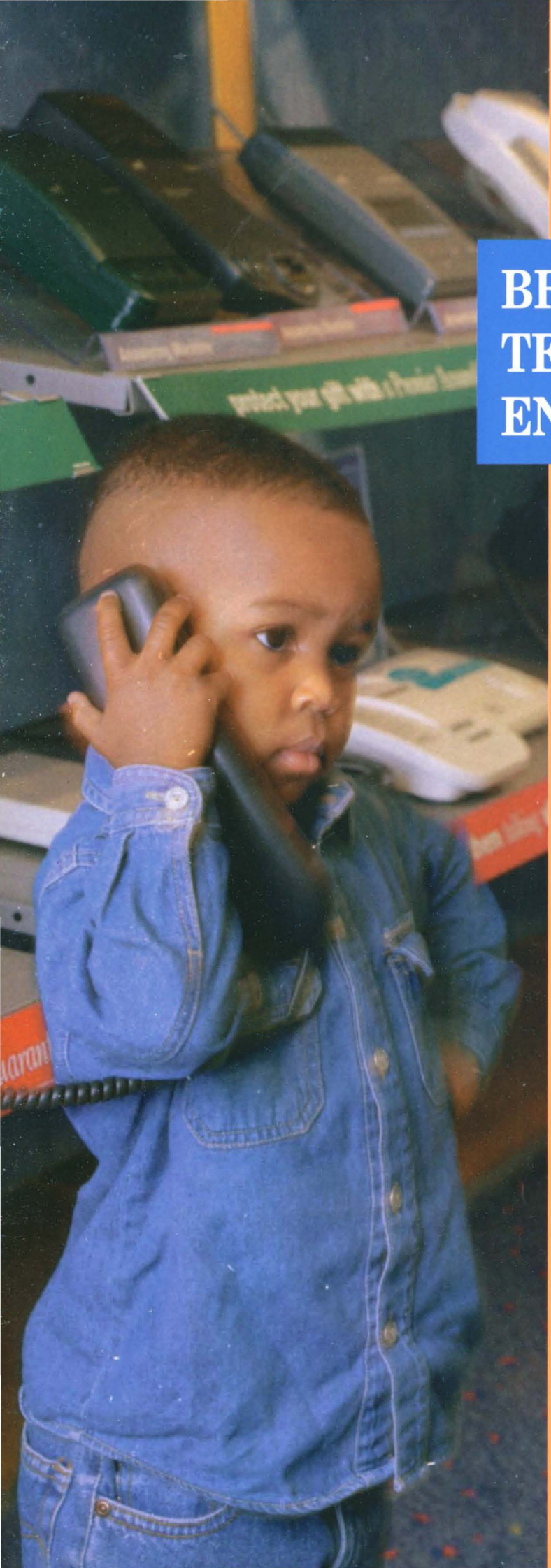

VOLUME 18 PART 1 APRIL 1999

BRITISH TELECOMMUNICATIONS ENGINEERING

Included in this Issue

Setting the Global Service Standard

Whither Video?

Year 2000 Engineering in BT

The Journal of The Institution of British Telecommunications Engineers

BRITISH TELECOMMUNICATIONS ENGINEERING

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(IBTE)

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Alan Hardie

Setting the Global Service Standard

New initiatives in people development, supplier quality and technology investment are bringing key benefits to the service organisation for BT's global business customers. These initiatives are vital to ensure customer loyalty and growth of business. This article reviews the approaches being taken and identifies the benefits.

Introduction

Customer demand for service excellence is universal. Irrespective of customer size, the need to deliver a prompt, reliable and high-quality service is constant. Emotionally, customers' needs are identical. Today, it is customers' increasing complexity that drives radical thinking on service if continuous improvement is to be delivered.

This article focuses on the new rationale and approach taken by BT's Global Business Markets Division in the way it provides centralised service support for corporate and international networking products supplied to its customer base via two global customer service centres (GCSCs). It reviews the essential approaches being taken for cultural change, people development, supplier management, and technological innovation, and identifies the tangible benefits emanating from the programme.

The centres serving the Global Business Markets customer base are located in Docklands (City of London) and Burnham-on-Sea near Bristol.

This 250 customer base can be defined as:

- operating in a global industry,
- having substantial activities in multiple countries,
- using substantive transborder telecommunications,
- shaping and leading their respective industries, and
- providing a significant global opportunity for BT and its alliance partners.

Overall, BT and the division are committed to contributing to the business success of its multinational clients. The division's contribution is to provide customised services which give excellent value for money, and service quality which delights. This commitment clearly defines the way forward and the investment needed to be made in customers.

Investing in Customers

The key driver for customer service is to focus on building customer loyalty and, as a result, win the lifetime business of the division's 250 client base. Easily said, not so easily done.

The plan for improving customer satisfaction and loyalty is based upon the Investing in Customers strategy, which seeks to implement a fundamental drive for loyalty by transforming service capability and delivery. The overall aim is to create apostles so that they will continue to spread the good word of the service quality achieved among the client base.

There are two key elements in the strategy:

- *service transformation* (the deployment of a newly focused organisation comprising Client Services, Client Applications, Client Advocacy and Client Fulfilment) and,
- *loyalty* (the deployment of the Partnership and Performance Index which provides a unique and competitively advantageous way of benchmarking improvements secured through service transformation).

In developing its service strategy, the division began by looking at the service profit chain model developed by the Harvard Business School. This model called for a new understanding of the economics of delivering profitable revenue through excellent service. This new paradigm highlighted the elements and linkages that led to gaining loyal customers and increased revenues. It also focused attention on investment in people, supportive technology, innovative measurement techniques and employee compensation linked to performance.

Profit and growth are stimulated primarily by customer loyalty. Loyalty is driven by customer satisfaction, which is, in turn, a direct result of customers valuing the services provided. Without well-motivated, committed and well-rewarded people, achieving this value proposition is impossible. Without high-quality support and policies that enable employees to deliver results, there are difficulties in achieving the required levels of commitment and motivation.

Delivering the strategy calls for a radically different approach to almost everything that was in place. Customer satisfaction was being measured by using event-driven measures. Legacy product-based systems were being used, and people were being paid on the basis of their seniority/grade. The influencing elements on customer loyalty were unknown, and the division was organised to deliver service in a way that had not changed in 10 years. Benchmarking service outside the company was rarely done. All of this has now changed.

The objective is simple: to set the global standard for service—quite a challenge especially when viewed against the demands of a customer base that reads like a who's who of international companies.

These companies are faced with both opportunities and threats from globalisation, industry restructuring through mergers, acquisitions and joint ventures, cost reduction, re-engineering and significant regulatory and environmental pressures. Their quest is to make themselves responsive to those opportunities, and their pursuit of customer satisfaction and value for money presents a significant challenge. By successfully addressing this challenge, significant revenue-generating opportunities will be gained.

The objective is simple: to set the global standard for service—quite a challenge especially when viewed against the demands of a customer base that reads like a who's who of international companies.

In short, the division's role is to satisfy customers' worldwide need to communicate in this challenging environment.

Turning the Model into Reality

Radical thinking brought radical change. Bringing the model to life required a complete reappraisal of existing systems and innovating new practices that would now form key elements of the new culture and deliver the Investing in Customers programme.

Changing the culture and developing people

How many times do we hear that 'our people are our most important asset'? Research has shown that the impact of front-line people in dealing with customers either face-to-face or via the telephone is crucial to create the dynamic impression of a global company. The innovation of quarterly bonus payments, based on customer-rated satisfaction, for all service grades, had already been achieved by the division. It was now necessary to expand new thinking to cover other areas.

For the individual, reward and recognition are of equal importance. Reward is not necessarily always financial; the team and working environment also take a high priority.

To achieve service goals it is essential that the division becomes an enjoyable and stimulating place to work—a place where professional expertise is valued and learning encouraged. This drive takes the form of a number of cultural initiatives comprising Knowledge Management, Diversity, Skills Transformation, a non-managers Learning Fund and a Globetrotters Guide providing timely support for the division's international travellers. To help achieve these goals, Global Business Markets has created the special initiative 'A Great Place to Work', and this initiative now provides the bedrock of cultural change.

Building on this foundation, along with the success derived from the Investors in People programme the decision was taken to further professionalise the role of service managers. It was recognised that they play a vital part within the overall client relationship, and through a series of innovative and effective people programmes the delivery on service would be enhanced and recognised as world class.

