely that most telcos will introduce a family of ATM switches. An important feature of ATM is its capability to create and address sub-networks; this feature has already been demonstrated on corporate intranets. A community network could be realised as one of these sub-networks. The new access technologies could be used for providing access to ATM sub-networks which may be located on a local ATM switch or in the core ATM switch fabric. As is usual practice with intranets, servers are accessible by users. These servers will provide the local services and features for the C-Net. One can envisage there being a number of local sub-networks each tailored to the requirements of different groups, for example a local health net, education net or civic net. These need not be provided by the same network operator, so they could be on different physical infrastructures. However, it is in the interests of the community as a whole that such sub-nets are accessible by local people. The generic community network provides

Figure 6—Future functionality of a C-Net



an important gateway or consolidation function into these other sub-networks.

But the local information infrastructure has the potential to provide much more; Figure 6 illustrates some of the functionality that we could envisage appearing, indeed in some places aspects of this functionality are already coming into place.

Conclusions

From the view point of the local user, services provided over the local C-Net appear integrated, and navigable, although there may be many infrastructure providers locally. Communities can determine their priorities, evolve their own development plans and most importantly, ensure that they have the local information infrastructure most suitable for them to be prosperous within the Information Society.

European telcos should place more emphasis on understanding the commercial and social needs of local communities as a holistic whole. Ideally local communication solutions should be integrated across the community rather than being market segmented. This approach would support and encourage the growth in local services and the introduction of new user technology. However, this approach must be sensitive to the needs of each community, one of partnership, rather than domination and commercial exploitation.

If the ideas expressed in this article are realised, and there is mounting evidence that something of this nature is happening now, then community-based local information infrastructures offer the telcos many new and exciting commercial opportunities in the next millennium.

Disclaimer

The views expressed in this article are those of the authors and do not reflect BT policy or necessarily the views of those engaged in community networking initiatives.

Acknowledgements

The authors would like to thank all those people who over the last couple of years have helped and worked with them to understand the importance of community networking; in particular, David Wilcox and other members of the UK Communities on Line.

The UK Communities on Line web page at URL http://www.communities.org.uk is a useful starting pointing for finding out more about community networking.

Biographies

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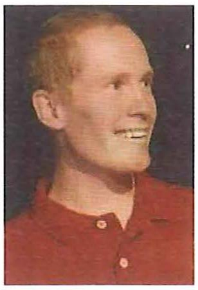
BT Networks and Systems

David Greenop works in the Global Technical Strategy Department of BT Networks and Systems. He has a B.Sc. joint honours degree in Physics and Logic and a Masters degree in Telecommunications Systems. He joined BT in 1975 and spent several years on operational planning before moving to BT Headquarters to work on the development of computer modelling tools for network planning. He has been involved in many studies looking at various aspects of telecommunications networks. In recent years, he has focused on the longer-term developments in telecommunications and their impact upon BT's future networks. He has taken a keen interest in developments within Europe through European collaborative bodies like EURESCOM and has contributed to the thinking on the development of the Information Society and the structure of the evolving global information infrastructure.



Doug Williams
BT Networks and Systems

After graduating from Sheffield University in 1987, Doug Williams joined BT Laboratories working on the design and fabrication of special optical fibres with amplification, switching and wavelength applications. In the eight years he worked on these topics, he published widely, completed a Ph.D. (again from Sheffield University) and filed several patents. In 1966, he joined a new team looking at the strategic impact of community networks. In this role he helped launch a UK organisation sponsored by the Department of Trade and Industry (UK Communities On-Line) which supports and encourages the use of the Internet and other IT tools for community benefit and is now working with BT Business Division in the commercial exploitation of community communication networks.

Fiona MacKenzie

The Challenge of Universal Personal Communications

Universal personal communications (UPC) promises access to 'anything, anytime, anywhere' communications. The integration of third-generation mobile systems (TGMSs), intelligence and mobility enabled, fixed, multiservice networks should finally bring UPC within grasp. However, true UPC may be precluded by divergent approaches within the Internet protocol, asynchronous transfer mode and TGMS communities.

This article is based on a paper presented by the author at the 36th European Telecommunications (FITCE) Congress, 22–27 Sept. 1997, Thessaloniki, Greece.

Introduction

In an age of computing, broadcasting and telecommunications convergence, as evidenced by information networking, computer telephony integration, and the World Wide Web, we are about to enter a new convergence phase—the age of mobile multimedia.

The rising popularity of cellular networks over the past two decades has been a tremendous success story. The Universal Mobile Telecommunications System (UMTS) Forum[1] estimates that the EU mobile market will reach 200 million subscribers by 2005, with service revenues of over ECU100 billion. The corresponding mobile multimedia market in 2005 is estimated at more than 30 million subscribers, with service revenues of ECU40 billion. Most services and applications are expected to be associated with electronic commerce and electronic information transfer as a result of changing business processes, and are likely to be Internet based, requiring access to servers on the fixed network.

However, with the exception of a small percentage of data users, the province of current mobile networks is person-to-person voice communications. The networks are designed and operated as separate entities from their fixed counterparts, requiring users to accept multiple subscriptions, multiple service environments, multiple service providers and limited interworking. A new generation of network is required to provide multimedia access to both fixed and mobile users. This is the aim of the UMTS currently being specified in the European Telecommunications Standards Institute (ETSI).

Universal personal communications (UPC), based on UMTS, promises users the ability to access their own virtual home environment (VHE) from any location, at any time. Services will be personalised, with access and delivery via the most convenient network and terminal for the user at a given time. 'On demand' handover between networks will be provided. Multimedia services will be supported efficiently within UMTS compatible core and access networks.

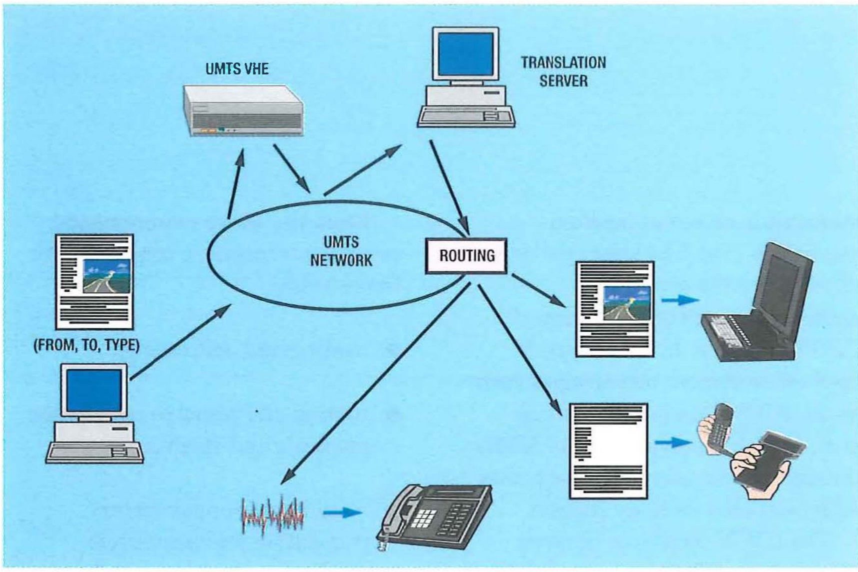
However, with interworking requirements for legacy networks such as the public switched telephone network (PSTN) and the global system for mobile communications (GSM) and potentially separate development of mobility within corporate local area network (LAN) environments, the challenge is to provide a single point of contact, and a consistent set of services across networks with very different characteristics operating under different regimes. The picture is further complicated by the diversity of standards bodies involved in current developments within the mobile arena.

This article discusses UPC and UMTS requirements and the potential role of intelligent agents in the provision of UPC services, highlighting standards issues still to be resolved.

Universal Personal Communications and Intelligent Agents

In this age of increasing computer usage, personal communications is no longer restricted to person-to-person voice calls. It has been suggested[2] that the proportion of traffic from

Figure 1—Selection of network



e-mail on current-generation mobile networks may reach 50 per cent within five years. Users also require access to information services, booking services, messaging, teleconferencing, collaborative working, shared diaries and files, databases, training services, location-based services, Intranet access, WWW and a myriad of other services and applications.

Over the next 10 years, multimedia information and communications technologies and applications will be required for 'mission-critical' applications—where IT is fully integrated into business processes rather than just used as a support tool. As a result, mobile access to these applications will be essential.

Requirements for each of these communication types will vary: for some, the focus will be on urgent delivery of information; for others the cost of information delivery may outweigh the urgency; some will require high bandwidth multimedia networks (for example, streamed video); others may be messaging services requiring the delivery or storage and retrieval of a few bytes; some will be conversational in nature; many will be person-to-machine based (transactional services).

To handle some of the complexity on behalf of the user, *intelligent personal agents* will be developed. These agents, together with downloadable applications resident within the user's terminal, may introduce the additional need for autonomous machine-to-machine communications as part of the user's personal communications service.

A UMTS network must be able to satisfy each of these requirements, given the constraints of the access networks and terminals available to the user at a given time and the user-defined preferences stored within the VHE. The role of intelligent agents[3] within the VHE is to make decisions about the 'best' way to handle the information, as shown in Figure 1, given the constraints and user preferences associated with that particular information type or originator. Metrics used may include network quality of service (QoS), cost, security and urgency.

The 'best' way may be to deliver the information via a computer on the user's corporate LAN, to defer delivery until the user enters an area of high bandwidth public cellular coverage or to translate some or all of the message into a format suited to immediate delivery; for example, e-mail delivered as a voice call on the PSTN using a text-to-speech translation.

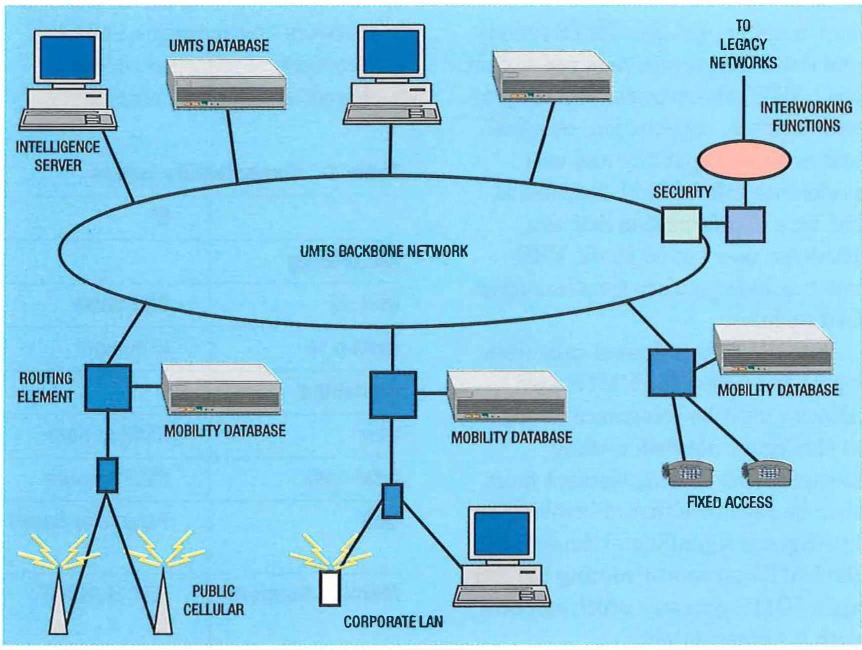
Charging for such services is no longer likely to be based purely on the number of bits transferred, or even the network QoS provided, but will also have to take into account the value of the information and any translation performed on it.

Architectural Requirements for UMTS

From the previous section, it is apparent that provision of UPC services on UMTS requires timely delivery of information in an appropriate format via any (or a mixture) of wide area networks (WANs) and corporate LANs as shown in Figure 2, as well as interworking with legacy networks including GSM, PSTN and integrated services digital network (ISDN).

Within ETSI SMG, a new UMTS air interface is proposed to allow provision of wide area cellular

Figure 2—Proposed UMTS network architecture



multimedia access at medium bandwidth (144–384 kbit/s per user), allowing mobile access to multiservice networks in areas of UMTS coverage. In the corporate LAN environment, technologies such as the ETSI Hiperlan family will provide high bandwidth (2–10 Mbit/s throughput per user) wireless access with local area mobility support.

The UMTS backbone network must provide efficient support for transactional, messaging, conversational and streamed service types. Connections may be unicast, multicast or broadcast and assymetry is likely. Where necessary, network resources must be reserved to allow end-to-end QoS guarantees to be met. In addition, where wireless access is provided, mobility support must extend to in-call handover for maintenance of higher-layer sessions. The need for in-call handover extends to the case where a user moves between UMTS coverage areas and areas where coverage is provided only by legacy networks.

Use of the network-based intelligence requires suitable interaction between routing elements and the intelligence 'servers' concerned. Information may need to be routed to the end user via media translation servers or network interworking functions. Interaction between the user terminal and the UMTS servers and databases is also required so that the UMTS service provider has up-to-date location, registration, terminal and network capability and user preference information available at the time of information delivery. However, user access to the VHE must include security from unauthorised updates.

For UMTS-terminated calls from legacy networks, the UMTS user identity must be recognised as such at the legacy network routing element. This routing element must then be capable either of invoking an intelligence signalling exchange with the UMTS servers or routing the call via a UMTS gateway which can deal with it appropriately.

From the above requirements, several internetwork compatability issues arise:

- naming and addressing,
- routing and resource reservation protocols and strategies,
- handling of supplementary, translation and bearer/tele services,
- interaction between user terminals, routing elements, mobility databases and intelligence 'servers',
- charging and billing, and
- security.

Divergent Standards

The development of global standards for UMTS networks is essential:

- to drive the market to a critical mass, at which point growth is self-sustaining;
- to generate economies of scale and reduce costs of terminals and infrastructure; and
- to enable roaming across different network environments and provision of seamless services based on the VHE concept.

The most likely candidates for a UMTS backbone network are those based on the Internet protocol (IP) or asynchronous transfer mode (ATM) offering support for multimedia services. None of these is a perfect solution at the current phase of development. ATM currently has higher-capacity switching platforms and provides the ability to segregate traffic onto virtual networks, while IP offers a widespread and growing user base, network independence and better support for transactional and messaging services. Native ATM applications are in short supply. End-user voice support is still being developed for both IP and private ATM networks.

At the present time, ATM- and IP-based standards diverge in a number of the compatability areas highlighted in the previous section, as shown in Table 1.