This new programme, the *Service Manager Accreditation Scheme* (viewed as best in class) is aimed at providing a major service differentiator in this competitive environment. For service managers themselves the scheme provides an opportunity to achieve professional

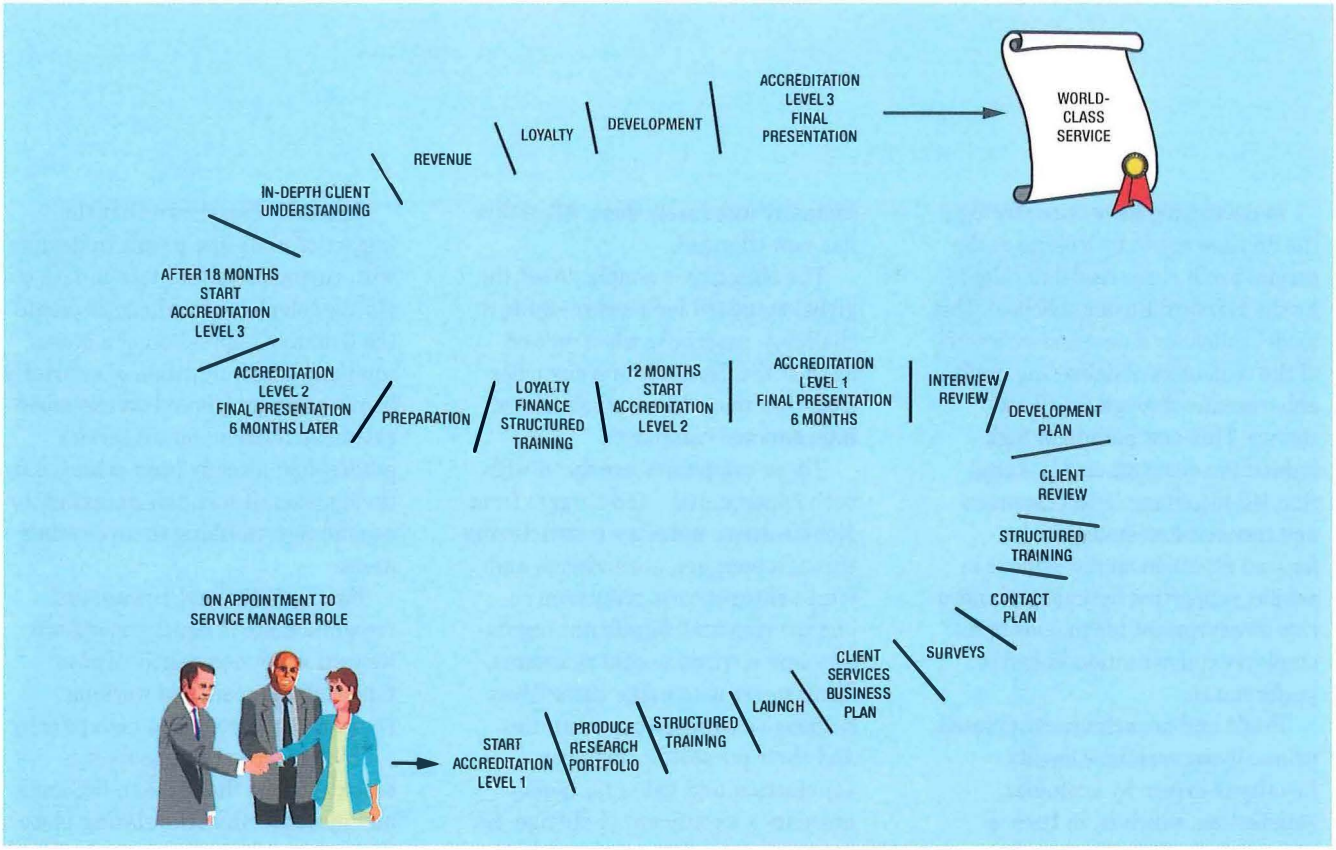


Figure 1—Service manager accreditation—the route to success

recognition in a rewarding and exciting career. Figure 1 identifies the progression towards achieving full accreditation by an individual over a period lasting approximately 18 months.

There are three levels of accreditation all involving a challenging practical work programme aimed at enhancing skills in identifying and managing client service needs. Each level combines training, on-the-job experience and formal external assessment by the Yale School of Management.

Level 1 reviews how to prepare a client research portfolio, a client service business plan and planning the detail of operational surveys and contact plans.

Level 2 considers client reviews and the preparation of a client service development plan.

Level 3 is designed to build on the tools and techniques covered in the earlier modules viewing the client relationship from a more strategic perspective and concentrating on financial targets and performance.

When service directors and service managers achieve final accreditation they will possess industry-leading professional skills with an externally-assessed major qualification. Internal and external recognition of the standard achieved is a natural by-product of the programme.

Career ladder

Inevitably, the Investing in Customers programme has resulted in organisational changes with a complete revision of individual job descriptions and associated competencies and behaviours. Of significant benefit is the emergence of a comprehensive 'career ladder' that now ensures that every staff member has a clear view of development opportunity and job progression. Equally, the importance of importing and exporting key experience at the right time is also catered for with entry and exit to and from the many varied disciplines within the business.

Figure 2 identifies the potential entry and exit routes for personnel wishing to move into new roles. This role transition is seen as particularly useful in developing elements in bespoke service propositions for different customers' needs thereby enabling service product enhancement.

It is anticipated that the first group of service professionals will graduate during the summer of 1999. In addition, associated people initiatives will be rolled out. The Customer Team Coach concept ('role model' experts to assist with spreading best practice), training needs analysis feedback, and refresher customer awareness sessions will all contribute to 'making it happen'.

Investing in Suppliers

Another key element in this cultural change is in the way the division now needs to manage suppliers. Continuous monitoring, preventative maintenance and rapid resolution of arising problems are obvious approaches to take, but it is the link with supply that is essential when service fails and speed of repair becomes critical.

Management of supplier relationships

There is no doubt that supply chain management (SCM) is the next major frontier for effective competition. One needs to understand the SCM concept and to recognise the need to see SCM strategically. It requires new competencies in trust building, information system linkages and other communication mechanisms. It

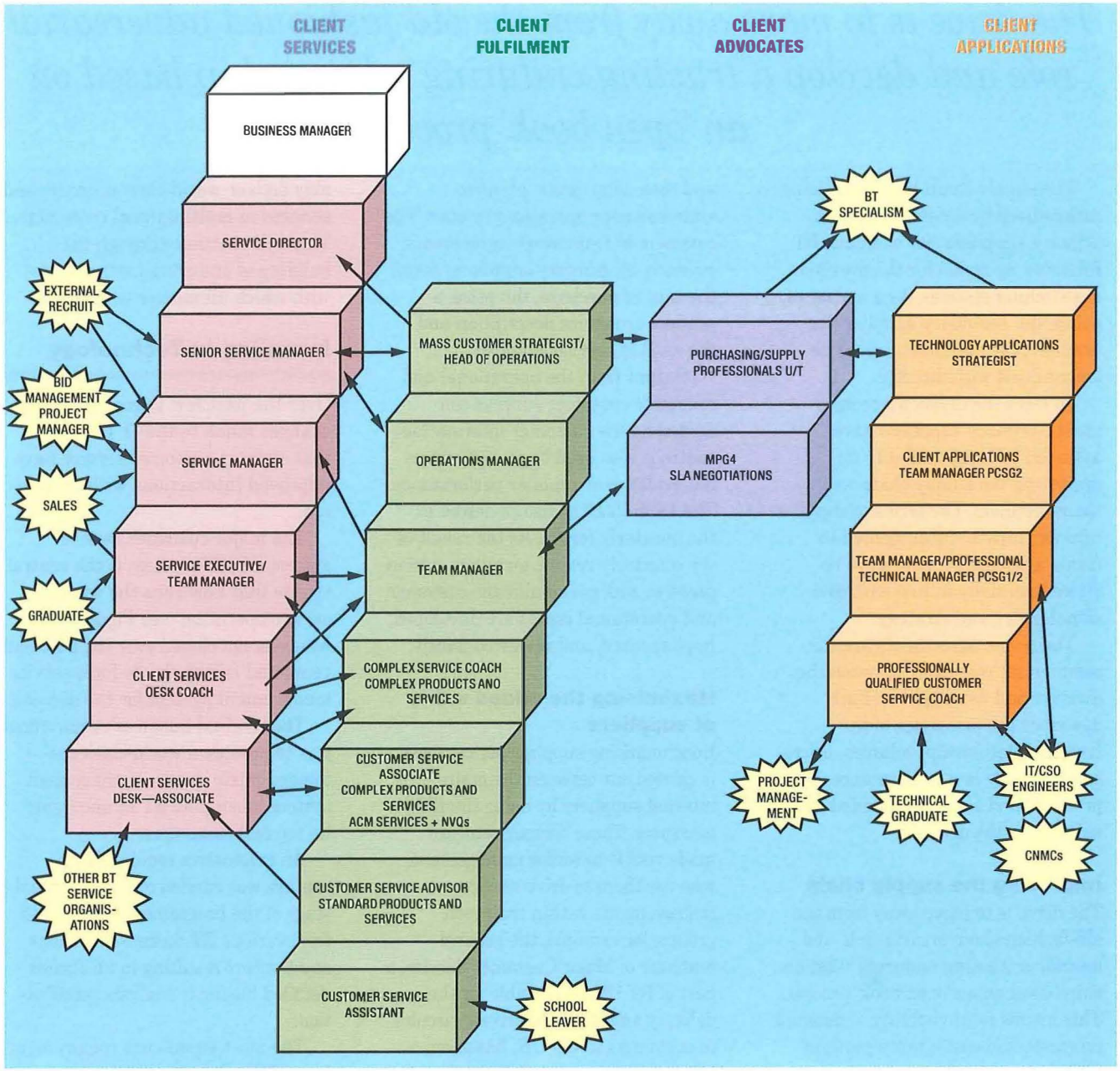


Figure 2—Service career ladder

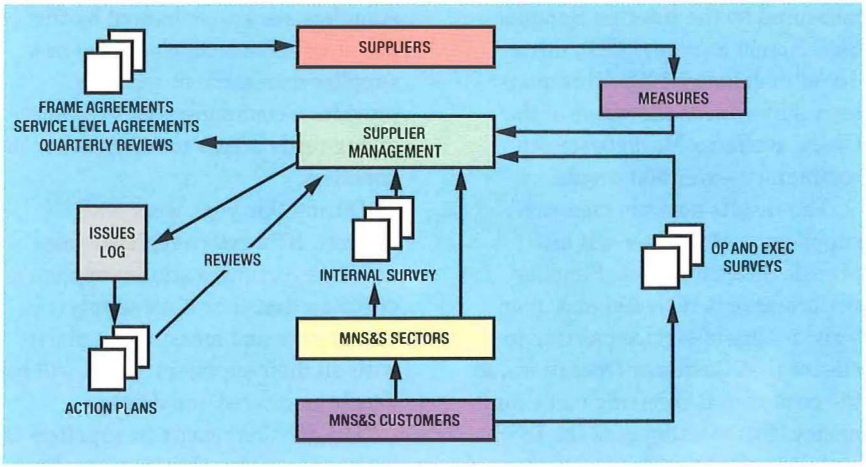
also requires an 'unlearning' of many present practices; in particular, the move from a focus on margin, to a focus on costs.