Work within the Internet Engineering Task Force (IETF) and ATM Forum to address support of IP over ATM is taking place. This is likely to address alignment of QoS parameters, naming and signalling. The ATM Forum and International Telecommunication Union (ITU) are also working to achieve interworking between ATM and broadband ISDN (B-ISDN). Manufacturers are beginning to introduce combined IP routing/ATM switching products providing support for IP 'flows' over ATM connections. As an end point of these developments, it

Table 1 Compatability Issues

	IP	ATM	B-ISDN
Addressing			
user_id	DNS name	DNS name proposed	E.164 number
routing_id	IP number	NSAP address	E.164 number
Signalling			
user	RSVP or none	UNI4.0	Q.2931
inter-node	RSVP or none	PNNI	SS7 B-ISUP
QoS	Parameter based	Moving to parameter based	Class based
Mobility Support	IETF Mobile IP	ATM Forum WATM—under development	None

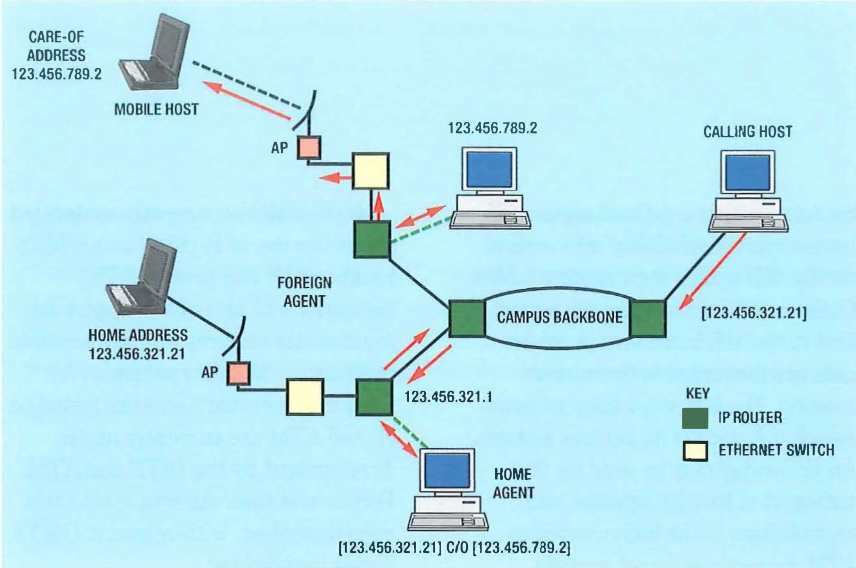


Figure 3 – Base mobile IP

is possible that IP- and ATM-based networks will ultimately converge to a common solution. At the very least, we can expect interworking between them to be widely supported within the timescale of UMTS core network deployment. From a UMTS perspective, however, the critical issue is the present lack of coordination between the UMTS Forum, ETSI SMG, NA IETF, and ATM Forum mobility working groups, for service requirements, radio interface and mobility management aspects.

Mobility solutions for fixed multiservice networks based on IP and ATM are currently under development by the IETF and ATM Forum, as described in the next two sections 'IETF Mobile IP' and 'ATM Forum Mobility'. These are mainly targeted at roaming or local area mobility using limited range, high bandwidth wireless LANs based on the ETSI Hiperlan family. However, if suitably coordinated with work in the ITU, UMTS Forum and ETSI SMG, a consistent evolutionary approach could allow these developments to form, not only 'UMTS compatible' corporate networks, but a common UMTS core network supporting mobility.

IETF Mobile IP

The IETF has developed a solution to support mobility of computers (mobile hosts) across IP subnets. The primary requirements were avoiding changes to existing routers and software within the Internet. This has resulted in an overlay approach using IP encapsulation techniques[4] being adopted.

Figure 3 shows how *base mobile IP* supports mobility within an IPv4 network. In summary:

- A mobile host (MH) has a permanent IP address for use on its home network.
- A MH obtains a 'care-of' IP address at the visited network—usually the IP address of the foreign agent (FA).
- It updates a location database (the home agent (HA)) on its home network.
- Incoming messages will first be routed to the home network, where they are intercepted by the HA.
- The HA adds a new address header (the care-of address) and forwards the message to the FA.
- Outgoing messages use the home address as an identifier and are routed as normal IP packets.

Extensions (still at draft stage) to the basic version allow for the HA to send the care-of address to the calling host, where it is cached, so that subsequent packets can be sent directly to the MH. If the MH moves during a session, it may inform the old FA, which will forward any packets in transit before the HA is updated.

The IPv6 proposal (also at draft stage) requires the MH to inform the calling host (correspondent host) directly of its care-of address and any updates. The initial routing is still via a HA, however, as the calling party may not have a current binding for the MH. IPv6 requires the MH to maintain active connections via old and new care-of addresses for a time to avoid loss of packets during a move.

UMTS issues

The speed at which the HA update can be performed may be a limiting factor for fast-moving MHs requiring voice support. For cellular technologies, the signalling overheads associated with mobile IP messages may be significant unless the network topology is designed carefully.

IPv6 suffers from the problem that all active correspondent hosts must be updated whenever the MH changes its care-of address, which may result in an unacceptable amount of signalling traffic for a cellular air interface and a substantial overhead for the core network. Additionally, forward handover would be required to enable pre-warning of the change in care-of address.

ATM Forum Mobility

The mobility management schemes proposed by the WATM community[5] are based either on location registers or on extensions to the network routing protocol, PNNI[6], used in private ATM networks. It is currently unclear which of the mobility management schemes will be adopted by the ATM Forum.

The location registers scheme is similar to the HLR/VLR scheme of current cellular networks. Database look-up would be performed by the 'first mobile aware' ATM switch. Ideally this would be the ATM switch closest to the calling party, but an alternative is to use an IP HA type approach, with call set-up signalling messages routed to the home network in the first instance.

The extended PNNI scheme uses PNNI routing protocol packets (exchanged by ATM switches) to update switch nodes as an MH moves.

Switches within a defined region will have correct reachability information for the MH within their routing tables. Calls outwith that region are routed first to the MH home switch, where calls are forwarded to the current location. The MH must keep its home switch informed of its current address. An IP overlay may be used for the transport of location updates and registrations to the home switch as ATM connections do not provide efficient support for short messages.

Support for in-call handover between cells served by different ATM switches requires rerouting of ATM connections. This involves a QoS reservation phase at any new switch. Extensions to the existing signalling protocols would be required to achieve this.

UMTS issues

Like mobile IP, the extended PNNI scheme requires updating of the home register each time the MH moves. This may cause a significant signalling overhead. Widespread mobility would have an impact on the frequency of routing-protocol updates within the scoped area as these are used to update routing tables. The extended PNNI scheme is only applicable within networks using the PNNI protocol.

Although an IP overlay has been suggested for routing mobility management messages, no commonality with mobile IP messaging has been proposed. Where IP over ATM is used for service delivery, it is unclear which layer will deal with mobility aspects.

Conclusions

Mobile access to multimedia services, based largely on transactional communications with servers in the fixed network, will become increasingly important to users as IT is integrated with business processes. This article has described the challenges and incompatability issues associated with delivering multimedia based UPC services to users across UMTS and legacy networks.

ETSI SMG is currently undecided about the use of B-ISDN as a UMTS backbone IP and private ATM networks will also offer support for multimedia services and are suitable candidates. Mobility solutions for fixed multiservice networks based on IP and ATM are currently under development by the IETF and ATM Forum and their current status has been described, with relevant UMTS issues highlighted.

From a UMTS perspective, the critical issue is the present lack of coordination between the UMTS Forum, ETSI SMG, NA IETF, and ATM Forum mobility working groups, for service requirements, radio interface and mobility management aspects.

In particular, the development of different mobility management messaging sets and protocols is likely to prevent a single UMTS provider from maintaining the required information for UPC service delivery without complex interworking.

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Glossary

ATM Asynchronous transfer mode
B-ISDN Broadband integrated services digital network
B-ISUP Broadband ISDN signalling user part
DNS Domain name server
ETSI European Telecommunications Standards Institute
FA Foreign agent
GSM Global system for mobile communications
HA Home agent
IETF Internet Engineering Task Force
IP Internet protocol
ISDN Integrated servicces digital network
ITU International Telelcommunications Union
LAN Local area network
MH Mobile agent
NA Network Aspects
NSAP Network service access part
PNNI Private network–network interface
PSTN Public switched telephone network
QoS Quality of service
SMG Special Mobile Group
RSVP Resource reservation protocol
UMTS Universal mobile telecommunications system
UPC Universal personal communications
VHE Virtual home environment
WAN Wide area network
WATM Wireless ATM

Biography

Fiona MacKenzie
BT Networks and Systems

Fiona MacKenzie joined the Optical Research Division of BT in 1988 and authored a number of papers in the area of optical switching and waveguides before moving into mobility research. She currently leads a group researching network architectures for UMTS. Fiona holds a B.Sc. (Hons.) in Physics from Aberdeen University and an M.Sc. in Telecommunications Engineering from the University of London. She is a member of the IOP and IBTE.

Achilleas Kemos

Perspectives of Universal Service within a Competitive European Environment

The notion of universal service in telecommunications has had a long history. The author examines and compares the contrasting modes of evolution of the universal service obligation in the United States of America and in Europe, and calls for further evolution of the concept to encompass both the new liberalised environment and the Information Society in order to ensure economic and social development.

The Birth of the Notion of Universal Service in the United States of America

The notion of *universal service* appeared quite early in the history of telecommunications, but its meaning and content have evolved with time. In 1894, Alexander Graham Bell's patent expired, thus ending the American Telephone and Telegraph Company's (AT&T) Bell System monopoly. Telephone penetration was at that time very low. The entrance of new players into the market place, favoured by diseconomies of scale, was quite spectacular, and as many as 87 independent networks had opened by the end of 1894. Given that positive influences external to the network characterise the demand for connection to service, a vital objective of the competitors was to enrol the largest possible number of subscribers in order to increase the network's social value. They offered service to clients with low ability to pay, sometimes falling below the profitability threshold. Even by the end of 1894, a fierce price war had broken out.

Penetration rose from 2·3 per cent in 1902 to 12·7 per cent in 1920, when the total number of telephone lines exceeded 13 million for the first time. Even so, this remarkable growth had a major drawback: a large proportion of the new networks were not interconnected with the Bell System. In sharp contrast to the present competitive situation in telecommunications, operators were refusing to interconnect with each other. In several large cities, where many networks were competing, heavy users were obliged to subscribe to more than one operator. With respect to the local loop, the Bell System market share rapidly decreased, and in 1907 it controlled less than 50 per cent of local lines. On the other hand, its position remained dominant in long-distance transmission, where the independent companies controlled less than 20 per cent of the traffic. In developing AT&T's strategy, Theodore N. Vail had in mind the model of telegraphic services development. Western Union, where he had worked in 1860–70, had managed to dominate the telegraph market by deploying a nationally interconnected network, and, by that means, had isolated and then eliminated its rivals.

By following this strategic model, AT&T adopted a policy of taking over independent networks, advocating at the same time the emergence of a unique network in a monopoly situation. In support of this it launched a big campaign in 1907 based on the slogan 'One policy, one system, universal service'. Henceforth, AT&T based its development on linking the independents, by acquiring parts, by licensing and setting conditions necessary for their interconnection and by promoting the idea of universal service. The notion

This article is based on a paper presented by the author at the 36th European Telecommunications (FITCE) Congress, 22–27 Sept. 1997, Thessaloniki, Greece.

of universal service was thus from the start an element in AT&T's competition and relationship strategy, conceived from earlier telegraphic experience.

By 1934, when the Federal Communications Commission (FCC) was created, all the networks had been interconnected with the Bell System, and AT&T directly controlled about 80 per cent of the market. This situation remained stable for the next 50 years. AT&T had a monopoly in long-distance traffic, a monopoly which ensured interconnection, and a cohabitation at local level with GTE and 1200 small independent companies connected to the Bell System. It was thus proved possible for a monopoly to ensure the provision of its services without geographic or social discriminations.

With the implementation of a new institutional framework after 1934 and the generalisation of local monopolies interconnected to the Bell System, the notion of universal service became broader and changed sense. The principle of *universality*, achieved by the homogeneity of a service unified by interconnection, tended more and more to be assimilated to the objective of securing access to the telephone network by a large percentage of the population, by means not excluding cross-subsidisation or tariff distortion between call, rental and connection charges. It was a semantic shift then that accompanied the transmutation of universal service to natural monopoly. Starting from an initial situation of competition in the history of the American telephone network development, and ending with a monopoly, it was the 'connection race' which, in the USA, underpinned the rapid growth of the telephone penetration rate, not public intervention. On the contrary, other national experiences, such as those of the United Kingdom and France before 1970, have shown that the existence of a natural monopoly is not a sufficient condition for the rapid development of the network. The objective of developing a large clientele must *inter alia* be a priority objective for public authorities. Hence, the notions of 'universal service' and 'natural monopoly' are not intrinsically linked. In the USA, for instance, it was competition that was at the origin of its early and high telephone penetration—competition that was accompanied by price falls and the subsidisation of an access deficit by a usage surcharge, expressing a financial solidarity between big and small users. It is this solidarity that has been the motive power for the specific development of telephone service.

The Development of Universal Service in Europe

In Europe, the institutional framework of telecommunications has for many years depended on national specific requirements, even though the model of national monopoly managed by public administration bodies ended up by prevailing in most cases. Nevertheless, by the mid-1980s, the European Commission (EC) sought to harmonise national characteristics, mainly inspired by American liberalisation experience. Under pressure from the UK, competition laws become applicable in the field of telecommunications. The exclusive and special rights of national operators could no longer be justified in the case of public operators incapable of satisfying total demand.

The implementation of an overall European policy for telecommunications was initiated with the publication of a Green Paper on the development of a common market in services and equipment, and on the nature of this market regulation. Among the analyses and proposals contained in this Green Paper appeared the principle of a distinct separation between an official regulation and control authority and the operational functions. It mainly refers to the FCC practice in the USA, adopted by the UK with the creation of OFTEL in 1984. Other European countries like France and Germany were already considering the problem, but without having implemented any reforms. Publication of the Green Paper helped to accelerate a process which had been blocked by old institutional compromises. In other domains, like opening up to competition, the consideration of the diversity of national positions has led to certain notions with unclear content, like the open network provision (ONP). There is a progressive consensus on the ultimate objective of liberalisation, but the parties concerned (the Commission and member states) still diverge on methods and timetables. Thus, member states more favourable to liberalisation, which consider the technical harmonisation of European networks to be a direct consequence of the competition process resulting from liberalisation, are opposed to those countries that consider technical harmonisation to be a prerequisite to liberalisation.

The liberalisation process is pursued further by DG IV, the Commission Directorate in charge of competition, which according to Article 90-3 of the Treaty may act autonomously to make and enforce competition rules without requiring the approval of the Council of Ministers. Two Commission directives liberalising the equipment sector and the service sector were published in 1988 and 1990 respectively. In the debates about the latter directive and in competition guidelines proposed by DG IV, reserved services protected by exclusive and special rights are reduced to infrastructure provision for 'basic services'. Thus there emerged for the first time in Europe the notion of 'universal service', not assimilated to the public character of the service (its provision mode) but to the service actually rendered, the 'basic service', which is a minimum one. The first official definition of the term appears in a Communication of 21 October 1992, and relates to the 'service'

The liberalisation process of the telecommunications sector can be interpreted retrospectively as an implicit element of industrial restructuring

directive: 'a given minimum service, whose quality has been specified, for every user, at an accessible price'. The elimination of the term 'public' serves to affirm that the offer of this service is not the role of a public authority.

The development of the internal market project, the awareness of new competencies acquired by operators in liberalised markets, the fact that competition at a supra-national level was considered inescapable and the willingness to benefit from the international opportunities offered by liberalisation pushed towards a faster than expected liberalisation. In October 1992, the Commission initiated a debate between member states on the evolution of European liberalisation policy, and this led, after much discussion, to a Resolution by the Council in June 1993. The principle of voice-telephony liberalisation by 1998 had been decided, with supplementary delays for certain countries.

The Green Paper on infrastructures (25 October 1994/25 January 1995) proposed the imposition of ONP principles, and hence the possibility of universal access, on every enterprise in a dominant position. Moreover, the Commission recognised the evolutionary nature of 'universal service'. However, a difficulty resides in the impreciseness of the notion. At present, nothing is stated about future extensions; for instance, those linked to information content. Universal service obligation appears mostly as minimal indispensable support for market mechanisms to function in providing the whole set of services. This technical support consists of interconnection plus basic services (voice telephony, public phones, emergency services etc). These are sometimes extended to certain service complements, such as itemised billing. The main idea is that basic services can be provided by competing operators. Nevertheless, the Commission proposes to create universal service national funds, financed by new entrants who decide not to participate in the provision of these services. The Commission also allows, incidentally, the payment of interconnection access charges, without, however, being proactively in favour of them, as such charges are considered to be incompatible with the principle of 'price orientation to costs'.

The choice of the decision makers relies apparently on a competitive credo, but there may also exist the influence of international lobbies and the strategies of multinational companies, which see an immediate advantage in a broader liberalisation. Once the procedure is launched, auto-reinforcing mechanisms tend to come into play. The expert group which initially adopted this institutional strategy managed to impose it progressively through a gradual evolution of the decision makers' convictions. Above a certain critical threshold, participants have, in fact, an interest in adopting opening-up and spatial extension strategies in order to be able to benefit from certain advantages linked to scale and liberalisation; for instance, institutions in charge of regulation in the most liberalised zones insist on reciprocity. In consequence, at member state level, every policy aiming to favour the international expansion of a national operator will carry with it a requirement to open up its own national market as a condition of ensuring access to the liberalised zone. After such a commitment, the process would seem to be irreversible, and participants, even those desiring to maintain conservative strategies, will be forced, one by one, to adopt international strategies. In order to avoid exclusion, only a forward move may constitute a viable strategy. The liberalisation process of the telecommunications sector can thus be interpreted retrospectively as an implicit element of industrial restructuring, an instrument that is profitable mainly to those who have first experimented with it and have considered the European, international and world markets as the real field of competition, even though imperfect.

The Extension of Universal Service in the Context of Information Society

In the last 20 years, we have witnessed a fundamental change in telecommunications, as a result of digitisation. Technological progress is transforming the telecommunications network towards a high-capacity 'information highway'. The integration of computer intelligence into the network has led to the creation of a series of services, firstly in the field of telematics and more recently in multimedia services. The integration of broadcasting, editing and computing with telecommunications will lead to the creation of new services, which will certainly influence economic activity and social development. Such new services, given only as examples and by no means exhaustive, include teleshopping, telelearning, interactive games and video on demand. New services are of interest to the business community as well as to the big residential market. Whereas most residential requirements can still be satisfied by good-quality basic telephony, many business applications require higher-performance infrastructures, such as the integrated services digital network (ISDN).

In such a context, where numerous services exist, a differentiation of users into groups is essential. It is necessary to determine whether services are indispensable for certain user groups,but are of minor importance to other groups. In the era of the Information Society, fixed voice telephony is a generic service, but it cannot claim effectively to play the role of universal service. An effective universal-service policy offers services when and where they can be used to good effect. What this implies is that a different standard of universal service should be offered to different groups of users, according to their requirements.

This extended definition of universal service obligation derives from the definition of universal service based on user requirements, rather than on network characteristics.

Table 1 offers a dynamic outline for universal service in the context of the Information Society. It considers two different time horizons: the 'immediate' applications are intended as targets to be attained without delay, while 'medium-term' targets should be reached by the year 2000, which for peripheral countries, broadly coincides with the introduction of full liberalisation.

Three different levels of universal service are outlined, based on different types of need:

- for all users;
- for small and medium enterprises (SMEs) as the motor of sustainable regional growth;
- for the local community, enhancing key social services such as health and education, for internal use; and
- for students and the public, who may have access through institutions.

To ensure a minimum level of access to Information Society services for all users, connection to the PSTN must cover fax and data (for e-mail, on-line services etc.) of a reasonable speed and quality. The level most commonly available on customer equipment and offered by service providers in the EU is 14·4/28·8 kbit/s (V.34).

A fully digital network has the advantage of facilitating virtually all of the services involved, and going some way towards ISDN provision for more advanced services. A network with 100 per cent of subscribers directly connected to a digital switch might thus be a good medium-term target. However, for some SMEs, ISDN access would be necessary in the medium term, if not immediately.

Ensuring the participation of private individuals, and the non-profit making community and voluntary sectors, presents problems. Access to many advanced services requires costly terminal equipment, and sometimes network capabilities beyond the basic level mentioned above. Yet it may become very costly to bring such services and user equipment directly into every home and business. Here, local community access, for use both by education and health institutions and directly by the public, in schools, health centres and libraries, might constitute a reasonable definition.

Table 2 records the content of universal service obligation in the framework of voice telephony, and proposes two possible extensions, to accord with two distinct objectives: integration into the Information Society and an optimum level of economic and social cohesion.

This extended definition of universal service obligation derives from the definition of universal service based on user requirements, rather than on network characteristics. It maintains and enhances the role of telecommunications as a key factor for economic and social development, while the cost of providing such a service remains reasonable. As the definition proposed by the Commission insists on a minimal level of service, it is the responsibility of the regulatory authorities of each member state to decide the content of universal service obligation according to the principle of subsidiarity. The disparities that may arise between member states on this issue raise the question of the need for a European regulatory authority.

Table 1 Proposals on Principles and Levels of Universal Service (Source: Nexus, 1996)

Principle of Access	Applications Technology	Universal Access
Access to all users, domestic and business. Available on demand at uniform connection cost and affordable tariffs	*Immediate*: Reliable, basic telephony, accessing services (fax, e-mail) at usual speed *Medium term*: Call forwarding, intelligent services	*Immediate*: Telephone line to support 14·4 kbit/s modem *Medium term*: Digital switching in local loop
Economic development access for SMEs, including in rural and peripheral areas, as they become available in developed urban areas, at same connection fee and common tariff bands	*Immediate*: Networking, electronic data interchange (EDI), e-mail, call forwarding/switching, intelligent services *Medium term*: Networking, advanced EDI to core regions, access to new networking business services	*Immediate*: Digital switching in local loop *Medium term*: Basic-rate ISDN
Local community access, institutional: Key social services, for own use, in health centres, educational institutions. Direct student/public access to terminals in schools and public libraries	*Immediate*: Basic telemedicine; access to educational resources and networking between schools; public e-mail access to libraries *Medium term*: Public Internet (and other on-line) access, and distance education, in public libraries; student e-mail access in schools; access as needed to advanced telemedicine and higher-level educational needs	*Immediate*: ISDN in public institutions *Medium term*: Bandwidth on demand to health and educational establishments that need it

Table 2 Content Evolution of Universal Service Obligation (Source: Nexus, 1996)

	Universal Service in Voice Telephony	Universal Service for Integration into Information Society (IS)	Optimal Economic and Social Cohesion
Universal Access			
Use of Services	Voice telephony for social needs	Basic integration with IS for social and other needs, in the home	Use of IS for economic activity, from, and to, the home
Network	2·4 kbit/s	14·4 kbit/s	14·4 kbit/s rising to ISDN
SME Access			
Use of Services	Voice telephony for business needs	Basic business interaction with IS: EDI, e-mail, call forwarding/switching	Full integration with advanced IS; new network business services
Network	2·4 kbit/s	14·4 kbit/s; Digital switching in local loop	Basic-rate ISDN
Community Access: Institutional			
Use of Services		Access to health centres, educational institutions to benefit public	Advanced use of health and educational services
Network		Leased lines, ISDN	Bandwidth on demand
Community Access: Direct to the Public			
Use of Services	Public telephones	Basic interaction with IS for social and other needs in libraries, resource centres, etc.	Advanced use of IS in public centres
Network	2·4 kbit/s	14·4 kbit/s; Digital switching in local loop	Basic-rate ISDN

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Biography

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Achilleas Kemos graduated from the Electronic and Electrical Engineering Department of University College London. He then moved to France where he obtained two post-graduate degrees: Diplôme d'Études Supérieures Specialisées on 'Project Analysis for Industry and Agriculture' at the Université de Rennes I, and a Mastère on 'European Business Engineering' at the École Nationale Supérieure des Télécommunications de Bretagne, where he is lecturing and carrying out research in the Economics Department. He is currently preparing his Ph.D. thesis on the liberalisation of Greek telecommunications. He is participating in the European Project ACTS 226 OPTIMUM (optimised network architectures for new multimedia services). He has contributed to the general methodology and is monitoring four business cases involving SME participation. He has worked as a consultant for the European Union Directorate General XVI, evaluating the impact on cohesion of community policies for telecommunications.

Paul Tomlinson

Telecommunications and the Disabled—Friend or Foe?

This article provides a user perspective on the ways in which telecommunications products and services help or hinder disabled people in their daily lives, and suggests ways in which the level of support provided by the telecommunications industry could be improved.

Preamble

When Alexander Graham Bell invented the telephone he was working at a school for deaf children, and was investigating the electrical analogue of speech in the hope that he could find a method of using this knowledge to help his pupils overcome their handicaps. He would therefore be very disappointed to be told that today the telephone is often seen by hard-of-hearing people as a potent symbol of their isolation from society. Hence from the outset of telephony we have had the paradox that developments intended to help disabled groups can have the effect of creating barriers between them and the rest of society. This article, written by a practising engineer who is also profoundly deaf, reviews the current state of play on this paradox, and considers how successful the telecommunications industry has been in persuading disabled people to look upon it as a source of help and support rather than as a source of obstructions and impediments.

Who are the Disabled?

Statistical data about disability issues is quite scarce, and often needs using with care: partly this reflects the low priority which society gives to disability issues, but also the difficulties of adopting precise definitions of each form of disability. The National Disability Council has estimated that in the UK population of 58·4 million:

- 6·5 million are disabled—over 10% of the population;
- 250 000 have a profound hearing loss;
- 1·1 million are eligible to be registered as blind or partially sighted;
- 250 000 have both visual and hearing impairment; and
- 1 million people have learning difficulties.

A separate study via the UK Labour Force survey gives a more detailed analysis, shown in Table 1, of the subset of these people who are actively seeking work.

Table 1 UK Labour Force Survey of Disability

Form of Disability	UK people of working age actively seeking work
Difficulty in seeing	56 000
Arms, legs, hands etc	683 000
Difficulty in hearing	60 000
Skin conditions, allergies	72 000
Chest, breathing problems	261 000
Heart, blood pressure, circulation	121 000
Stomach, liver, kidney, digestion	42 000
Diabetes	64 000
Epilepsy	45 000
Learning difficulties	33 000
Mental health problems	58 000
Other problems	87 000
All forms of long-term health problems or disabilities	1 582 000

This article is based on the paper presented by the author at the 36th European Telecommunications (FITCE) Congress, 21–25 Sept. 1997, Thessaloniki, Greece.

Two basic messages emerge:

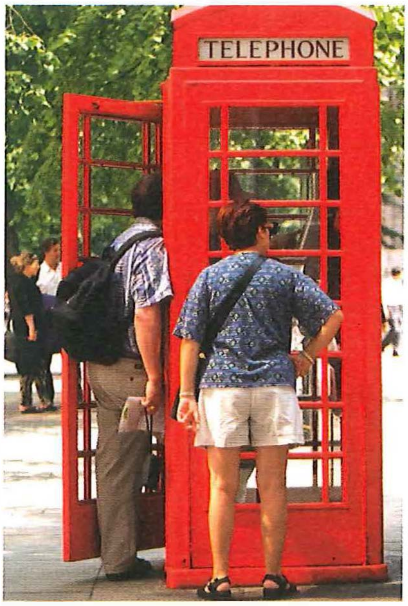
- Firstly the sheer scale of the problem: the number of disabled people in the UK is substantially greater than the entire population of Scotland, and only slightly smaller than the combined population of Scotland and Wales. Whether we look upon disabled people as a disadvantaged group that the telecommunications industry should be seeking to help, or as a market opportunity for our industry, the numbers of people involved are huge. And as the population ages, the proportion with disabilities will increase.

- Secondly the wide diversity of forms of disability, and thence the very wide range of potential solutions we need to consider. Within most of these groups there are many sub-groups, each with their own distinctive needs.

Solutions with Today's Technology

This section looks at ways in which current telecommunications technologies and practices impact on the lives of some of the major disability groups.

Figure 1—Scott kiosk



People with mobility/dexterity problems

In general these people have a positive image of the telecommunications industry: they can use the telephone to do things which they would otherwise have had to make difficult journeys to achieve. The ever increasing availability of reference data on the World Wide Web, and the growth of teleworking, are both broadly positive developments for this group.

On the debit side, this group continues to be disadvantaged by the inaccessibility of many public payphones. Figure 1 shows the classic Scott design of kiosk which BT inherited from the GPO: much loved by many people, including film producers around the world! And indeed it was a landmark piece of industrial design. But from a disability perspective it is a real horror story. It is not very easy to see where you are supposed to go in, you have a small, high, and quite awkward hand grip with which to open a heavy door, the door doesn't open wide enough for most wheelchairs, and even if it did there is a step in the way to stop them! Figure 2 shows BT's current design, which overcomes many of these problems. Unfortunately pressure from the public and from conservation groups has forced BT to retain far more Scott kiosks than it would like.

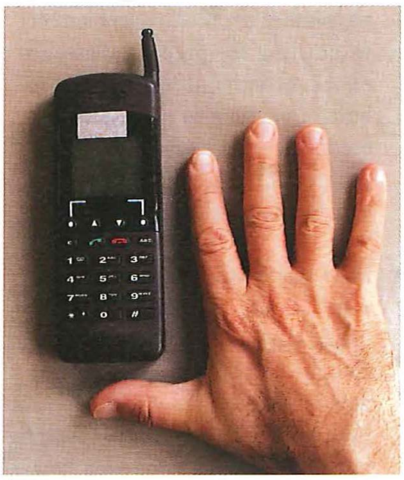
Figure 2—Current kiosk

While the increasing availability of mobile phones goes some way to alleviate this problem—albeit at the cost of dramatically increased call charges—mobile phones illustrate another way in which the telecommunications industry is not living up to the expectations of this group; that is, the considerable physical dexterity which is needed to operate a lot of modern telecommunications equipment. Pictures of the type shown in Figure 3 are often used to show how successful designers have been in miniaturising equipment, but it is instructive to consider what the spacing of these keypads mean for people with muscular disorders, or coordination difficulties, or arthritis. More generally, the ergonomics of a lot of telecommunications equipment is unhelpful as seen by people who have limited physical dexterity, or are limited in the range of angles from which they can view and approach equipment. The fact that these people choose to buy what are often rather ugly looking telephones with specially enlarged buttons shows how unsatisfactory they find our standard equipment.

People with visual problems

Many people with visual problems are forced to live in a predominantly auditory or tactile world, so the

Figure 3—Are small keypads always a good thing?



telecommunications industry's historical emphasis on transmitting speech means that it is generally looked upon as being helpful to the blind. The growth of e-mail systems is also potentially of benefit to this group, provided that the e-mail system offers a smooth interface to either a Braille reader or a text-to-speech synthesiser. However, there are many areas where the detailed equipment designs are unhelpful:

- Although the cost of putting a tactile symbol on the centre button of telephone keypads to act as a locator guide for blind users is utterly trivial, by no means all telephones on sale in the UK have this facility. (Audible 'beeps' to acknowledge key depressions are also invaluable for the blind.)
- Although human-factors engineers have identified that certain fonts are more easily read by people with poor vision, the fonts used to label telecommunicaiotns equipment often seem to be chosen with more concern for their aesthetic effects.
- Not only are visually handicapped people usually unable to read the display on a payphone to see how much credit is left on their phonecard, most phonecards don't incorporate a Braille symbol to indicate which way up they should be inserted in the first place!
- While the use of credit cards in payphones avoids the problem of exhausting the prepaid allowance on a conventional phonecard, the bulk of payphones require the credit card to be inserted in a different orientation to that used on cash dispensers.
- Most pager systems rely on the user's ability to read a compact visual display, and operate complicated button sequences to achieve the desired result. (Motorola is developing a speaking pager; it remains to be seen how successful and economic this will be.)