How Customer Operations develops and improves supplier relationships

A new Supplier Management team was set up in 1997 to develop and implement a supplier management strategy for the division, ensuring that the services and products delivered exceeded customers' expectations.

This team now provides a single focused interface between the sales sectors (the customers), and the suppliers, reducing the need for individual sales sectors to deal directly with suppliers. Team members have particular responsibilities for account managing sales sectors and main suppliers. This two-way interface minimises duplication of effort (Figure 3).

Figure 3—Supplier management information flow



The drive is to move away from the old-fashioned adversarial role and develop a trusting enduring relationship based on an 'open book' process.

The supply chain has been further rationalised by dealing only with primary suppliers (for example, BT Business Systems) for the provision of switching systems. As a matter of policy, the secondary supplier (for example, the manufacturer) is no longer dealt with directly.

To meet the division's requirements, primary suppliers have assumed full responsibility for improving the supply chain with their suppliers. The terms of supplier relationships are documented in frame agreements, which are reviewed annually in line with divisional policy and strategy.

The frame agreements are the commercial 'contracts' between the division and its suppliers. Each describes the principles of the trading relationship, volumes, prices, service levels and performance, for products and services provided by the supplier to the division.

Improving the supply chain

The drive is to move away from the old-fashioned adversarial role and develop a trusting enduring relationship based on an 'open book' process. This means total visibility of demand forecasts and cost/quality performance.

Problems are solved jointly and work is carried out together with partners to reduce transaction times and remove cost from the process. Performance measurement is now a crucial part of the relationship.

Suppliers' performance is now measured by the Internal Supplier Satisfaction Survey (ISSS), introduced in January 1998. This quarterly survey polls the whole of the Global Business Markets service community—over 600 people.

The results not only measure suppliers' performance but also provide direct feedback. Supplier performance is reviewed at a quarterly quality-of-service meeting to ensure that Customer Operations, as the customer, is receiving value for money. This meeting uses the ISSS output as the basis for developing and reviewing action plans to address major operational issues. The commercial framework agreements, covering all primary suppliers, detail the unit of purchase, the price, a product or service description and the level of service supplied.

Output from the operational and executive customer surveys conducted by the customer information centre is also used to provide external evidence of supplier performance. The ISSS itself is also reviewed at the quarterly forum. As the result of the quarterly review meetings, action plans to address significant customer and operational issues are developed, implemented, and reviewed jointly.

Maximising the added value of suppliers

Benchmarking supplier performance is carried out between the main internal suppliers by using the ISSS measures. These comparisons are made visible to senior management, who use them to drive service improvements within their own groups; for example, the general manager of Major Customer Service, a part of BT UK responsible for the delivery and repair of private circuits to customers in the UK, has given a bonus-related target to all his operational managers (a minimum 10% very satisfied ISSS score by the year end). This has the benefit of focusing the drive for customer service improvements, both within and outside the delivery organisation.

General communications with suppliers are also enhanced by the use of web-site technology. The new supplier management web site provides a communications channel giving ready access to information on suppliers.

During this year, work with Concert, BT's external global voice and data communications supplier, is ensuring that they have supply agreements and measures in place with all their suppliers, which will be jointly monitored and driven.

The division's focus on suppliers is key to its continued drive to profitably deliver world-class products and services to multinational customers. This will continue through the building of enduring partnerships with which all parties will benefit.

Investing in Technology

Over the past few years, significant changes made to the IT platforms that support customer service have improved interactions with customers.

The major customer service system (MCSS) system is the central engine that now runs the whole service operation (see Figure 4). It has been developed over the past four years and is now the de facto service management system for the division.

The original business requirement was to provide a world-class customer-centric service management system to support BT in managing its top 500 customers.

An exhaustive requirements capture was carried out at the initial stage of the programme with inputs from various BT business divisions and Concert resulting in an agreed detailed business analysis specification.

The most significant requirement identified a system which removed the need for users to be familiar with, and trained on, the complexities of the existing domestic and global service delivery systems.

The current system evolved through several iterations and has at various times been known as CRS/CEMS, BCH and most recently, after amalgamation with the ServiceView programme, MCSS.

Today MCSS is used to handle provision and repair service requests for all customers for all of the standard BT and Concert services and is now being implemented within the expanded BT North America division, part of the Global Business Markets organisation.

Implementation

MCSS is built on a standard client/server architecture using Solaris

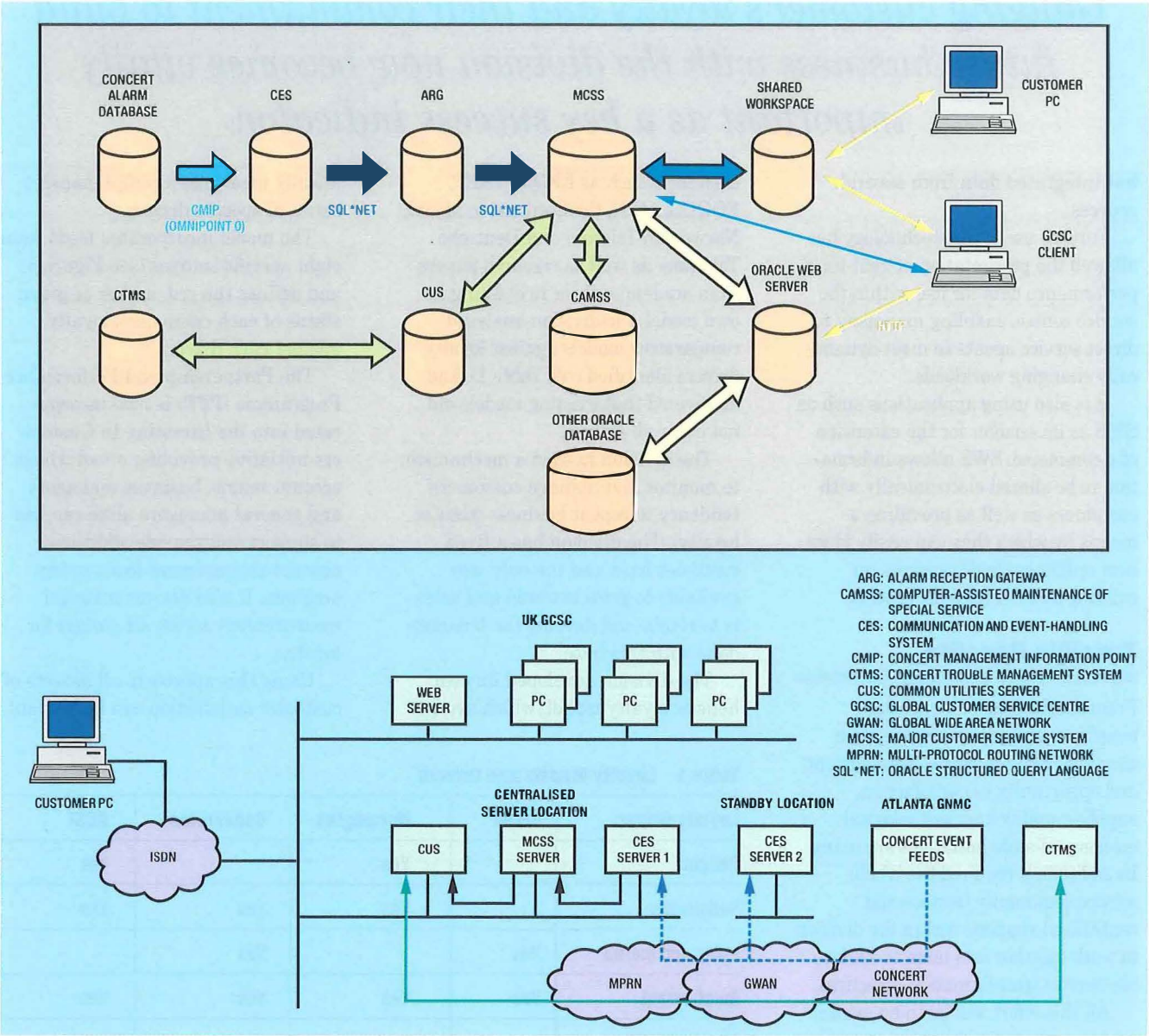


Figure 4—Major customer service system (MCSS)

operating systems and Oracle relational databases. (See Figure 4.)

The system implementation uses five separate Sun Microsystems servers, each aligned to an individual line of business.

The implementation project, jointly carried out by a team from Global Business Markets and BT Networks and Information Services has been responsible for the deployment of more than 500 users into the division.

MCSS contains a complete service inventory for each customer, extracted and cleansed from existing BT and Concert systems.

The system has customer access which allows individual customers to trade electronically with BT. This has subsequently enabled the introduction of e-commerce using shared workspace (SWS).

Current initiatives

The current focus of the development team is to rationalise MCSS architecture by using thin client web interfaces to exploit service data held within the MCSS Oracle databases.

This new initiative will allow seamless integration of data currently located across several data sources to support the composite views required by operational users.

One example is the recent replacement of the non-Y2K compliant information management system technology, used to give service centres visibility of Concert network events. By using a combination of the communication and event-handling system (CES), MCSS and a web browser, any service centre user can be presented with a customised view of Concert network events.

This demonstrates how a very expensive and complex architecture, previously available to only a small minority of service centre users, can be replaced with a simple yet fully featured web application available to all service agents.

Another initiative is the modification of the MCSS core data, used to define the system state model and work flow, to support the new service philosophy currently being introduced into the service centres.

The introduction of the client service and client fulfilment concept created the need to give service agents composite views of customer's data from multiple sources. In the past, this required users to log on to and access multiple systems. The new business requirement has been met using a web application, which

Gauging customer's loyalty and their commitment to build future business with the division now becomes vitally important as a key success indicator.

has integrated data from several sources.

Further use of this technology has allowed the presentation of 'real-time' performance data for use within the service centre, enabling managers to direct service agents to meet dynamically changing workloads.

It is also using applications such as SWS as an enabler for the extension of e-commerce. SWS allows information to be shared electronically with customers as well as providing a means by which they can easily place new orders or check progress on existing orders and fault reports.

Tangible Benefits

From the forgoing it is clear that benefits to the service organisation accruing from the people development and opportunity, job satisfaction, supplier quality and technological economy-of-scale initiatives are many. In addition, it required the whole service community (sectors and centralised support) within the division to work together as a team to achieve the service transformation objectives.

All this effort will be to no avail if customers perceive no improvement in service delivery. Gauging customer's loyalty and their commitment to build future business with the division now becomes vitally important as a key success indicator. This is where the most tangible of benefits will be seen.

Customer loyalty

Customer satisfaction, and particularly satisfaction with the service received from support teams, has a major impact on the future revenues that the organisation will be able to earn.

The strategy is to develop a best-in-class loyalty and satisfaction programme and the division's view that customer satisfaction measurement was not sufficient was confirmed by benchmarking findings. It was ncessary to understand the complexity and linkages of the drivers which contribute to customer loyalty.

Research discovered that several other loyalty initiatives were in existence (such as EFQM, TARP, FOQUS, ACSI, the Conversion Model, Norwegian Telecom and Deutsche Telecom), as well as research papers from academia. Prior to defining its own model, the division analysed comparative models against loyalty drivers identified (see Table 1), and discovered that existing models did not cover all drivers.

The division needed a mechanism to monitor and manage customers' tendency to repeat business (that is, loyalty). The division has a fixed customer base and the only way available to grow revenue and sales is to retain and develop the business done with this base.

The division developed its own holistic loyalty model, which systematically measures a comprehensive series of specific drivers.

The model incorporates feeds from eight specific sources (see Figure 5) and defines the red, amber or green status of each customer's loyalty against each driver.

The Partnership and Performance Programme (PPP) is now incorporated into the Investing In Customers initiative providing a tool which account teams, business managers and general managers alike can use to support and provide additional account management focus to key accounts. It also derives a formal measurement across all sectors for loyalty.

Using this approach, all aspects of customer satisfaction can be brought

Table 1 Loyalty Models and Drivers

Loyalty Driver	EFQM	Norwegian	Conversion	ACSI
Delight		Yes		Yes
Satisfaction		Yes	Yes	Yes
Rules and Inertia	Yes		Yes	
Relationship	Yes	Yes	Yes	Yes
Interdependency				
Market Position	Yes	Yes	Yes	Yes
Competitive Offering	Yes			

Figure 5 – Partnership and performance index (loyalty measurement)

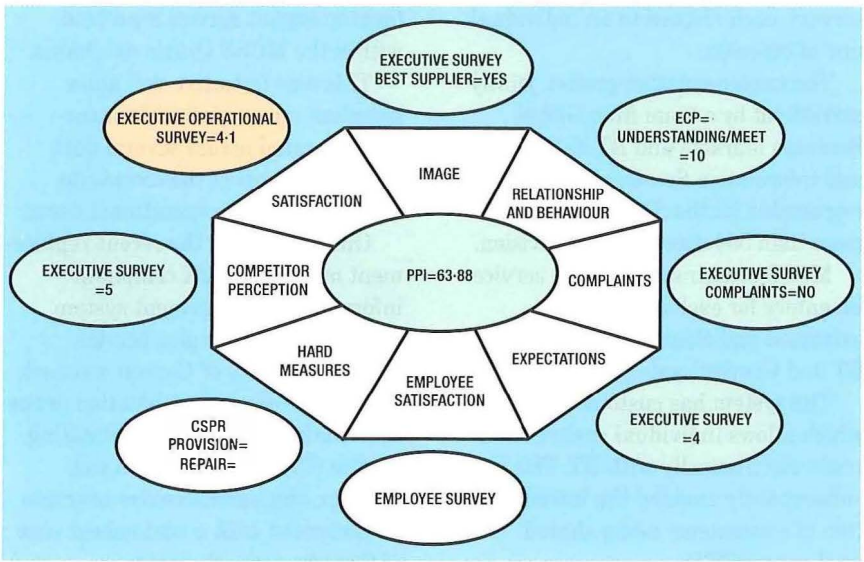
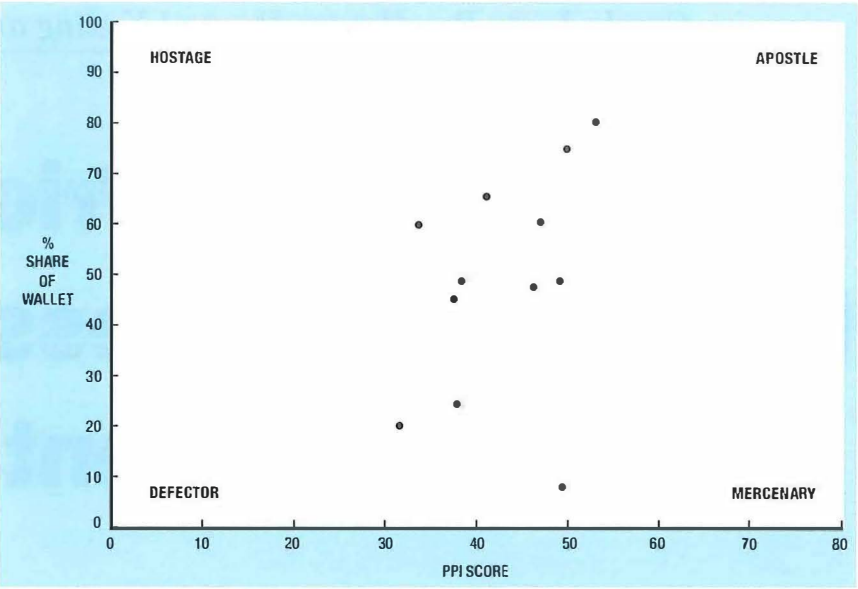


Figure 6—Sector scattergram



together for measurement. This additional focus will further contribute to driving up revenue, reducing cost and deriving best practice.

The division's Partnership and Performance model is still being developed and has therefore not yet been incorporated into the pay plan. The programme was launched to account teams via 117 facilitated workshops; feedback from these workshops has been assessed and is being incorporated into subsequent issues of the model.

New versions will generally be launched at six monthly intervals. Scattergrams showing customer accounts, as measured by the Partnership and Performance Index and against four buyer categories, are reported quarterly on the divisional web site. A derived sector scattergram example is shown in Figure 6 (the names of customers have been deleted for reasons of confidentiality). From this, business and account managers can use the indicator to make decisions on management for the account, and can assess actions required, based on the type of customer loyalty reflected. The goal is to move and retain as many accounts as possible within the upper right quarter of the diagram in the shortest possible time.

Conclusion

The customer-facing element of Global Business Markets currently has a relatively static base located within a rapidly-changing highly-competitive marketplace. Its key strategy is to retain customers and progressively grow business with them.

All the division's activity is focused on this customer base and is designed to support the development of relationships at an individual customer level.

These relationships are built through highly trained and well-motivated people integrating account and service management into a unified customer team.

It is customer service that now differentiates the BT proposition within the marketplace and BT's ongoing mission is to ensure that it is BT who continues to set the global standard for customer service within the marketplace.

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MNS&S EQA assessment, Nov. 1998.

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For further information, contact Bob Semaine at bob.semaine@bt.com

Biography

Alan Hardie
BT Global Business Markets

Alan Hardie joined BT in 1960 from Madras College, St. Andrews and Strathclyde University. He progressed to Deputy Finance Controller Scotland in 1984 before becoming Operations Manager West of Scotland in 1988. In 1992, he became General Manager for Scotland responsible for all customer service to business customers north of the border. In 1993, he became General Manager UK Service responsible for all UK customer service delivered to BT's top 1000 customers. Since 1994, as General Manager, Global Business Markets, Customer Operations, he has been responsible for the leadership and strategic direction for BT's global customer service across the BT/Concert Alliance partners. His operational and support units oversee the service delivery for BT's global clients on the Concert and satellite product set. Recognised as an expert in his field, he is the author and driver of the key Investing in Customers strategic initiative which develops and sets the standard for the customer service proposition for global customers into the new millennium. He is chairman of the International Quality Council, comprising BT, Concert and its international partners, which agrees and secures worldwide service consistency and customer responsiveness across the Alliance.