It should also be noted that while the ubiquitous availability of fax machines is a boon from the perspective of the deaf, they are not always perceived very sympathetically by the blind. When operated in the send direction most fax machines use visual displays to monitor progress of the outgoing call, along with poorly labelled keys. In the receive direction the quality of the printed output often defeats standard scanning software, and hence the option of feeding it into Braille or text-to-speech synthesisers.

People with hearing problems

The dominant role of telecommunications networks remains that of transmitting speech, so the disabled group on which it makes the most obvious impact are those with hearing problems. Hence it is useful to look more closely at the available statistical data, shown in Table 2.

The figures in Table 2 relate to the performance of the better ear, averaged at 0·5, 1·0, 2·0 and 4·0 kHz, for adults in the United Kingdom. Again, the absolute numbers are awesome: roughly 3 million customers in the UK have a hearing loss equal to or greater than 45 dB—excluding children. Another way of looking at these figures is to note that in the UK the maximum amount of gain permitted on amplifying handsets is limited to 24 dB; this reflects concerns over possible acoustic shock effects for people with normal hearing. So something like 16% of the population need to use an amplifying handset at full gain just to achieve a normal level of sound response! How are we treating this huge customer group?

Starting with non-specialised solutions, the move to all-digital networks has yielded a steady improvement in both the average transmission quality of telephone networks and its consistency, which is a boon to these customers. It is also good news that the bulk of public payphones are equipped with inductive coupling handsets, though sadly only a minority of commercially supplied domestic handsets have this facility, despite the trivial cost of providing this facility in a volume production environment. Conversely the widespread use of answering machines (often of abysmal sound quality), of voice guidance systems, and of telesales methods are all unhelpful for this group.

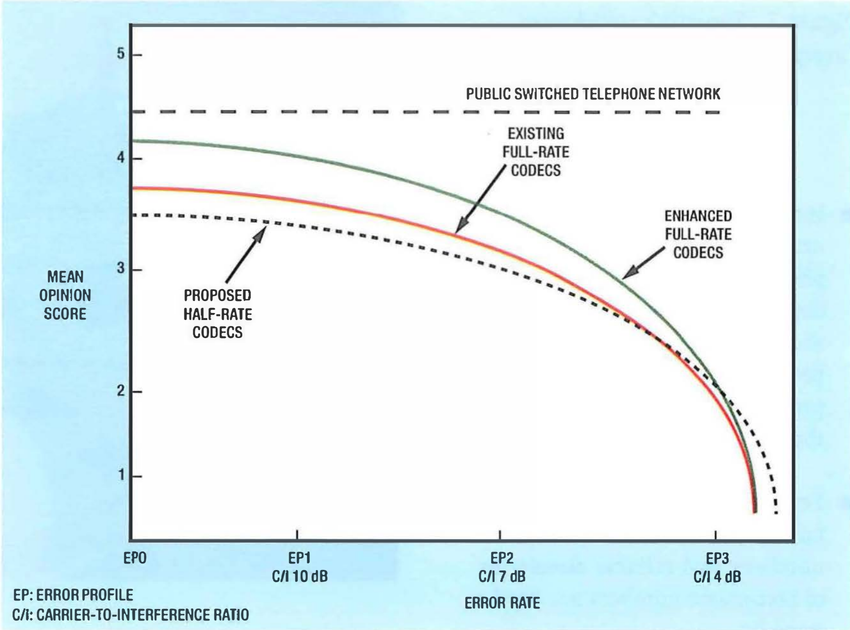
The introduction of mobile phones, especially those using the global system for mobile communications (GSM) standard, has also created major problems for hearing impaired users. Firstly, the use of GSM mobiles can cause serious interference to adjacent hearing aid users. Having spent some years denying that there was any interference, some parts of the telecommunications industry now seem to be arguing that it is all the fault of hearing-aid users for having aids which are susceptible to interference! It is to be hoped that a practical cooperative solution can be found: to date this story is close to being a text book example of how not to manage electromagnetic compatibility (EMC) issues. Secondly, the speech quality of the current generation of GSM handsets is often criticised by people with normal hearing, and is unusable for most hearing impaired users. It should be remembered that most people with hearing problems loose their natural ability to distinguish

Table 2 Hearing Statistics

Hearing threshold	$\geq$ 25dB	$\geq$ 35dB	$\geq$ 45dB	$\geq$ 65dB	$\geq$ 95dB
Percentage incidence	16·1%	8·2%	3·9%	1·1%	0·2%
Absolute numbers ('000s)	8579·7	5140·1	2939·9	898·4	150·3

Source: Hearing in Adults, A. C. Davis, Whurr Publishers, 1995.

Figure 4—GSM speech quality—effect of different codec designs



signal from noise, so injecting quite low levels of noise or distortion into speech renders it unintelligible to the hard of hearing. With an ever increasing proportion of calls across the BT network either originating or terminating on a mobile unit, the performance of current GSM handsets is creating a very unsatisfactory situation for the hearing impaired. Figure 4 compares customer perception of GSM sound quality with that of calls via ordinary public switched telephone network (PSTN) sets, as a function of the error rate of the radio link. The red line shows the performance of the full-rate codecs currently in use, comparing this with the upper dashed line shows the gap between current GSM performance and that of a conventional fixed link. The green line shows the performance of the enhanced full-rate codecs which are now coming onto the market. From the point of view of the disabled, it is desirable that these improved codecs become standard issue very quickly indeed. Unfortunately the dashed line at the bottom shows the performance of the so called half-rate codecs which one or two European operators propose introducing—not good news for anyone with hearing problems!

It may be worth noting that the unsatisfactory sound quality of many GSM sets is not solely a consequence of the compromises inherent in the use of relatively low bit rate codecs; the basic acoustic design of many of these handsets is also deeply unsatisfactory. Over the years human-factors engineers have built up a set of well understood standards on aspects of handset design such as the separation of receiver and transmitter, optimal angles for the mouthpiece, and provision of screening to protect the transmitter from background noise. Unfortunately the market for GSM handsets is now becoming distinctly fashion conscious, and designers are perhaps being forced to pay increasing attention to the showroom appeal of the handset—often at the expense of moving away from the approved human factors standards.

To end this section on a brighter note, there are two linked modern developments which have greatly increased the accessibility of the telephone network to the deaf: text-phones and text-relay services.

Text-phones use low bit rate data modem techniques to connect together matching pairs of keyboards and visual displays over the PSTN, thus allowing deaf people to exchange text messages. As originally developed in the US these systems used Baudot coding, but within Europe a V.21 interface is now more or less standard. These systems, a typical modern example of which is shown in Figure 5 and 6, have undoubtedly been a great success in giving hearing impaired users more control over their own lives, but suffer from a number of limitations:

- It is a slow method of communicating: a text-phone call usually takes roughly six times as long as an equivalent voice call.

Figure 6—Minicom folded for transport

Figure 5—Minicom opened for use

Figure 7 – Typetalk's switchroom, Liverpool

- It is inherently a closed user group arrangement, the value of a text-phone to any given user is very dependent on how successful he/she can be in persuading other people and organisations to provide a text-phone – and to train their staff to use it.

- Few firms provide adequate publicity for their text-phone numbers, and reliable directories of text-phone numbers are hard to come by.

Perhaps as a result of these limitations the numbers of text-phones in use is not as great as it might be: the UK text-phone population is a few tens of thousands, which only scratches the surface of the potential market.

Text-relay services introduce a human operator into the link, to allow text-phone users to communicate with people using normal PSTN connections. The relatively large number of text-phones in use in the UK is closely allied to the impressive growth over the last decade of the Typetalk text relay service. Typetalk is operated from buildings in Liverpool by the Royal National Institute for the Deaf, but funded by BT. Figure 7 shows a general view of the switchroom at Liverpool. The operating statistics for Typetalk show both its importance to the hard-of-hearing community and the need to have a secure funding arrangement: at February 1997 Typetalk employed 386 operators (some part time) who staff over 70 operator positions in busy periods, and handle over 40 000 calls a week from roughly 20 000 registered users. Typetalk now also provides deaf people with text-phone access to the emergency services.

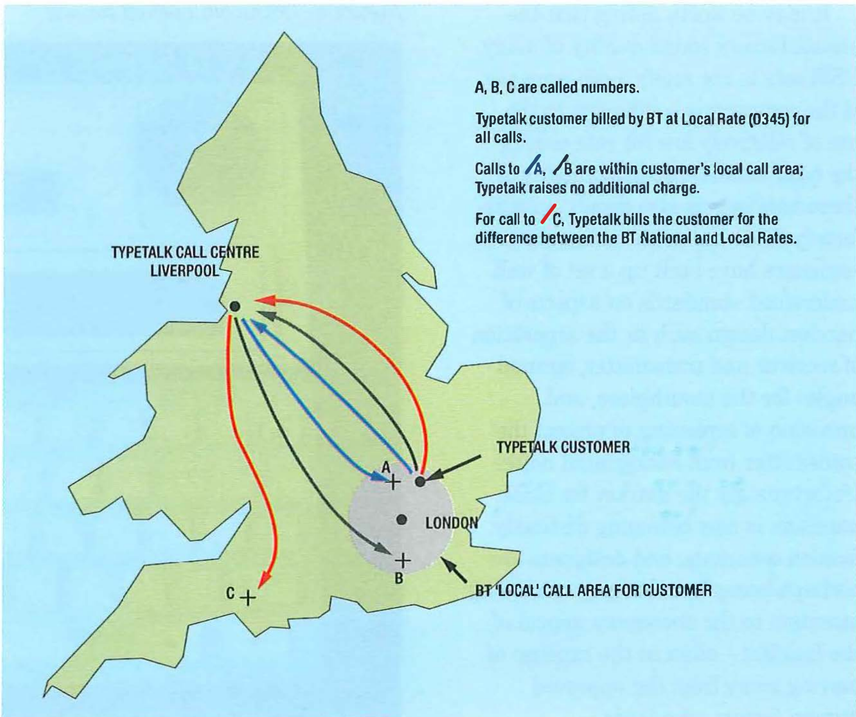
In addition to the direct costs of developing and running the Typetalk centre at Liverpool there are additional costs involved in the circuitous routing of calls via the Typetalk centre, and the need to develop and maintain special billing software to implement Typetalk's 'fair charging' policy. This is illustrated in Figure 8, the principle being that the customer should be billed as if the call had been route directly from his/her line to the person he/she wishes to speak to.

Initially the funding was drawn from BT's charitable donations budget, but the success of the service led to BT's licence being amended by the UK regulator to oblige BT to fund Typetalk, effectively as an extension of its universal service obligation. Although it may be seen as unfair that BT is required to meet all the costs of running Typetalk, without any contribution from any of the other licensed operators, it is impossible to underestimate the impact which it has had on the daily lives of thousands of people. This is well illustrated in a quotation from a lady, deaf since birth, who has recently discovered the Typetalk service:

'I have found the service invaluable. The telephone was the biggest source of discrimination, but now a whole new world has opened up for me.'

'Typetalk has given me the independence and confidence to do my own work. Gone are the days when I had to ask, beg, plead with someone to make calls for me ... and then had to wait until they fitted them into their own busy schedules.'

Figure 8 – Typetalk call routing and charging



People with speech problems

One group of disabled users whose needs are often overlooked are those who have difficulty in speaking. In fact a significant percentage of Typetalk's UK customers are people in this category, who are using a text-phone to send messages to the operator for her/him to speak on their behalf to the distant user. Another response to this problem has been the development of devices such as the BT Claudius system, shown in Figure 9, which allow users to store a limited repertoire of pre-recorded phrases, which can then be played back over the telephone line. The increasing availability of laptop computers with large memories, and of improved text-to-speech synthesisers such as the BT Laureate system, should provide a means of significantly enhancing these systems in the near future.

Figure 9 – Claudius unit

Solutions with Tomorrow's Technology?

How do we ensure that emerging technologies are used to help the disabled rather than hinder them? Here are a few pointers:

Calling line identification (CLI) systems are a useful illustration of an easily overlooked point, namely the way in which the disabled can—with a little lateral thinking—often derive a lot of benefit from systems which were not initially designed with their needs in mind. For example, it is most unlikely that the designers of CLI gave much thought to its use as an aid for the disabled. In practice this service, marketed by BT as Caller Display, and giving customers a visual display of who tried to call them and when, is quite an effective answering machine for the hard of hearing! See Figure 10.

Teleworking has the potential to be quite liberating for some of the disabled, especially those who have mobility difficulties and find travelling to work difficult, if it is implemented in a sensitive way. The downside is that the teleworking culture takes it for granted that everyone can use any telephone with ease, and can freely participate in audio and video conferences. It also tends to deprive the disabled of the company and support of a group of collocated colleagues, who often willingly do the many little things which make life so much easier for the disabled. Increased isolation of the disabled is a serious risk for these schemes.

Videophones have the potential to support remote use of sign-language and lip-reading, and thence enable these disability groups to have a new form of access to each other. Unfortunately the essence of sign-language and lip-reading is accurate tracking of relatively small three-dimensional movements, whereas many of the commercially oriented video compression systems tend to sacrifice tracking of movement to achieve improved resolution of a predominantly static picture. Although trials of existing

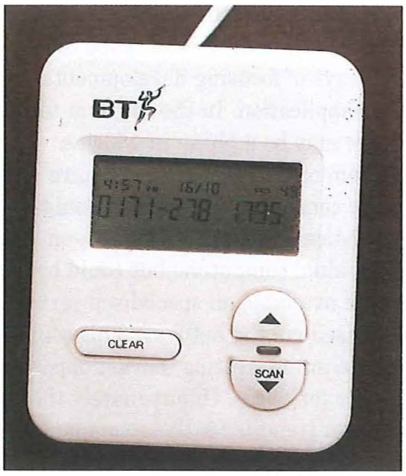


Figure 10 – Caller Display unit

videophones by British Sign Language users have been quite successful, we need to encourage the development of systems with better response to moving images.

Speech-recognition technology should ultimately take the deaf into the promised land, of having a machine akin to a laptop computer which takes in speech on one side (from a microphone or telephone line) and displays it as text on the other side. Unfortunately this represents a spectacularly challenging task for speech-recognition technology, as can be seen from Table 3, which compares its requirements with those of the voice-dictation systems which have recently come on to the market.

Table 3 Why is Speech Recognition for the Deaf so Difficult?

Characteristic	Voice Dictation Systems for Use on Home PCs	Speech Recognition Systems for the Deaf
Quality of sound received	Direct from a local microphone.	Compromised by the band-width and quantisation distortion limitations of the telephone network.
Speed of operation	Slow dictation speed, with accentuated pauses between words	Full conversation speed, variable quality diction.
Voices and accents to be recognised	Just one, often supported by extensive "training" of the algorithms.	Any incoming caller is to be recognised immediately.
Vocabulary to be recognised	The limited set of words one person uses in a business environment.	The rich vocabulary used by many people in every day speech.
Accuracy required	High	Medium

Despite the difficulties, it is very much in the interests of telcos to look for ways of focusing developments on this application. In the medium term there may be a phase in which a system of this type would require more computing power than could realistically be made available on individual computers, but could be made available on specialised servers accessed via the network. This could create an interesting market opportunity for telcos. Unfortunately the current trend is for those companies with know-how in this area to see it as part of their competitive advantage, rather than something to be pooled for the common good. If the companies concerned could harness their joint research and development capability to give their hearing-impaired customers a viable real-time speech-to-text converter this would be a wonderful way of opening the new millennium.

Internet access provides predominantly visual access to remote data, so it is a boon to the mobility impaired and the deaf. It also holds out the exciting prospect of the blind being able to download newspapers etc over the Internet and 'read' them through text-to-speech converters, or Braille transcribers. Unfortunately this will only happen if we can develop Web browsers which are genuinely usable by the blind, otherwise the Internet will be regarded as a distinctly threatening development by the blind. Microsoft have recently said that their packages will always allow the blind to do with a keyboard those things which other people can do with a mouse—an equivalent telco vision is needed.

Video-on-demand and other multimedia products have an enormous potential to provide a range of alternative access routes to information for the disabled—a subtitle channel for the deaf on videos, an audio description channel for the blind, etc. Do we have the political will to ensure that this potential is translated into reality?

Systems for the remote monitoring of the elderly and infirm could meet a huge and growing social need by allowing these people to continue living safely in their own homes rather than having to move into a nursing home or hospital environment. Potentially it offers telcos major new revenue streams.

Regulatory and Commercial Aspects

It has been argued in some countries that disabled people and their families represent a major market segment, so normal market forces should provide the special services and equipment they require. Although some useful developments have been triggered on a profit-making basis, they are in most cases the exceptions which prove the general rule that market forces will not meet the needs of the disabled. There are three key reasons:

- Although at first glance disabled people represent a major market opportunity, when looked at more closely it disintegrates into a huge number of small, specialised, but geographically dispersed sub-markets.
- Statistically the dominant characteristics of disabled people are that they are either elderly and/or unemployed, hence their disposable incomes are often very low, and consequently they form a very cost-conscious market.
- Many of the support services which the disabled need—adapted equipment, text-relay services, Braille bills etc—are much more expensive for the telco to provide than their normal equivalents, so charging for them at cost would negate the concept of equality of access to basic services which is now generally accepted as the starting point for a civilised society's approach to these issues.

Hence firm regulatory action is needed to ensure that the disabled have effective access to a realistic range of telecommunications services. A few of the threads which should be addressed in future legislation on universal service obligations are:

- wheelchair accessible payphones;
- basic customer premises equipment suitable for use by the blind and dexterity impaired;
- inductive couplers on all telephones, and 'pilot' pips for the blind on all keypads;
- text relay services for the deaf and speech impaired;
- reduced call rates for text-phone users to allow for the greater length of their calls;
- reduced Internet access rates for the blind, to allow for the greater length of their calls;
- free access to Directory Enquiries for disabled users, especially the blind; and
- provision of effective national text-phone directories.

Conclusions

So to return to the opening theme, has telecommunications proved to be a friend or a foe for the disabled?

On the credit side our industry can rightly point to many positive moves over the last few years: the provision of some modified telephones and payphones for people with physical disabilities, the relatively widespread availability of inductive couplers and amplifying handsets, the launch of world-class text-relay services for the deaf, the recent emergence of viable text-to-speech systems, and various Web-based services for the disabled. Although the present regulatory treatment of the needs of the disabled is rather patchy, to have the issue on the agenda for debates on the universal service obligation is a step forwards.

Unfortunately, the extent to which these disabled-friendly services and devices have achieved volume roll-out rarely matches the scale of the underlying problem. Equally importantly, telecommunications-based solutions continue to spread into every facet of our daily lives. As Western jobs and life styles become more and more reliant on easy access to ubiquitous telecommunications services, those people who are denied equal access to these services find themselves at risk of being ever more cut off from mainstream society. The enactment of the Americans with Disabilities Act, the US Hearing Aid Compatibility Act, and the US 1996 Telecommunications Act recognises these factors, and sets benchmarks for the way telcos should treat disabled customers which few European countries can yet match.

So the challenge for the next decade must be to use some of our increasing wealth and technology to greatly accelerate the levels of provision our industry makes for all forms of disability. In terms of specific technologies, the key opportunities are probably:

- to make mobile telecommunications technology more accessible to all disability groups;
- to ensure that teleworking and telesales technologies are exploited in ways which do not further disadvantage the disabled;
- to press forward with the development and deployment of Web browsers and kindred Internet products which are truly usable by the blind;
- to ensure that videophone systems are available which are tailored to the needs of the sign-language community; and
- to develop viable speech-to-text conversion systems for the deaf.

It is unlikely that many—if any—of these developments will happen simply as a result of market forces. A proactive approach is needed, both at a regulatory level and through collaborative work between telcos and other players in the informatics industry. Perhaps above all we need to get awareness of disability issues into the bloodstream of our profession, so that people developing new products and services instinctively ask themselves the question 'how will people with various forms of diability use this service?'

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Acknowledgements

This article has been written in a personal capacity, and does not represent an official statement of the policies of British Telecommunications plc. I am grateful for suggestions made by several of my colleagues—disabled or otherwise.

Biography

Paul Tomlinson
BT Networks and Systems

Paul Tomlinson joined the then GPO in 1969 having studied physics at Bristol University and taken a Master's degree in Operational Research at Lancaster. After a couple of years working on the development of some of the early stored program control switching systems, he spent most of the 1970s in teletraffic engineering, including leadership of the System X teletraffic work area. This was followed by several years in procurement, leading the technical costing team on System X, and subsequent involvement in the introduction of AXE10 and 5ESS into the UK network. A move to corporate strategy work in 1987 led to a series of posts in the 1990s working on the strategy and business planning functions within the UK network engineering headquarters units. He is a Chartered Engineer and an IEE Fellow.

Michael Luck

Mission Accomplished

BT technology has expanded opportunities for enhanced learning in ways we could never have imagined and video conferencing is one of the benefits now available from this technology. A recent video conference between Wales and America shows how BT's advanced technology can make a real difference to teaching and learning.

Introduction

'20 July 1969. Man lands on the moon.' Neil Armstrong, Buzz Aldrin and Michael Collins become household names.

Many people, as indeed did the author, will remember watching this fantastic spectacle on a black-and-white television set at their local primary schools. At that time, it must perhaps have been difficult for teachers to find up-to-date information on such an event in order to carry out further classroom activities. Media coverage would have been one source of information and a trip to the local library may have uncovered some outdated material. How things have changed!

Today's technology enables people to collect relevant and up-to-date information immediately, through services like the Internet and video conferencing using the integrated services digital network (ISDN).

Educational Links

While developing programmes to guide teachers and pupils on the use of the Internet, BT in Wales forged links with the Education Division at the National Aeronautic and Space Administration (NASA) Headquarters in Washington DC with a view to explore how video conferencing could be used to facilitate educational collaborations. Teachers from primary schools in Wales have been able to benefit in various ways from these links.

Working in collaboration with NASA, it has been possible to obtain access to a mass of information from its extensive resource libraries and, using BT's ISDN and video conferencing, future trends in space exploration have been discussed. It has also been possible to become involved in NASA's distance-learning projects.

Contact with NASA

The first contact with NASA HQ was made in 1996. At the time several Welsh primary schools were trying out video conferencing and it was agreed that it would be valuable to setup a conference between NASA and the Welsh teachers. Some 20 teachers attended this first conference to technical staff at NASA's HQ using BT's ISDN and video-conferencing equipment. The pilot link up was voted a success by everyone involved and resulted in the planning of future video-conferencing programmes, this time involving teachers with similar interests based in the United States (US).

As, each year, NASA runs an educational workshop for primary school teachers it was felt that this could usefully be extended to include 25 teachers in Wales for the next video conference.

The BT-NASA Video Conference, 1997

On 24 July 1997, BT and NASA held the next, more ambitious, video conference. The following is a brief account of the conference and the subsequent distance-learning project that was developed for the primary school teachers in Wales and the US.

The teachers in the US were taking part in NEWEST (NASA Educational Workshop for Elementary School Teacher's), the NASA-sponsored workshop, and the Welsh teachers were invited by BT and the Education Business Partnership Ltd. to work in collaboration with the US teachers on Internet-based projects.

The Welsh teachers were sited at three locations: Carmarthen, Merthyr Tydfil and Llangefni. They were

The Year of Engineering Success

Welsh participants at the BT-NASA video conference

controlled from Carmarthen, while the American teachers were at the Johnson Space Centre (JSC) in Houston. This video conference made exciting use of available technology and covered six time zones! It was the start of a distance-learning project, designed to link teachers and their students through the use of the Internet. Each teacher was assigned an international partner and could participate in three different projects, the most involved being *Mars Base International*.

The conference opened with welcomes from Deborah Gallaway, Education Program Manager, Fred Berger, ViTS facilitator at NASA HQ, Wendell Mohling from the Stennis Space Centre, and myself and a brief project description from Norma Rhoads and Jim Christensen from the NEWEST programme. There followed an opportunity for the teachers involved in the project to introduce themselves. Three engineers from JSC then made a presentation about Mars to the teachers at the four locations. Then the Welsh teachers had the opportunity to ask questions of the engineers, while the American teachers raised their questions after the conclusion of the video conference.

During the next school year, the teachers and their pupils from both sides of the Atlantic will work together on their chosen projects. All the primary schools have access to the Internet and they will gather information from Internet Web pages created specifically for these projects. They will produce short video tapes of their work and mail them to their partner school.

Mars Base International

Teachers choosing this project help their students to design and build a Mars Base. The students will be required to research relevant information provided by NASA and find other important facts by accessing the Mars Base Web site on the Internet. This site has been specifically designed for this project. The students will be encouraged to e-mail their partner school and discuss and ask questions about design, the Mars environment etc. At the end of the project, each school will videotape a short presentation of their work and mail it to their partners.

Video-Teleconferencing Network

When connecting to the ViTS network, one is opening up a gateway to an enormous teleconferencing system. The ViTS network is spread across the USA. Without this advanced network already in place, the BT-NASA video conference would not have been possible.

The conference ran smoothly and to time, enabling the full agenda to be completed. This, however, was not by chance. It was thanks to the expertise of the technical staff of the ViTS network and the forward planning of the education division that guaranteed a successful event.

The BT-NASA conference used a multi-point connection and utilised NASA's international switched off-network configuration. The following gives detailed information about how this was achieved and also a description of the physical layout and technical specifications of the system.

NASA's Video Teleconferencing System

At its inception, NASA's ViTS was designed as a cost-effective and flexible communications tool, enabling teams of people to work face-to-face with one another while in different locations. Using a time-division multiple access (TDMA) satellite system, ViTS provides NASA with agency-wide video teleconferencing capabilities using interactive audio, full-motion video, and static-image graphics. The first phase of ViTS established 16 full-service rooms at 15 NASA sites (Figure 1) and the video teleconferencing control centre (VTCC).

New requirements from ViTS users for enhanced viewing capabilities and a need to transport services from the satellite network have resulted in the all-terrestrial ViTS (ATV) with a fast selection (FS) network.

At five NASA centres, ViTS Tellabs digital cross-connect (DXC) switches form network hubs. These route ViTS room connections and trunk circuits terrestrially. The requirements of FS are met by micro-directory and access control system (μDACS) switches at each hub site in conjunction with the Tellabs DXC. With ATV/FS, all ViTS rooms in a conference configuration are routed to one of the hub locations and connected to a common μDACS for FS switching.

With FS, selection of the primary and viewer sites in a ViTS conference is controlled at the ViTS room—either by the room operator or by a conference participant. Using the FS controller or the wireless remote, any room in the conference can switch 'who they see' in three seconds or less. As the central control point of the ViTS network, the VTCC has the capability to override FS commands from any ViTS room.

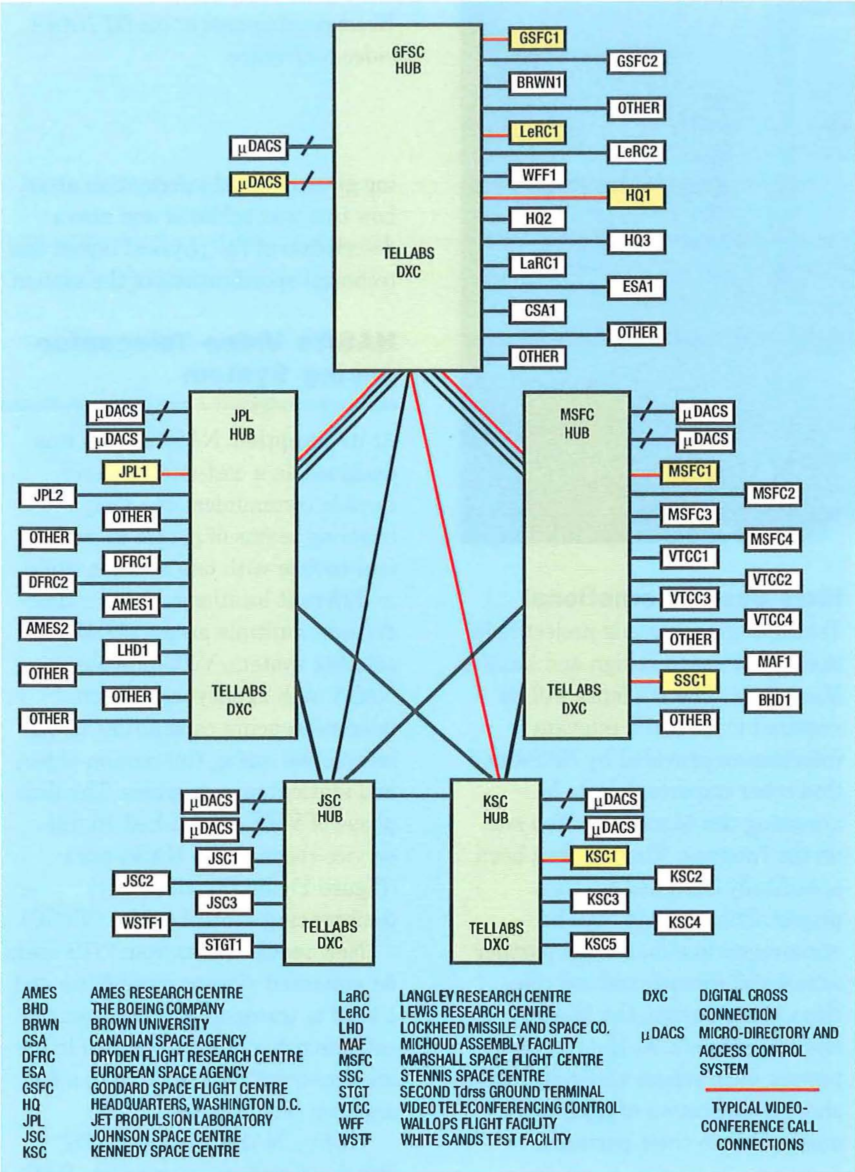


Figure 1 – The NASA video-conferencing network showing a typical conference in progress

Modes of Video Teleconferencing

The design of the network allows two modes of video teleconferencing: point-to-point and multi-point with FS switching.