Carole Jones, Ray Hooper, Howard Keeling and Matthew Thomas

Improving the Prioritisation Process for Access Research and Development Projects

A tool has been developed to assist in prioritising access change research and development (R&D) project proposals. It considers the R&D life-cycle as consisting of four phases. Project proposals are screened before entry into each phase, using criteria that are appropriate to that phase. All of the proposed projects for a given phase are plotted on a screening matrix, *which enables the programme manager to make informed decisions about which projects should proceed.*

Introduction

Imagine you are a programme manager with responsibility for a large number of research and development (R&D) projects. You are faced with a difficult decision: you have received four project proposals, all of which offer potential business benefits, but you have sufficient funds to support only one of these projects. You could do one or more of the following:

- divide the funds into four parts *pro rata,* wait to see which project does best, and then close down the other three;
- start all four projects and hope that more funds become available to complete the work;
- fund one project only and drop the other three; or
- negotiate with the project proposers to reduce the bids if you think they are too high.

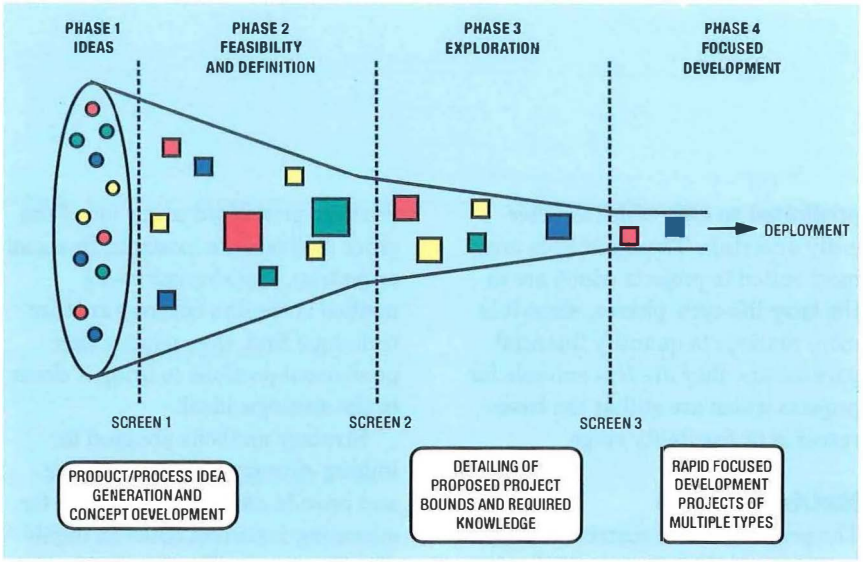
But on what basis could you judge which course of action is best? Estimating the business benefits that projects might deliver is fraught with difficulty. Often the benefits are not known in any reasonable detail until the project is almost complete. Nevertheless a decision has to be made because no company, however large, has the resources to bring to market in a timely way all the product, service or process concepts generated within it. Project prioritisation is a fact of life in any R&D environment.

For a big company, recovery from a wrong prioritisation could be expensive and time consuming. Therefore getting the prioritisation right as early as possible is important, particularly in today's business environment, where time to market is so vital. It has to be accepted, therefore, that projects will sometimes have to be halted if their benefits are found to be less than those offered by alternative projects. Terminating projects has to become a way of life with no blame, stigma or other impediments. Such terminations need to happen quickly and cleanly so that resources can be freed up for project work with a greater potential return.

But how does a company achieve excellent prioritisation? Wheelwright and Clark[1] have postulated the idea of a development funnel, as shown in Figure 1, whereby many concepts flow into a wide open mouth but are then gradually filtered out along the route through the funnel until only a few pass out at the far end to be exploited commercially. The development funnel concept is a well established idea in the R&D world, but the key to its effectiveness lies in understanding and operating the filtering process.

All companies operate a *de facto* development funnel, since they are nearly always resource-limited and not concepts-limited. The question then becomes one of how aware senior management is of the filtering process and whether it accords with

Figure 1—The development funnel



the company's strategic intent. There is anecdotal evidence that companies often allow projects to penetrate too far into the funnel before being filtered out. Filtering and narrowing of the funnel need to take place earlier in the life cycle. At the same time, however, the generation of significant numbers of new concepts for products, services or processes has to be maintained.

This article describes a project prioritisation method that has been developed for BT's Access Product Line. The Access Product Line has commercial responsibility for the development of BT's UK access network. It aims to meet, at lowest cost, the requirements of the customer-facing BT divisions. Its vision is 'to be the leading UK wholesale provider of managed access bandwidth to both internal and external customers with a commercially priced product set segmented by cost, quality of service and bandwidth'.

In order to discharge this responsibility, the product line must ensure that all projects which impact on the access network (access change projects) are both consistent with the commercial strategy and network design principles, and provide maximum financial return; that is, cost reduction and/or revenue generation. With continual pressure on development funding envelopes, and a potential project workstack in excess of funding availability, a sound prioritisation mechanism is required to ensure maximum impact from available investment funds.

Background

Several papers have been published on the subject of project prioritisation tools and techniques used by organisations to manage their R&D portfolios. One significant difference between much of the published work and that reported here relates to the nature of the projects within the portfolio. The majority of the literature refers to new product development (NPD) projects, whereas BT's access change portfolio includes some NPD work, but also projects aimed at developing or improving processes, systems and working practices. The aim was to develop a prioritisation tool to handle this wide range of projects and to provide a method for comparing the potential benefits of highly dissimilar projects.

Cooper, Edgett and Kleinschmidt[2-4] have carried out comparative studies of prioritisation methods used by various companies. These authors describe three primary aims when managing the project portfolio:

- to maximise the financial value of the project portfolio by obtaining a high return on investment;
- to achieve a balance of projects in terms of time frame, risk, project type and market; and
- to ensure that the project portfolio reflects the overall business strategy.

Cooper, Edgett and Kleinschmidt have devised a typology of project prioritisation tools which is aligned to these objectives. We have used a slightly different typology consisting of four categories, which are described in the sections below.

Financial methods

These tools have a primary aim of maximising the financial return on the R&D investment, and mostly use discounted cash flow (DCF) models. Each project is assessed for certain financial criteria, such as net present value (NPV) of future revenues, development and commercialisation costs, or expected net profit. This data is then used in formulae of varying complexity to calculate a financial index for the project, which in turn determines its relative priority. Some tools, such as the R&D effectiveness index method[5] use purely financial criteria, while others take account of parameters such as probability of success[2,6] or strategic importance[2].

A radical alternative to DCF models for comparing the financial merits of different R&D projects is the use of *options thinking*[7-9], whereby R&D investments are viewed as being analogous to share options. If, at the end of the R&D phase, the outcome looks promising, then the option will be exercised by making an additional investment in commercialisation. If it does not look promising, then the company will allow the R&D option to expire and the loss will be limited to the amount of the initial R&D investment. Several quite complex formulae are commonly used by options traders to model the distribution of uncertainty. Sharp[10] suggests that, when applying options thinking to R&D projects, a more pragmatic and intuitive approach should be adopted, by listing the options provided by each project, then making a subjective assessment of the value of each.

Financial methods are a good way of ensuring maximum 'bang for buck', and can take into account other criteria such as strategic importance or probability of success. However, although they attempt to use precise mathematical formulae, they are

predicated on data which is inherently uncertain. These methods are most suited to projects which are in the later life-cycle phases, when it is more realistic to quantify financial parameters: they are less suitable for projects which are still at the basic research or feasibility stage.

Matrix methods

The primary aim of matrix methods is to ensure a balanced portfolio of projects. Each project is plotted as a 'bubble' on a two-dimensional grid. Its position on the grid determines its priority, and the size of the bubble denotes the budget required for the project. Many parameters can be plotted on the axes of the matrix, including strategic fit, estimated financial return, probability of success or time to market[2]. Variants on this basic theme include using multiple matrices[11], using ellipses instead of bubbles (to indicate the possible spread of outcomes)[2], and the use of Monte-Carlo simulations to model probabilities[2].

Portfolio methods are information display tools, rather than decision-making tools, and, as such, are less prescriptive than other methods. They can be linked to strategy by favouring projects in particular areas of the matrix, or by ensuring that the overall portfolio includes a spread of projects from different parts of the matrix.

Strategy methods

This set of tools has a primary aim of ensuring alignment between strategy and the project portfolio. Cooper, Edgett and Kleinschmidt[3] describe two types of tool which fit into this category. *Strategic buckets* methods entail making a high-level decision to allocate certain amounts of money to certain areas, usually defined by overall strategies. Projects are then categorised into *buckets* corresponding to those areas. Dimensions used for the categorisation may include product lines, project type, geography and degree of familiarity to the business. Projects within each bucket are then prioritised using one of the other methods (for example, financial or matrix). The *strategic check* method is similar, but uses another technique first, then adjusts this provisional portfolio to bring it closer to the strategic ideal.

Strategy methods are good for linking strategy to R&D spending, and provide an excellent method for allocating resources between highly diverse projects. There is evidence[4] that these methods are widely used by the firms that are best at making prioritisation choices. However, they can only be used in conjunction with another method, and do not give explicit guidance about how the budget should be split.