Point-to-point video teleconferences

A point-to-point video teleconference establishes an all-terrestrial link between two sites, and codecs convert the video and audio signals into digital format. The digitised video data is compressed to fit within the transmission bandwidth. The digitised audio data is multiplexed into the same bandwidth.

The connection is established prior to the scheduled time and dropped at a specified time. For point-to-point video teleconferences, the VTCC involvement is limited to set-up. The VTCC cannot monitor video or room audio during such a video teleconference.

Multi-point video teleconferences

A multi-point video teleconference involves three or more rooms and, as in the point-to-point conference, codecs are used to convert the analogue video into digital format. This digital video data is compressed, transmitted, and received within the terrestrial transmission bandwidth. The audio is transmitted terrestrially through a four-wire audio connection to the voice conferencing bridging system and all sites on the multi-point video teleconference have interactive audio.

The primary site for the multi-point video conference is seen by all the other sites and the site selected as the secondary location is seen by the primary. The VTCC is connected as a viewer site to monitor the video teleconference for quality.

Description of a Full-Service ViTS Room

The size of a ViTS room is dependent upon the space available and the site's requirements. Existing ViTS rooms range from 1400 to 2000 square feet. The seating capacities vary from eight to more than 50. ViTS rooms have tiered seating, specially selected colours and furnishings, and special video-teleconferencing lighting. The tiered seating arrangement allows the cameras to have a clear shot of everyone seated in the room and participants to have a clear view of the video-projection screens. Furnishings, colours, and lighting are chosen for comfort, visual clarity, and appeal.

The equipment room is separate from the video teleconferencing area. The heating, ventilating and air-conditioning units, communications support equipment, video recorders, and facsimile machines are located in the equipment room or in the foyers.

Equipment in a full-service ViTS room

Each full-service ViTS room has three video cameras, two video projection screens for main display, a status indicator panel, audio equipment, graphics presentation equipment, and control panels. Figure 2 illustrates a layout of a typical full-service ViTS room and identifies the location of key equipment.

One camera is mounted in the front of the room and is used for transmitting images of participants in the room. A second camera, at the back of the room, is to transmit images of presenters, the marker board, and wide shots of the room. A third camera, mounted in the ceiling, is directed at the graphics presentation area. It is used to transmit graphics and pictures of three-dimensional objects placed on the graphics table.

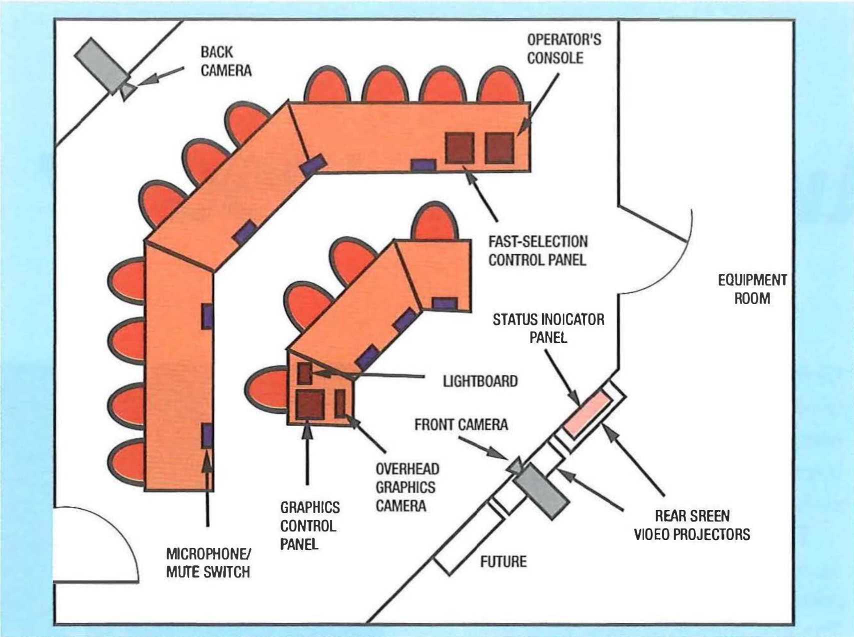


Figure 2—A typical ViTS room layout

At the front of the room is a status indicator panel and two 67-inch video projection screens also referred to as *main screen displays*. These displays allow viewing of the other site(s) and graphics during video teleconferences. The status indicator panel indicates when video teleconferences are in session so that users are made aware of the configuration and status of the room.

Switched Off-Network Connection

The switched off-network connection (Figure 3) can be used for an international connection. The data signals sent from the public network to the international site are transmitted on an as-needed basis. Throughout the reserved video teleconference, the public network arranges for the lease of an international terrestrial or satellite circuit.

NASA's Education Division

NASA's education division promotes excellence in America's education systems by providing access to NASA's exciting missions. It also endeavours to enhance the advancement of human knowledge and hopes that the inspiration and intellectual excitement inherent in the Aeronautics and Space Programme will enrich the study of social sciences, life sciences, physical sciences, mathematics and technology at all levels of education. NASA is committed to promoting excellence in education supporting the teaching profession, and increasing awareness of the impact science, mathematics and technology will have on the quality of life in the 21st century.

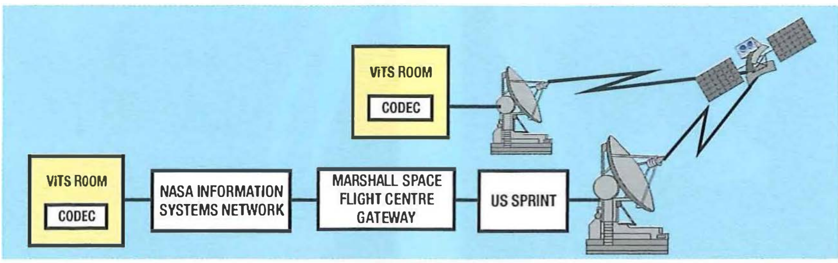
Teachers in the UK now have a unique opportunity to utilise NASA's educational programmes. We can provide links and contacts for pairing teachers across the Atlantic to share work and experiences while studying the Aeronautics and Space Programme.

Conclusion

This project has been most interesting and rewarding and the success has led to another similar project being planned. This type of work provides another route for BT to become fully involved with educational activities and thus help in the educational development of future generations. Teachers and pupils will use this opportunity to enhance their work in many areas of the National Curriculum such as English, IT, mathematics physics and history.

Working together can produce great results. This conference shows BT, NASA and the Education Business Partnership Ltd. working for a common goal....better trained teachers and better educated students.

Figure 3—NASA switched off-network connection



Biography

Michael Luck
BT Networks and Systems

Michael Luck's career with BT began in 1974. In the past five years he has become increasingly involved with education services and, by using innovative and creative methods, provided an accessible route for educators to learn and teach key scientific and technical skills that are appropriate to the National Curriculum. While working with the Education Business Partnership Ltd. and the Careers Business Companies in West Wales, he has provided the necessary expertise for work and teacher placement programmes. Recently, he has been promoting and developing specific programmes for the Year of Engineering Success campaign. Currently he is working on the first BT Education Visitor Centre, which will serve the needs of the education community of South, Mid and West Wales.

Journal Awards for 1996/97

The *British Telecommunications Engineering* journal is an important record by which the membership of the Institution of British Telecommunications Engineers (IBTE) and others can keep abreast of items of interest in telecommunications.

To encourage readers in furthering the role of the *Journal*, and to give authors due recognition for outstanding contributions, the Board of Editors operates an annual award scheme. Prizes are awarded to the authors of articles which, in the opinion of the Board, demonstrate excellence in content and presentation and which enhance the quality and range of contributions published.

For 1996/97, Volume 15 of the *Journal*, the Board awarded prizes for best *Journal* article, and two runners-up, and for best *Structured Information Programme* unit, and one runner-up. The prizes were presented by IBTE President Chris Earnshaw, Managing Director of BT Networks and Systems, at the IBTE Awards Dinner held on 3 October 1997 at the Mall Galleries in London.

Awards for Journal Articles

The prize for the best article from Volume 15 of the *Journal* went to Alec Livingstone for his article 'BT Interactive TV' published in the October 1996 edition. Alec received a crystal bowl inscribed with the IBTE's insignia, cash prize and certificate.

The authors for the two runners-up articles received IBTE crystal goblets, cash prizes and certificates. The first runner-up prize went to James Callaghan and Phil Flavin for their article 'Intranets. Corporate Nirvana—The End of the Traditional Organisation?' published in the October 1996 edition. The second runner-up prize went to Mike Arnavutian for his article 'How "Smart" Can We Get? Technology and Business Opportunities for Smart Cards in the Age of Electronic Commerce' published in the January 1997 edition.

Structured Information Programme Awards

Ian Groves received the prize for the best unit from those published in issues 20–23 of the *Structured Information Programme* for his unit 'Cellular Radio Engineering', Chapter 9, Unit 8.

The runner-up prize for the SIP went to Graham Hillson, John Strong, John Bullen and John Beard

Alec Livingstone (left), winner of the Journal *best article award, pictured with IBTE President Chris Earnshaw*

for 'Cordless Customer-Premises Equipment', Chapter 11, Unit 5. (The authors were unable to attend the awards ceremony.)

Article Assessment

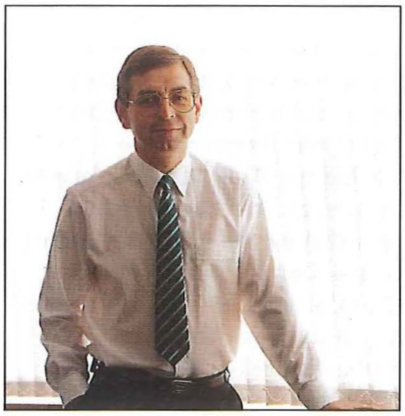
The Board of Editors is assisted in its decisions for selecting articles for article awards by a number of readers who completing article assessments for each edition of the *Journal*. Readers interested in participating in this activity are invited to contact the Managing Editor on 0171 356 8022 (e-mail: nicholsp@grsec2.agw.bt.co.uk).

James Callaghan and Phil Flavin won a Journal *runner-up prize (Phil was not present at the presentation)*

Discussing a point with Chris Earnshaw is Mike Arnavutian, winner of a Journal *runner-up prize*

Ian Groves, winner of the prize for the best unit from the Structured Information Programme

Peter Cochrane, Head of Advanced Applications and Technologies, at BT Laboratories, Martlesham Heath, continues his regular column in the* Journal *and considers new ways that our very essence can survive beyond our lifespan.



Do We Have to Die 100 per cent ?

Ever since our species could reason, we have had an overriding urge to learn and understand, and to pass on our knowledge from one generation to the next. For thousands of years this was feasible as all of our knowledge could easily be contained in one human brain. Father would teach son, mother would teach daughter and each generation would add a little more expertise, a little more knowledge. Only a few thousand years ago it became necessary to record our information on cave walls, stone, clay tablets, skins and parchment. We had reached a critical epoch—the point at which all human knowledge could not be contained by one brain. Specialism and co-operation was vital as no individual could do it all, compete and survive. This growing sophistication and competition promoted communication, distinct crafts, professions, barter and trade. The process was repeated at progressively shorter intervals as the bifurcation of skills and our increasing dependence on information, communication, technology and each other, took hold.

Today, our problem is acute. It is no longer possible to be an expert in anything other than a very new and virginal topic. For example, just 500 years ago it was possible to be an outstanding author, artist, engineer and scientist at the same time. Even 30 years ago it was possible to understand a telecommunications network in minute detail. Every aspect of transmission, switching, management, operations and billing could be understood by just one engineer. Today, it is just possible to know a little about a billing system—and not much else. The same is true of motor cars, domestic appliances, military systems, computers and the information world. Who understands all of it? No one! We have to rely on abstractions—a higher level picture. Fortunately we do not have to understand the physics and chemistry of a safety match to use one—but someone somewhere does.

Despite all of this specialisation and an exponential growth in knowledge, we still see the rise of experts and people of outstanding ability who are able to master more of a topic and contribute more than the average. Unfortunately, being mortal, they die and their expertise and insights are lost for all time. The question is, can we capture their expertise, their very presence and hold on it for future generations and posterity? Do they have to be 100 per cent dead?

Multimedia holds out an interesting prospect of being able to capture the words and wisdoms of any individual, or group of humans, with the aid of the spoken and printed word supported by still and animated pictures. Simulations, videos and still pictures can be combined with words and people to make a rich teaching and learning environment. Now suppose that as some great teacher gives lectures and interacts one-on-one with students, the very essence of this expertise could be captured in the following manner. As student asks a question, they could be recorded along with the response and any debate. Over a period of years it is feasible to capture over 95 per cent of all the questions ever likely to be asked along with a rich variety of responses tailored to meet the needs of individual and problematic students. How difficult then would it be to construct an artificial persona of this great mind? Might we sit and listen and watch a lecture long after the death and still be able to interact in a meaningful way by merely asking questions that are answered in a variety of ways.

It is interesting to reflect that this vision is partially available with today's crude CDs of a mere 630 MBytes storage capacity. We can already visit the Natural History Museum and receive an adequate description of Barionix or the derivation of the word dinosaur. Granted, the presentation and style are limited by the medium, but the first indication of what might be done is here. Our rudimentary artificial intelligent systems can already cope with the filtering and assembly of the right slices of dialogue, animation and pictographic representations on demand, just triggered by a well-phased question. What is required, is more intelligence to filter what we require from a rather ill-posed question or proposition, and perhaps an ill-posed set of reply options. If only the medium could respond to: 'Describc a dinosaur named Barionix', or 'Was Barionix a dinosaur, and if so, what was it like?' While it is easy for you and I to recognise what is required and assemble a suitable answer, for an artificial intelligence system this is currently a formidable task. But not for long; a further five years will see such a task solved with a modest amount of computer power.

Another feature required to make the medium readily accessible is a voice input and output system that is conversational. We can already voice command telephones and computer interfaces, but to voice access in a wholly human manner is still difficult. However, we can look forward to an adequate and workable solution within the next 5–10 years. So we have before us almost all of the technology and every prospect of being able to create a medium that gives access to human knowledge, expertise and skills that died long

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MESSAGE FROM MARTLESHAM

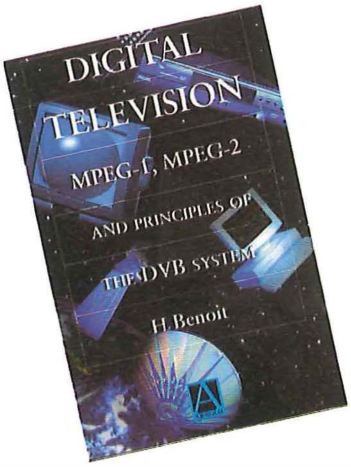
ago. We are thus approaching the Superman paradigm where his access to his entire history, mother and father, was possible with a single crystal in his Fortress of Solitude. Our crystal is currently the 630 Mbytes CD-ROM, and so may be the next generation with 6 Gbyte, but after that it could indeed be nearer a crystal. Only a decade from now a CD-ROM size device is likely to have a capacity of over 60 Gbytes. A further decade could well see a capacity of over 6 Tbytes, which is on a par with the human mind and in excess of Commander Data's brain on the Starship Enterprise.

In many respects, our ancestors yearned for immortality through their works of art, writings and understanding passed down the generations. Many of their names have been lost, many of their thoughts and ideas have disappeared, but their spirit lives on and is sustained as each generation effectively stands the shoulders of their predecessors. The CD-ROM is probably the first medium that we have produced that allows a much closer step toward immortality with the recording of our thoughts, gestures and in some respects, intelligence. As the next generations of storage media are developed, we will rapidly approach a time when our expertise, knowledge and persona can truly be captured for all time.