Scoring methods

Scoring methods use lists of criteria, against which each project is given a score. Those projects with the highest total scores are favoured. A good example of a scoring method is that used by Hoechst[2]. Projects are rated for 19 parameters in five categories: financial reward, strategic fit, strategic leverage, probability of commercial success and probability of technical success. The individual scores are added to give five category scores; these are then weighted and added together to give an overall score for the project.

Scoring methods tend to be the most comprehensive, since a large number of criteria can be considered. The scoring exercise can be carried out by several people in order to cancel out the effects of subjectivity. However, these methods can be very prescriptive, can suffer from 'imaginary precision', and projects which score well on one criterion tend to score well on others (the *halo* effect).

Aims and Objectives

The aim of the work reported here was to devise a tool which would be applicable to the full range of access change projects. A further prerequisite was that it should enable all three of Cooper, Edgett and Kleinschmidt's objectives to be achieved; this suggests that some hybrid approach combining elements of the four types of tool is required. From the literature review and an understanding of the requirements of the Access Product Line, the following list of guiding principles was devised:

- The tool should not rely solely on financial criteria for prioritising projects.
- The tool should ensure that the overall portfolio of projects is well aligned to the strategic imperatives of the Access Product Line.
- The tool should not be a 'black box' decision making tool, but rather a decision support tool.
- Different criteria should be used for assessing projects at different phases in the life-cycle, progressing from qualitative, subjective criteria in the early stages to quantitative, objective criteria later.
- The sophistication of the tool should not exceed the quality of the data available.
- The tool should be sufficiently robust to ensure that the output can withstand scrutiny.

Overview of the Tool

The tool is a hybrid of a strategic buckets and a matrix method, and also uses elements of financial and scoring methods to assess certain parameters. It is based around allocating fixed budgets to four buckets, which correspond to life-cycle phases. These phases have been defined in general terms, so as to be applicable to the full range of very diverse projects.

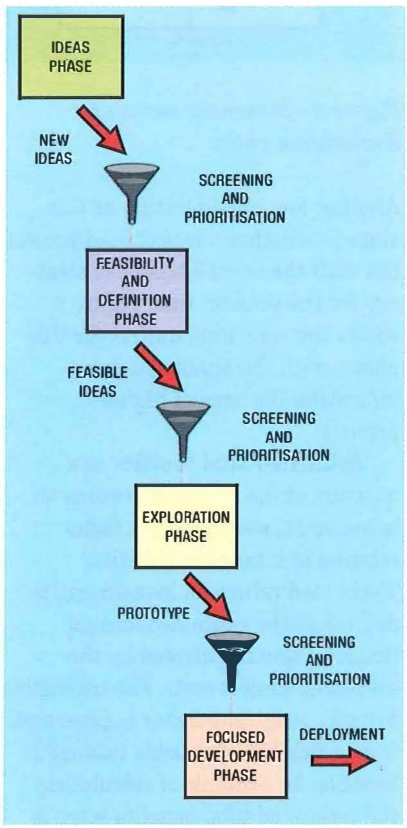
Project proposals for each phase will be screened for entry into that phase by asking a number of pertinent questions, which will

enable the portfolio of potential projects to be plotted on a *screening matrix*. The questions asked and the parameters plotted will, however, be different for each phase. The programme management team is then able to visualise all of the proposed projects in a concise way, enabling them to make informed decisions about which projects should proceed, but avoiding the degree of prescription associated with more quantitative methods. If a project passes successfully through one phase, then it is screened again for entry into the next phase, along with competing project proposals. This is in line with Wheelwright and Clark's development funnel concept[1] and with Cooper's stage-gate project control method[12].

The initial prioritisation will be carried out just before the beginning of the financial year, when the majority of project proposals are received. The prioritisation will subsequently be reviewed on a regular basis, as further proposals for R&D are received during the course of the year, and in the light of progress on existing projects. In this way, decisions can be made about whether to continue existing projects, or to cease them and re-allocate the funds to new projects.

Figure 2 gives an overview of the life-cycle structure and the screening process. There are three main phases: Feasibility and Definition, Exploration, and Focused Development, each of which has an associated bucket of funding. In addition, there is an *Ideas* bucket, which is available to fund short, focused pre-feasibility studies into novel concepts. As a rough guide, the budget split and relative numbers of projects at each phase might be approximately as indicated in Table 1.

Figure 2—The life cycle phases and screening process



Ideas Phase

The aim of the Ideas bucket is to encourage innovation and to provide a formal mechanism for conducting highly speculative studies. These studies are done on a very small budget within a short timescale, and the only form of screening is a brief check that the work has not been done before. The output from this phase is a very short summary of the findings.

Feasibility and Definition Phase

The aim of the Feasibility and Definition phase is to prove the feasibility of a concept and to define how it will be developed further. Projects within this phase are usually small, the probability of success may be unknown and it is acceptable for the risk to be high. The output from this phase will be a feasibility report and a semi-quantitative business case for further development work, containing an estimate of the financial and intangible benefits that are anticipated.

Figure 3 shows the screening matrix for this phase. Each project is represented by a circle, whose size represents the funding required. Coloured circles may be used to denote different types of project (for example, product development, process development or system development). The shading indicates the area in which projects will be given highest priority.

Note that financial measures are not used during this phase, since the degree of uncertainty is so great as to render such measures virtually meaningless. Instead, the *scope of benefits* is considered, such that those projects which provide a broad

Figure 3—Screening matrix for Feasibility and Definition phase

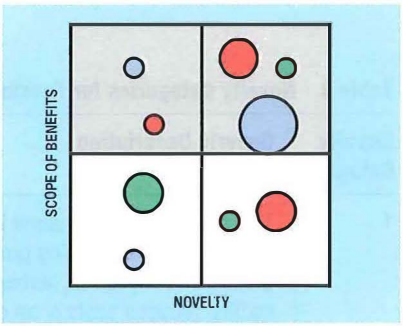


Table 1 Approximate Split of Funding and Numbers of Projects for Different Life-Cycle Phases

	% of Budget	Relative number of projects
Ideas	5	25
Feasibility and Definition	15	10
Exploration	40	5
Focused Development	40	2

platform for further development are favoured. This is measured using a tick-list of potential BT products and functions on which the project might have an impact. Table 2 shows such a tick-list for two sample projects: Project A has a relatively high scope of benefits, potentially impacting on 11 BT products and functions, while Project B is a niche project, which only scores 3, and is thus unlikely to be a priority for funding.

The other criterion on which Feasibility and Definition projects are assessed is that of novelty. The portfolio should contain a spread of projects, ranging from incremental improvements through to radical new concepts. Visualising all of the proposals on the matrix of Figure 3 will help to ensure that this spread is achieved. Five generic categories of novelty have been defined, two examples of which are shown in Table 3, along with some familiar examples of each.

Table 2 Scope-of-Benefits Scores for Two Sample Projects

		Project A	Project B
Products	Basic telephony	✔	✔
	ISDN2/BT Highway	✔	
	ISDN30	✔	
	etc...	...	...
	...	...	...
Functions	Planning the network	✔	
	Building the network	✔	
	Connecting customers	✔	✔
	etc...	...	...
	...	...	...
Total Scope-of-Benefits Score		11	3

Exploration Phase

A prerequisite for entry into the Exploration phase is that projects should have been shown to be feasible. The aim of this phase is essentially to build a prototype or demonstrator, along with a full business case. Projects in this phase are larger and are believed to have a moderate probability of success. By the end of this phase, the risks and benefits will be well understood, such that a full business case can be produced. When projects are screened for entry into the Exploration phase, it becomes feasible to estimate the financial benefits; however, intangible benefits must also be considered.

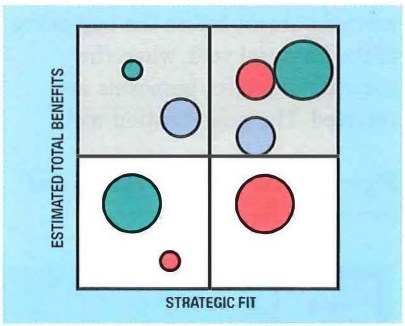


Figure 4 – Screening matrix for Exploration phase

Table 3 Novelty Categories for Feasibility and Definition Projects

Novelty Category	Generic Description	Familiar Example(s)
1	This project will bring about incremental improvements to existing products, services, processes or systems, perhaps leading to better quality, reduced costs or an extended life-span. The concepts around which it is based are well understood and the risk is low.	An upgrade to anti-virus software.
2	This project will bring about incremental improvements to existing products, services, processes or systems, perhaps leading to better quality, reduced costs or an extended life-span. The concepts around which it is based are less well understood and the risk is therefore moderate, but the potential benefits are moderately high.	Windows™ 98
etc.	...	...

Another key consideration at this stage is whether the proposed project fits with the overall business strategy for the product line. Figure 4 shows the screening matrix for this phase, with the shading again indicating the area of highest priority.

'Estimated total benefits' is a measure of the estimated return on investment, weighted by a factor relating to intangible benefits. 'Estimated return on investment' is defined as the estimated annual financial benefits divided by the estimated project costs. The intangible benefits weighting factor is generated from a tick-list of possible intangible benefits. An example of calculating the estimated total benefits score is

shown in Table 4 for two sample projects. In this example it can be seen that, although Project C has a projected higher return on investment than Project D, Project D scores slightly higher overall, when intangible benefits are taken into account.

The Access Product Line has identified nine strategic imperatives for its development activities. These include reducing faults in the access network, extending the bandwidth available over copper pairs and providing flexibility of evolution. Each project is assessed as to which one of these strategic imperatives it predominantly addresses. The screening matrix of Figure 4 will help to ensure a spread of projects across the various strategic imperatives, and enables the identification of any strategic imperatives which are not being adequately addressed.

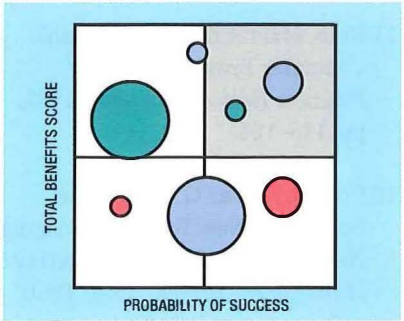
Table 4 Calculation of 'Estimated Total Benefits Score' for two sample projects

		Project C	Project D
Financial Measures	Estimated annual financial return	£5M	£4M
	Estimated project costs	£200k	£250k
	Return on investment score	25	16
Intangible Benefits	'Hard' spin-offs to other projects		✔
	Learning applicable to other projects	✔	
	Enhances BT's reputation		✔
	etc...	...	...
	...	...	...
	Intangible benefits score	1	8
	Intangible benefits weighting factor	1·1	1·8
	Estimated total benefits score	27·5	28·8

Focused Development Phase

A full business case and a good fit with strategy are prerequisites for entry into the Focused Development phase. Projects in this phase are usually large and have a high probability of success. The aim of the Focused Development phase is to take projects from a prototype through to readiness for deployment into the business. Financial measures are the predominant criterion for entry into this phase; however, technical and intangible measures must also be considered. The screening matrix for Focused Development is shown in Figure 5.

Figure 5—Screening matrix for Focused Development phase

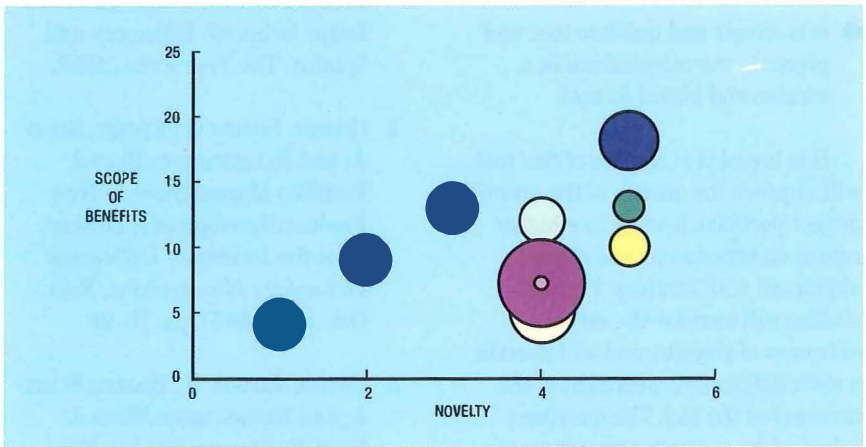


'Total benefits score' is defined as the NPV of future revenues multiplied by a weighting factor for intangible benefits. This weighting factor is calculated in the same way as described for the Exploration phase. Probability of success is assessed by listing the technical hurdles, and the commercial, regulatory or cultural hurdles which must be overcome. From these two lists, figures are estimated for the probability of technical success and the probability of commercial success. The overall probability is calculated by multiplying these two figures. Projects in the top right hand quadrant of the Focused Development matrix, having high total benefits scores and high probabilities of success, will be given highest priority.

Application of the Tool

The tool was tested using a selection of access change projects from the 1998/99 financial year. Figure 6 shows, by way of example, the screening matrix for 10 projects in the Feasibility and Definition phase. The tool was found to be quick and easy to use, the results were easy to

Figure 6—Screening matrix for a selection of access change projects entering the Feasibility and Definition phase



understand, and there was a good spread of projects across both axes of the screening matrix.

At present, the tool consists of a simple spreadsheet. However, it is envisaged that it will eventually be developed into an intranet-based tool. This will enable people submitting project proposals to visualise the complete portfolio and to identify any gaps which they can potentially fill.

Conclusions

A tool has been developed to assist in the prioritisation of access network R&D projects. The tool has the following benefits:

- despite the wide diversity of access R&D projects, the tool is applicable to the vast majority of these projects;
- it uses different criteria to assess projects at different phases in the development life cycle;
- a broader range of criteria than just financial measures is used to assess projects;
- it is not prescriptive, and constitutes a decision support tool;
- the methods used to assess technical criteria, such as probability of success or scope of benefits, force the person proposing the project to consider and justify these parameters; and
- it is simple and quick to use, and presents the information in a concise and visual format.

It is hoped that the use of this tool will improve the quality of the overall project portfolio, leading to a higher return on investment and closer alignment with strategy. Future studies will monitor the actual outcomes of projects, and will provide a more definitive assessment of the accuracy of the tool. The questions asked when screening project proposals have been designed to be relevant to each life-cycle phase, and it should therefore be possible to give more realistic estimates of the business benefits than is the case if only financial criteria are considered. However, users of the tool must recognise that no screening process is perfect, and must regularly review the prioritisation in the light of experience, and be prepared to change those priorities if necessary.

Although the tool was originally developed specifically to prioritise access change projects, it is hoped that it will prove to be applicable to other parts of BT and, indeed, to other organisations. Some amendments will be required when transporting the tool elsewhere, such as modifying the lists of strategic imperatives, products and functions. However, the authors believe the basic principles to be highly portable. They are already using these principles to prioritise work within their own units, and plan to investigate the use of the tool for prioritising other project portfolios within BT.

Acknowledgements

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Biographies

Carole Jones
Networks and Information Services, BT UK

Carole Jones is a member of the Advanced Operational Solutions Unit within BT Advanced Communication Engineering, based at BT Laboratories. She graduated from Durham University in 1984 with a first class honours degree in Applied Physics and Chemistry, and obtained a Ph.D. from the same university in 1987 for work on dielectric thin-films. After a year's postdoctoral research at Cambridge University, Carole joined BT in 1988. She initially worked on the development of non-linear optical devices, and subsequently on silicon micro-engineering. During this time she was involved with the development of several novel silicon micro-engineered devices, including a low-cost fibre-pigtailed laser package and a high-speed transceiver. In 1996, she began working on process management, where her main interest has been a study of production management and its application to BT.

Ray Hooper
Independent Business Consultant

Ray Hooper now works as an independent business consultant, having previously been a member of what is now the Planning and Implementation Unit of BT Advanced Communication Engineering. He joined BT Laboratories in 1970 after graduating with a first-class honours degree in Electrical Engineering from Middlesex University. He initially worked on optical-fibre communications systems, specialising in the design and development of receivers and transmitters. During this time he contributed to the original digital optical-fibre communications field trials. In 1986 he was seconded to BT&D Technologies (now part of Hewlett Packard), a joint venture company set up by BT and DuPont to manufacture optoelectronic components. He was responsible for the development and design of the early optical receiver products and managed the integrated circuit development programme. He returned to BT Laboratories at the end of 1990 to work on optical components for the access network. Subsequently, he managed a team supporting new technology pilots and trials including TPON, IMS and EXTACT. He led a team developing network planning rules and tools as well as contributing to research on production management prior to leaving BT.

Howard Keeling
Networks and Information Services, BT UK

Howard Keeling is a member of the Programme Operations Unit within *Network*BT, based at BT Laboratories. After a somewhat varied career, commencing with a mechanical engineering apprenticeship with the Ford Motor Company, Howard joined BT in 1991 working as part of the Product Assurance Team providing Business Assurance coordination to the Transmission Network Surveillance project within the Network Control Layer Division. In 1993, he joined the Programme Operations Unit providing planning, budgetary and cost control and QMS support to the Transmission Domain Surveillance Programme, again within the Network Control Layer. Since then Howard has continued in a similar role matrixed into a number of N&IS programme managers and is currently working as part of the Access Product Line, providing consultancy to that team in terms of requirements capture, change control, budget and cost control and risk management. In addition, he has recently taken on responsibility for leading the Programme Operations Team providing management and control services to the programmes that comprise IP and Data Services within *Network*BT's Network Transport business unit.

Matthew Thomas
BT Networks and Information Services, BT UK

Matthew Thomas is a member of the Planning and Implementation Unit of BT Advanced Communication Engineering. He graduated from Bradford University in 1985 with a degree in Mechanical Engineering, and in 1986 with an M.Sc, in Microcomputer systems. After finishing his industrial training with Wimpey Engineering, he carried out industrially sponsored research in the field of plant condition monitoring, gaining his doctorate from Manchester University in 1990. Subsequent to this Matthew worked for an engineering consultancy in the field of maintenance management primarily in the petrochemical industry (on and offshore) prior to becoming a lecturer at Strathclyde University where he specialised in condition monitoring and maintenance management. He joined BT Laboratories in 1995 to work on plant failure analysis and modelling to provide tools and information which can be used by the business to assist operational and strategic decision making, and is currently responsible for a number of teams working in this and other areas.

Robert Brockbank, Gary Crook and Derek Emerson

ClickDial

Web-Enabled CTI

Using just a web browser on the desktop can give new power to computer telephony integration. Simple dialling from web-based directories right up to full control of the telephone is now possible. Trials have shown that the simplicity of this approach is much appreciated, and that the underlying web interfaces can readily be used for new and enhanced services.