Just imagine the solution to Fermat's last problem, not scribbled on a piece of paper and lost for ever, but recorded for all time; alternatively, the many works and ideas of Newton that never saw the light of day. Perhaps, more powerfully we should contemplate the electronic merging of personalities, works and ideas with artificial intelligence systems able to access all of these works and coalesce the myriad of concepts and results that currently escape us due to our limited human ability and memory. Perhaps in future, none of us will die, but our very essence, an echo of our passing will live on. At 50 years old, and another decade or two to realise this world, I might just see you there.

book reviews

Digital Television—MPEG-1, MPEG-2 and Principles of the DVB System
by Hervé Beniot



Before I read this book, I partially understood JPEG (joint photographic experts group) and MPEG (motion pictures experts group) compression techniques and I wanted a book that I could use as a self-teaching aid for a more detailed description of video- and audio-compression techniques. This book met my need.

I have seen many papers relating to MPEG compression techniques and a few papers detailing the digitisation of analogue television signals, within a studio environment. There are also a few books relating to digital television but very few that describe set-top box functionality for the home, an area that will be of interest to virtually all households over the coming years. This book covers all these areas in plenty of detail.

The opening chapter covers the history of analogue television signals, detailing monochrome and colour formats and sets the scene for the rest of the book. Subsequent chapters discuss why things should change and why TV should go digital. Information about typical bandwidths for uncompressed and compressed video is given leading to detail on the compression techniques used for both video and audio signals.

Then the real detail starts showing how MPEG-1 and MPEG-2 are encoded, and the diagrams (for me) clarified an area of long-standing confusion. At times, the book is so detailed that, at times, I lost the plot and had to re-read the section to be able to continue.

Subsequently, terms like MP@ML, which appear in everyday digital video broadcasting (DVB) specifications, took on a new meaning as this book has described its meaning in relation to decoded picture quality.

The book then describes the organisation of MPEG multiplexing, leading to a description of the data stream that needs to be transported.

Scrambling and conditional access are covered next, topics new to many people but soon will affect all our lives. Error correction, random-ising and convolutional coding are all explained and even quadrature modulation is described (since techniques used in cable broadcasting have evolved from modem technology).

The penultimate section covers reception of digital signals showing typical set-top box designs for satellite, cable and terrestrial systems. This up-to-date information will soon be superceeded, although the underlying principles will remain.

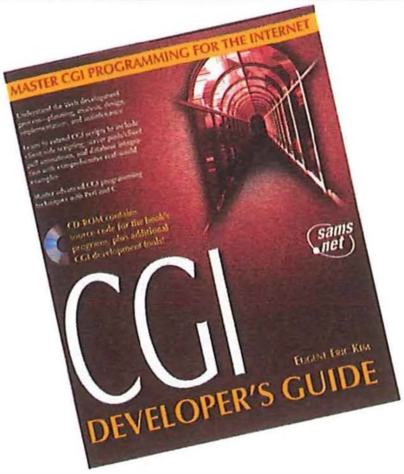
The final chapter looks to the future with the set-top box integrated into the television and a positioning statement for MPEG-4 is included for completeness.

I found this to be a readable, but highly-technical book, which will make interesting reading for technically-oriented people associated with radio and television broadcasting. It is well worth reading, even though it is heavy going at times.

Published by Arnold (a member of the Hodder Headline Group)
ISBN 0-340-69190-5
£19·99. viii + pp. 163.
Reviewed by Martyn Bottomley

book reviews

CGI Developer's Guide
by E. E. Kim



This practical book tells you how to create World Wide Web (WWW) pages that are interactive, such as forms, and pages that have dynamic content.

CGI stands for *common gateway interface*. Through the use of CGIs, users can, for example, fill in forms on the WWW that get e-mailed back to the author of the page, or they can access almost any other application via the WWW. The author is clearly a CGI expert with an in-depth knowledge and the book is for programmers. It has examples in the two most common CGI languages *Perl* and *C*. This book is self-contained with good tutorials and a CGI quick reference. It covers hypertext markup language (HTML) forms, CGI input, processing and output, hypertext transfer protocol (HTTP), image-maps, server-environment variables, server-side includes (SSI), server-push, tips, debugging, security, and cookies. All source code is included on CD-ROM.

This book is well structured and I found it easy to locate subjects. It is fairly up to date. However, this first edition misses out on several recent products that can for many applications remove the need for your own CGIs. These products include FrontPage 97 server extensions, and WWW database products such as Oracle Web Server 2.0. The author misses out the CGI.pm library and instead wrote all examples using the obsolete cgi-lib.pl.

Personally, I found the book a bit too long and wordy.

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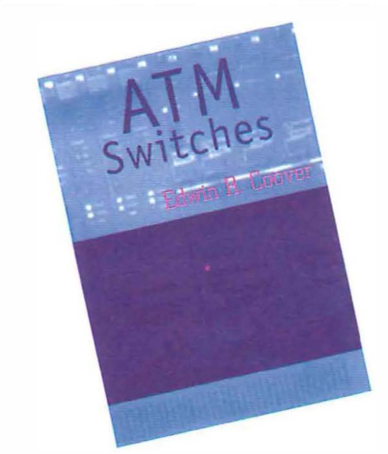
ISBN 1-57521-087-8
£41·50. xi + pp. 497.
Reviewed by Adrian Silvertown

ATM Switches
by Edwin R. Cooper



Having heard the term *ATM switch* (asynchronous transfer mode switch) on a number of occasions, I decided that it was time to find out what these switches are and how they work and so this book seemed a good starting point. It soon became apparent that this is a book aimed at the data specialist: 'most people reading this book are presumed to have a general knowledge of the ATM standards'.

The book is intended to survey the fruits of the first-generation ATM technology—the first commercial products using ATM technology, their network role and the purported capabilities—which is carried out in chapters 6–9.

The book is filled with abbreviations and acronyms which some people, not familiar with this area of telecommunications, may find a bit of a burden. Having said that, there is an 87 page acronym list at the end of the book to help those less familiar with the terms. There is also a 57 page bibliography which, with four chapters dedicated to products presently available, leaves 100 of the 336 pages dedicated to the nuts and bolts of ATM.

I particularly liked the way the author used analogies of everyday situations to explain techniques and concepts. For example, his analogy of compression coming in two flavours—lossless and lossy. Lossless is like sitting on an over-full suitcase to get it closed—hopefully, nothing is lost in the process. Lossy compression is likened to holding a garage sale—equally hopefully, superfluous items are released while the essential ones remain.

Published by Artech House
ISBN 0-89006-783-X
£41·50. xi + pp. 336.
Reviewed by Jeff Marsham

telecom focus

BT Welcomes Universal Service Statement

BT has welcomed Oftel's Statement on universal telephone service which includes proposals to increase the number of telephone users in the UK. The statement also endorses BT's commitment to reductions in the levels of disconnection.

The proposals for a new service for people without telephones give BT the commercial freedom to develop special prices for customers who cannot afford the standard service. These customers will be able to receive incoming calls and make outgoing emergency calls.

A BT spokesman said: 'We believe that this new service will encourage more people to have a telephone installed and hope that many will go on to enjoy the benefits of full service.'

BT is delighted that Oftel has fully endorsed its new Code of Practice on Disconnections, and has encouraged competitors to adopt similar principles. BT believes that the costs of universal service should be shared among all operators immediately, but welcomes Oftel's commitment to a thorough review of funding arrangements from 1999.

The spokesman added: 'BT is proud of its record in serving the whole of the community. We are the only operator who provides universal service across the UK. We remain committed to providing excellent and affordable services to everyone.'

BT and Government Boost Computer Links for Schools

BT Chairman, Sir Iain Vallance, has warmly welcomed the Prime Minister's confirmation that schools throughout the UK will now benefit from innovative special pricing packages for access to the Internet.

Sir Iain said: 'BT has always shared the Prime Minister's commitment to education and his recognition that telecommunications technology is central to transforming the quality of teaching and learning in our schools.'

BT is set to offer imaginative pricing packages designed to respond to the Government's drive to kick start the use of information technology in the UK's 32 000 primary and secondary schools.

Sir Iain said: 'We are conscious that schools work on particularly tight budgets and a perception of price can stall the take-up of these new, exciting technologies.

'I firmly believe this will herald the start of a dramatic transformation in the level of use of information technology in schools throughout the UK.'

BT and MCI Complete Strategic Investments in Portugal Telecom

BT and MCI have announced the purchase of their shares in Portugal Telecom as part of a strategic alliance announced in April 1997. The alliance also called for Portugal Telecom to distribute Concert global services, BT to provide management assistance and MCI to consult on telecommunications opportunities in South America.

The Portuguese Government sought strategic shareholders as part of its global offering of 26 per cent of Portugal Telecom stock. BT bought 1·9 million shares for Esc 14 193 million (£49 million) representing one per cent of Portugal Telecom's equity and MCI bought 950 000 shares for Esc 7097 million (US $40 million) representing half of one per cent of Portugal Telecom's equity. The other telecommunications shareholders which will have, upon the closing of the third phase of the privatisation process, strategic investments in Portugal Telecom are Telefónica de España (3·5 per cent), Telebras (0·75 per cent) and the Atlantic Alliance—a Telebras and Portugal Telecom joint venture company (0·5 per cent).

Francisco Nabo, Chairman of Portugal Telecom, said: 'We are delighted to have taken this important step in the development of our strategic relationship with BT and MCI. We look forward with great enthusiasm to the future development of these strategic relationships in the years ahead.'

Sir Iain Vallance, Chairman of BT, said: 'Our shareholding in Portugal Telecom underpins our alliance and represents a key element of our trilateral agreement announced in April. There are a number of joint projects already underway and many more opportunities for us to develop which will benefit customers of the alliance.'

Bert Roberts, Chairman of MCI, said: 'We are pursuing opportunities in Brazil and other Latin American markets with Portugal Telecom. We are delighted to become strategic shareholders as well as partners.'

Latest European Standards For ISDN

BT is introducing a new European compliant version of ISDN 2—its high-speed digital communications service.

From October 1997, ISDN 2e became BT's standard offering for all new provision of ISDN 2 'basic rate' lines. ISDN 2e will interwork with BT's existing ISDN 2 service for both voice and data calls. All customers of ISDN 2 will continue to be supported for as long as they want the service.

ISDN 2e complies with the latest European standard and is designed to encourage further the introduction of low-cost European customer premises equipment into the UK. In future, customers will be able to take advantage of additional network features such as user-controlled call forwarding and call hold.

Mark Bullock, BT's Integrated Services product manager, said: 'The introduction of ISDN 2e will enable customers to choose from a wider selection of low-cost equipment from across Europe, driving down the overall cost of ISDN ownership.'

New features of ISDN 2e available at launch include a multiple subscriber numbering option, allowing customers to choose from two, three, eight or ten numbers on each line and a new BT-assisted call forwarding facility for both voice and data calls.

The ISDN 2 and ISDN 2e services fully interwork for voice and data calls—both offer a digital line comprising two 64 kbit/s channels into customer premises and supports many applications including file transfer, video conferencing as well as Internet access and voice calls.

However, future planned developments for ISDN 2e will include call waiting for four calls at a time, call hold, customer control of call forwarding and call deflection—a service by which calls can be forwarded depending on their calling line identities.

Mark Bullock continued: 'Currently there is little difference between the two services and the existing one will continue to represent value for money. We do not expect customers to upgrade, as existing ISDN 2 already delivers cost-effective and competitive business solutions.'

In the past year, BT has run a comprehensive test programme in conjunction with ISDN terminal manufacturers in the UK. The results show that the vast majority of terminal equipment designed for ISDN 2 is also ISDN 2e compatible.

ISDN 2 and ISDN 2e both comply with international standard I.420. ISDN 2 was introduced in 1991 prior to the completion of the latest European ISDN standards. As a result, small technical differences exist between the two, which will be removed by the introduction of ISDN 2e.

Interactive Service Network Development

BT has announced that, as part of the next phase in its development of high-speed interactive networks and services, it is inviting companies in the service- and content- provider industries to take part in a trial in West London during 1998.

The trial will be based on asymmetric digital subscriber line (ADSL) technology. ADSL technology runs over existing BT telephone lines at speeds up to 50 times faster than is currently possible using conventional modems. Telephone calls can be made simultaneously.

Today's announcement builds on BT's interactive television trials in East Anglia and Westminster which successfully demonstrated a sustainable market for interactive services.

Since those trials, there has been an increasing shift towards the importance of the Internet as a delivery mechanism, and it has now become an intrinsic part of BT's plans.

The trial will provide independent telecommunications service providers with their first opportunity to participate in such a venture. BT is inviting them to discuss their requirements. In addition, BT will also offer services direct to customers as part of the new trial.

The network will enable very high-speed access to the Internet and video-rich server-based content.

Boost For Helplines

A new service from BT will make it easier for the worried or desperate to get instant help over the telephone.

From this month, all BT Phone Books will have two pages set aside to list telephone Helplines dealing with matters ranging from alcoholism and sexual problems to dealing with debt.

BT already helps fund the Telephone Helplines Directory, published by the Telephone Helplines Association, a registered charity which is itself made up of representatives of major British charities. The new Phone Book section will complement the Directory and give guidance to people who may be in urgent need of help but have no idea how or where to start looking for advice or guidance.

The list was compiled by the Telephone Helplines Association and BT, and details were checked by both organisations. The Helplines are listed under 17 separate categories and include a brief description of the assistance offered.

Ian Ash, BT's Director of Corporate Relations, said: 'Communication is the key to any counselling—and can come in many ways. BT is committed to communication in all its forms.

'This new service will make it so much easier for those who need help to get in contact with those who can provide it and should make a difference to the community in which we all live and work.'

The special section will appear in every one of the 21 million BT telephone books printed each year. There are 180 different editions and each is updated and reprinted about every 18 months.

Launches of Bill Payment Card

BT today introduced its first ever electronic payment option for residential customers—the BT Payment Card. The card is designed for use with the new national bill payment network, PayPoint, which was also launched recently.

The BT Payment Card allows customers to pay money towards their bills in corner shops, filling stations, newsagents and a host of other local outlets as well as through most post offices and BT shops. The card is swiped through a terminal and the amount paid towards the bill is registered. A receipt confirms the amount.

BT will be sending application forms to millions of customers over the next few months, on a region-by-region basis.

A successful trial of the BT Payment Card and the PayPoint network was run in Northern Ireland last year.

The card will be particularly useful for the UK's four million households, out of 23 million, that only use cash to pay their telephone bills, as well as for those customers without a bank account.

Customers who apply for a BT Payment Card will be eligible for a one-off discount equivalent to 120 minutes of local weekend calls if they clock up five PayPoint transactions and pay a minimum of £25 in two months.

Mervyn Leah, BT Marketing Manager, said: 'One of our key objectives is to make the paying of bills as painless as possible.

The new BT Payment Card scheme will help customers to budget and manage their money while at the same time giving them more flexibility about where and when they pay.'

PayPoint is currently being introduced at carefully selected retail outlets across the country. Locations targeted have extended opening hours and are either close to where potential Payment Card users live or in major shopping centres.

Delivery of Songs on the Internet

AT&T has announced a trial of its A2B Musicsm platform, combining compression and encryption technologies from AT&T Labs to promote and deliver CD-quality music quickly and securely over the Internet.

First participants in the trial are RCA/BMG recording artists The Verve Pipe, who are offering on-line users a free, never-before-released live version of a song from their million-plus-selling CD, 'Villains.'

AT&T's A2B Music platform enables fast downloads of CD-quality music, and flexible licensing options.

There are plans to incorporate microbilling capabilities in future stages of the trial to investigate ways that the Internet can be used efficiently for an emerging electronic-commerce application—the selling of soft goods; that is, content that can be distributed digitally, such as a single song.

AT&T Labs' compression algorithms deliver music over the Internet at CD quality using fewer than one-tenth the bits, cutting download time for a 3-minute song to 9 minutes using a 28·8kbit/s modem. The A2B Music platform's security features protect distributors, artists, record labels and customers from electronic theft, while allowing flexible licensing such as single, multiple or shared uses of music distributed electronically.

Digital Highway to the Home

BT is to trial Home Highway—a new digital communications service that will transform a customer's existing home telephone line into a high-speed Internet and multimedia connection.

The trial, starting early 1998, will involve about 300 households in the Midlands.

BT Home Highway will use the latest digital access technology, supplied by GPT and Ericsson, and operate over existing BT telephone lines at speeds several times faster than the fastest modem.

The technology offers the customer a choice of using a combination of analogue or digital connections: two digital data channels, one analogue voice channel and one digital data channel or one analogue voice channel.

This means a family, for example, could surf the Internet at high speeds and make and receive telephone calls simultaneously. Currently, users with a single analogue line have to disconnect from the Internet to use the telephone.

It also means that customers can benefit from a fast and clear digital connection without having to give up their existing telephone number, equipment and range of BT Select Services.

Other uses of BT Home Highway include:

- a much faster way of accessing the Internet than using a conventional analogue telephone line and modem;
- the ability to view goods on the Internet using a digital data channel and telephone over the order on the spare telephone channel;
- an effective means of transmitting data from home while still keeping a channel free for personal use;
- high-speed access to educational services such as BT HomeCampus—developed to provide on-line learning;
- improved experience of multi-player Internet-based computer games by allowing users to talk on the telephone while playing.

Rupert Gavin, managing director of BT's Consumer Division, said: 'The aim of the BT Home Highway trial is to assess customers' experience and enjoyment of using the Internet and on-line entertainment services by providing a faster, more affordable and reliable connection to the home.

'The service will open the doors to a number of new applications as well as enhancing existing telephone services.

'We are still working on the functionality and packaging and will be testing a number of pricing options during the trial to find out what customers want and how much they are willing to pay.'

All customers will be recruited by targeted marketing activity to allow BT to achieve an appropriate demographic sample of the UK population. A wide range of data will be collected about the customers, who will trial the service until spring 1998.

BT Home Highway is designed to be easy-to-install, providing an additional socket with two digital ports and two analogue ports connected to a customer's existing telephone equipment. Customers simply plug-in their existing telephone equipment and computers in much the same way as they do today.

Share Telegraph Poles and Cabling Ducts Says Oftel

BT and other telecommunications operators have been called on to agree to share space on telegraph poles and in underground cabling ducts by Don Cruickshank, Director General of Telecommunications.

Oftel had asked for industry views as to whether the sharing of underground cable ducts and telegraph poles with other telecommunications operators, instead of having each operator build new ones, would enhance network competition.

Announcing the conclusions of the public consultation, Don Cruickshank said, 'There are a number of ways forward. One way would be to force operators to share their duct and pole capacity with others.

'However, providing a framework that will encourage sharing of duct and pole capacity through commercial agreement is the most appropriate way forward and is in line with the provisions in the European Union's Interconnection Directive, which also supports a system of cooperation.'

Mobile Phone Number Portability By 1999

Oftel has now secured the agreement of all four mobile operators to a scheme which means that by 1 January 1999 mobile telephone users will be able to keep their number when they switch operators. At the moment mobile telephone customers cannot take their number with them if they change operators. This puts customers off from shopping around for the best deal and is a barrier to effective competition. After detailed discussions with Oftel, the four mobile telephone operators—Cellnet, Vodafone, Orange and One2One—have now agreed to licence modifications requiring them to offer number portability by 1 January 1999.

Don Cruickshank said: 'This is excellent news for mobile phone users. I have made no secret of my determination that the mobile operators should offer portability as soon as possible. Now all systems are go for the end of 1998.

'We have had long and often tough negotiations with the operators about how quickly the new arrangements could be brought in. The target is not easy but all four operators are now signed up and accept that the technical and administrative arrangements can be put in place by the target date. 'Mobile phone users want the best deal around. The introduction of mobile number portability will remove an important barrier to competition. This a victory for consumer choice, and an area in which we lead the world.'

Don Cruickshank to Step Down as Telecommunications Regulator

Don Cruickshank, Director General of Telecommunications, announced that he has told the Government he has decided not to seek to extend his appointment beyond his present term of office, which ends on 31 March next year.

Commenting on his decision, Don Cruickshank said: 'I decided about a year ago that one term of office as telecommunications regulator was right for me. I told Ministers of my decision soon after the General Election in May, and that I would like to divide my time in the future in a different way between public and private sector activities. Being substantively full time at Oftel does not allow that.

'Also relevant, as I made clear in my submission to the Government's review of utility regulation, is that I consider that the industry will be best served in the next century by a commission, not an individual regulator.

'The decision is being made public now so that the Department of Trade Industry can go about their search for my successor in a public and timely way'

'I have enjoyed my work at Oftel and with the industry immensely. I will continue to play my part during the rest of my term of office in the development of a communications industry which will serve the UK well in the next information age'.

Open University Holds Telephone Seminars

The Open University (OU) is using BT's conference call service to hold virtual seminars over the telephone in Scotland where more than one-third of the students live in isolated communities.

By using conference call, the OU has been able to bring together people from remote areas, saving valuable travelling time and still allowing students to take part in discussions with fellow students and tutors.

So far the OU has clocked up 350 hours worth of calls in extending its courses over the last two years.

Conference call can link up to 1000 people in the same conversation using any telephone.

Simon Lubin, head of marketing at BT conferencing says: 'The Open University is a wonderful example of how conference call can help to create new ways of working. By removing the need to travel students are saving precious finances.'

ITU: Work to Resolve Year 2000 Problems Stepped Up

The much acclaimed 'millennium bomb' is associated with software and systems (including embedded firmware) which are dependent upon two digit representations of the year, and which may malfunction at the change from 1999, represented in those software and systems as '99', to the Year 2000, represented as '00'. Such software is not only found in computer systems but also in certain transactions of telecommunication operations, in office buildings, in transport, power, manufacturing and banking.

Numerous press reports have been published about the possible catastrophes which this may engender. In the information technology world there has been press speculation about a Year 2000 Internet crash. Wall Street economist Edward Yardeni predicted a 35% chance that Year 2000 software bugs will cause 'at least a mild global recession' in that year.

The International Telecommunications Union (ITU) started to address the issue of the Year 2000 in 1995 in the context of Study Group 7, which deals with data networks and open system communications. In the 1995–1996 period, Study Group 7 developed technical solutions for the two problem areas—message handling and directory services—which were approved last March. The Year 2000 issue was subsequently brought up in May 1997 at a meeting of Study Group 2 in the larger context of telecommunication network and service operations.

What about telecommunication networks?

As certain processes in telecommunication networks make use of dates, the Year 2000 problem will also affect them, although in a more limited way. The main areas which have already been identified as being affected by the change from 1999 to 2000 are in message handling systems and directory services which use a two-digit representation of the year, as well as in some post-processing operations such as call charging, customer billing or other records used within the post-processing billing systems where, in simple terms, the start time and end-time are compared to determine the chargeable duration.

Message handling systems and the directory services

Study Group 7 of the ITU-T responsible for data communications and open communication systems considered the problems of the Year 2000 back in 1995. In March 1997, it completed its work and adopted the required corrective measures. The changes essentially define how 2-digit years should be treated to avoid turn-of-century problems and provide an option for transition to 4-digit years in implementations of message handling systems and directory services. Systems developed on the basis of these standards can therefore undertake the necessary adjustments to deal with the problem prior 1 January 2000.

ITU Standards Build the Global Information Infrastructure

The International Telecommunications Union (ITU) has created a new series of Recommendations specifically dedicated to standardisation of technologies that will underpin the new global information infrastructure (GII).

While many countries are already beginning to implement their own strategies to put in place new high-speed information infrastructures, there remains a need for a global approach which will foster world-wide compatibility between new technologies. The ITU, with its 188 government members and around 450 members from private industry, represents a global forum where members can develop standards that reflect the needs of a broad cross-section of the infocommunications industry, from operators and governments to service providers and consumers.

ITU-T Series Y Recommendations, as these new standards will be called, are the result of a meeting of Study Group 13 of the ITU's Telecommunication Standardisation Sector.

The first three Draft Recommendations agreed at the meeting now proposed for formal approval are:

- Y.100, which gives a general descriptive overview of the GII;
- Y.110, which describes the basic principles and concepts for the GII architecture;
- Y.120, which describes methodologies and scenarios which may be used for developing the GII,

The creation of the new series, and the three draft Recommendations, are the first practical results of the GII Project which has been established under the leadership of Study Group 13 of the ITU Telecommunication Standardisation Sector (ITU-T). The project was established with the aim of responding quickly to market requirements for standards on which to base the new kinds of equipment which will form the basis of the new global infrastructure.

More draft Recommendations in the new Y Series are expected soon, including a Recommendation on terms and definitions which should be used in the context of the GII.

ITU Drives Development of Multimedia Systems

The International Telecommunications Union (ITU) has initiated approval of a number of new Recommendations that will have the effect of speeding the delivery of multimedia and interactive applications to desktops all around the world.

The new Recommendations, which cover the areas of video conferencing, Internet 'telephony', text conversation and the use of asynchronous transfer moe (ATM) in multimedia systems, were accepted at a meeting of ITU-T Study Group 16 Working Parties, held in Sunriver, Oregon, USA last September. The meeting, hosted by the Intel Corporation, attracted more than 200 technical experts from around the world.

Hearing and speech impaired to benefit from new standards

The meeting agreed on two new Recommendations concerning text conversation.

The first Recommendation, T.140, defines a universal presentation-level protocol for text conversation which will work with all multimedia protocols and with the existing standard for text telephony, V.18. The second, known as T.134, is a companion to T.140 and defines a simple data protocol for text conversation in a data conferencing environment. Support for the T.140 Recommendation has also been added to the H.324 Recommendation which defines multimedia communication over the public switched telephone network (PSTN). These two Recommendations are expected to improve greatly the lives of those reliant on text-based conversation systems, such as the hearing and speech impaired.

Approval of PCM modems standard rescheduled for January-February 98

The Study Group 16 Working Party meeting also made considerable progress on the new Recommendation for PCM modems (also known as 56k modems). Because these new modems are designed for connections which are digital at one end and have only one analogue-to-digital conversion, they are expected to be widely used for new applications such as Internet and on-line service access. The commencement of the formal approval process for this Recommendation is now rescheduled for the next meeting of Study Group 16, in January-February 1998, with final approval expected in September of that year.

Multimedia conferencing applications soon to be available on mobile terminals

In addition, the meeting forwarded for approval extensions of ITU-T Recommendation H.324 (videoconferencing over standard telephones) which will allow it to support mobile terminal applications. H.324 covers terminals using the PSTN to carry real-time voice, data and video, or any combination of these, and forms the basis of videotelephony. The extension of the standard means that users with mobile equipment working in the field will be able to participate in multimedia conferences, exactly as if they were back in their own offices. Other extensions to the H.324 standard included implementations of the standard operating over geostationary satellite channels; and operation on ISDN circuits from the basic up to the primary rate.

Enhancements have also been made to the T.120 series of Recommendations, which cover data protocols for multimedia conferencing. The meeting finalised multicast adaptation extensions to the T.120 multipoint profile for products which require minimal data services, such as text telephony or pure audio-visual environments (in contrast to multimedia terminals encompassing audio, video and data services).

Agreement reached on standards for videoconferencing applications on the Internet

Significant results were also achieved in the field of packet-based multimedia communications described under Recommendation H.323 (videoconferencing over computer networks), with the finalisation of new versions of H.323 and of the related Recommendation H.225, which describes the way in which audio, video, data and control mechanisms are associated, coded and packetised. The H.323 standard has already met with widespread industry support, and is very likely to form the basis of Internet telephony products.

In addition, a new Recommendation, H.332, was finalised. H.332 describes how H.323 interactive video conferences can be connected to a large number of uni-directional, multicast endpoints over the Internet. Draft Recommendations were also prepared on security for H.323 conferences (H.235), and on interoperability between H.323 and H.320 terminals (H.246). There are also new draft Recommendations on supplementary services in H.450.1, H.450.2, and H.450.3, which will provide call transfer and call diversion facilities for voice traffic travelling over packet-based networks such as LANs or WANs. All these Recommendations are also expected to start the approval process at the next meeting of Study Group 16 in January.

BT to License Gilbert Scott Payphone Kiosks

BT has announced that it plans to license its trademark Gilbert Scott K6 payphone kiosk for use by competitors. The move is to promote competition where planning requirements by local authorities prevent other operators siting their modern kiosks.

Licences will be issued on condition that the operators use a colour other than red, and that they make it clear that the service is provided by an operator other than BT.

Until now, BT has been reluctant to allow use of the K6 design by other operators because of its strong association with the company and because the kiosk provides restricted access for customers who are disabled or infirm.

However, because of the continued insistence by a few local authorities that only the K6 can be used in designated areas, and the failure of an earlier site swapping agreement to open up these areas to competition, BT has decided to grant licences to help promote customer choice.

BT Operations Director Bob Warner said: 'We want our customers to have a choice of payphone provider—but then to choose to use a BT Payphone. Today's announcement that we are licensing the Gilbert Scott kiosk underlines our commitment to fair competition.'

Internet Tracking Services for Airline Cargo

TWA Cargo is the latest airline to offer its customers the ability to track their freight shipments over the CargoConnect Internet service created by Syntegra, the systems integration business of BT.

By keying-in each relevant air waybill number, the airline's cargo customers will obtain fast and up-to date status information on the movement of their goods throughout TWA's domestic United States and its international route network.

Dave Lancaster, TWA's Director of Cargo Sales, Marketing and Planning, said using CargoConnect offers the airline and its customers a host of benefits.

He added: 'We have been evaluating a number of ways to offer our customers the ability to track their cargo and have chosen Syntegra's CargoConnect service for its cost-effectiveness and reliability. It eliminates the need to create a complex global-systems infrastructure and means we can offer our customers this service straight away. Our United States based customers are especially pleased that we are taking this approach because the Internet is a tool used every day at work and at home and they welcome such a simple low-cost way of monitoring the transportation of their goods.

'We generate freight in some countries TWA doesn't even fly to so this service, especially when the initial carrier is also on-line for Internet tracking, is valuable to both our staff and customers. We believe this is the right way to go and recognise the tremendous opportunities the Internet offers, especially as our network grows.

'Electronic commerce is becoming increasingly important in the air cargo industry and in order to remain competitive, we believe airlines must be able to offer information services such as this.'

Christopher Shawdon of Syntegra, said: 'Recognition by the global air cargo industry of the need for electronic commerce and the value it brings to their business is adding new momentum to CargoConnect. The speed with which the service can be introduced for new airlines, its cost-effectiveness and its user-friendliness makes it an ideal solution.'

notes and comments

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