Introduction

This article continues the theme of discussing aspects of computer telephony integration (CTI). The first article[1] described the basics of CTI, including the distinction between first- and third-party modes. Following on from this came a variety of articles on the use and implementation of CTI, covering hardware, software and bearer capabilities. Since the first article, web technology and usage have grown enormously, and, in the light of this, enhancements in the deployment of CTI have been developed and trialled.

This article looks at how data retrieved from the Web can very easily be used to control and monitor a telephone using CTI. All the third-party user interfaces described here need nothing but a web browser on the computer desktop to operate, thus doing away with the long-standing problem of installing and upgrading executable files.

The first part of this article looks at the use of dialling from web-based directories and discusses how this can be implemented on an intranet.

The second part reviews the 500-user trial carried out by BT Laboratories (BTL) to test the underlying concepts and usability of the service.

Finally, the way forward is charted, with a discussion of possible enhancements and new services that could be made available using this approach.

The Web?

Everyone is using the Web nowadays, so why not combine it with CTI, to give web-computer-telephony integration? Access to a variety of data, including telephone directories, is easy. Completing the automation from the desktop and actually dialling straight from the directory is the next logical step forward.

For example, within BT there exists a web-accessible database of all BT people, the Teamconnect Directory. This contains contact information such as telephone (PSTN and BTnet) numbers, pager numbers and fax numbers, as well as physical locations and e-mail addresses. Traditionally, to telephone a colleague you first search the database via an HTML form displayed by a web browser, read the results and then manually copy the telephone number from the screen to the telephone keypad. This last operation typically takes 10 seconds, and is prone to error. This represents lost time, which summed over the whole business gives quite a sizeable figure (see the figures in the 'Business Case' section below). More importantly, it is an unwanted intrusion into a user's thought processes. What a user wants to do is contact a colleague to discuss a topic. What actually happens is that the topic takes a back seat while the mere process of making contact takes over. Any assistance that can be given to the user to minimise the break in concentration is a bonus. By integrating the web-presented information with the CTI layer, calls can be dialled, answered and cleared instantly at the click of the mouse.

Other directories such as white pages, business contacts, private numbers and workgroup-specific contacts could all be accessed via the Web, giving instant dial-ability without the interruption or delay.

The Missing Link

The 'missing link' between the web page and the telephone is filled by a

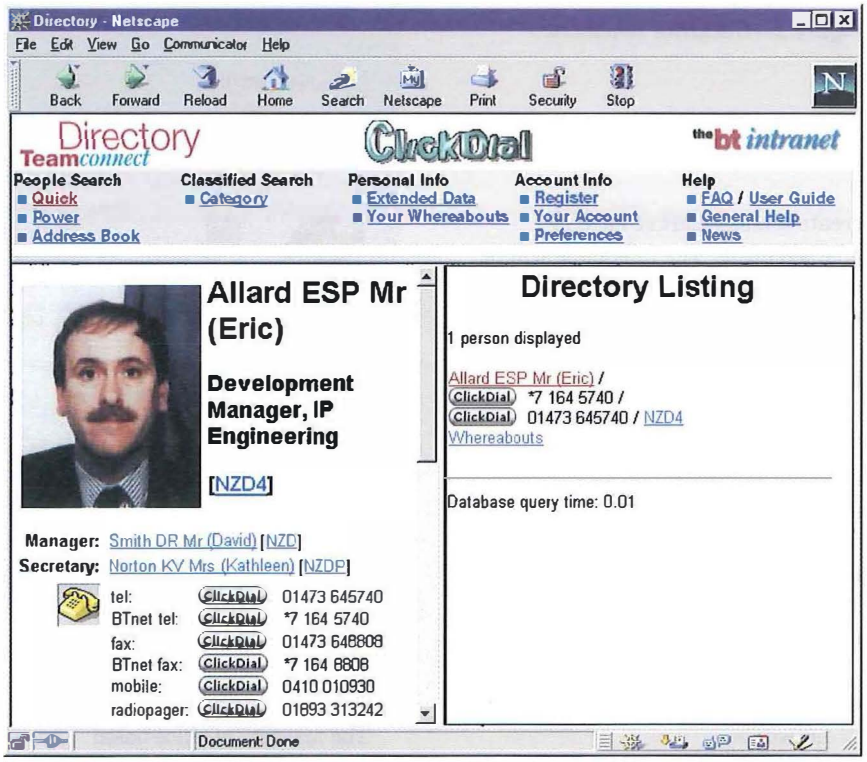


Figure 1 – Sample search results from the Teamconnect Directory showing the ClickDial buttons

CTI service, ClickDial, that takes the telephone number information from the screen and turns it into a request to the appropriate telephony equipment, instructing it to set up the call.

Although it is possible to use a number of CTI services using this approach, for simplicity this article will limit the discussion mainly to dialling services, although other elements are outlined in the 'Where Next?' section. Note that 'ClickDial' is used here as a descriptive term, and it is not intended to imply that any BT product would use the same name.

What the User Sees

From the modified Team*connect* Directory pages the user simply types the name of the person he/she wishes to call. The number is displayed along with a ClickDial button. Figure 1 shows a sample search result with the ClickDial buttons. Inquisitive users notice the ClickDial button for the first time and click to call. However, as the ClickDial service knows they are not currently registered, it returns a page asking the user to register.

The on-screen registration process displays a nine-digit registration number and asks the user to call the ClickDial registration line. This line answers '*BT ClickDial. Using your telephone keypad please enter the 9 digit registration number appearing on your screen*'. After entering the registration number, service will be available unless the user's line or PBX is not currently suitable for ClickDial. This information is displayed to the user and, in future, planned service dates will also be shown.

Serving the User

CTI has been publicised for many years, successfully informing the majority of communication engineers about how the technology can be used. But for many, CTI is a call centre technology, a technology which improves the productivity of agents while delivering cost-effective customer service. CTI does this by intelligent call routing, data screen pops prior to call answer and enabling calls and data to be transferred around an organisation.

Although the majority experience these benefits when doing business by telephone, very few are actual CTI users. The limitation has always been access to the technology, a barrier which the intranet has removed.

All users make telephone calls in the same way. They look up telephone numbers and dial. In recent years the way numbers are found has changed. Paper telephone books, including private lists, organisational lists and public books, have been replaced by personal organisers or web-based directories including the soon to be launched web-based BT *Phone Book* under the name PhoneNetUK. But once that number is to hand a telephone must be picked up and the number dialled. The telephone is the last office device to be integrated into modern desktops. By clicking on the screen, information can be found and exchanged, e-mails and faxes sent and received, and documents printed, but clicking on the screen can rarely generate a call.

A fundamental change needs to take place if the telephone is not to be criticised further for its perceived lack of integration. But that change is so fundamental that many users currently cannot see how it can be improved, although those using headsets are keen to control the telephone from the screen.

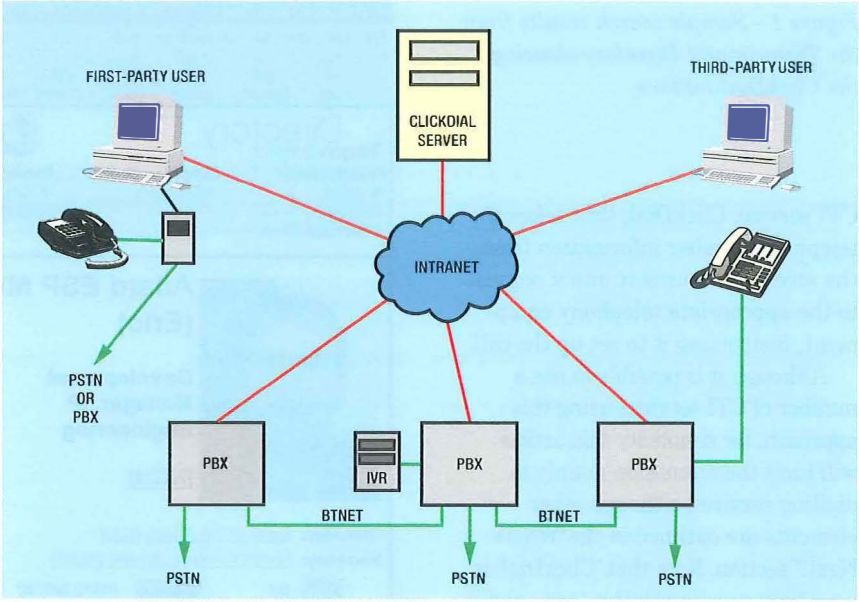
By studying users, the solution needed to be available from within a familiar environment, have a very simple user interface, require no user hardware or application installation, be easy to use, provide fraction-of-a-second connection, be very reliable and require no training. Users needed to experience something novel.

The result is a service accessed via a range of web browsers, with single click to call service, graphical call buttons in front of telephone numbers, behind the scenes CTI telephone enabling, automatic registration on initial use, no additional hardware for targeted users and a self-explanatory interface backed up by frequently asked questions (FAQs) with their answers.

To facilitate the fundamental change required, the initial offering provides one service with one click. To ensure that one click is successful, high server availability is required.

The existing user base of 500 triallists will see new services launched over the coming months to clear calls, answer incoming calls, see the names of any BT callers, see the names of missed calls, create personal calling lists, and e-mail call-me-back buttons to colleagues. All these changes will fundamentally change the user relationship and interface with the telephone, and help to

Figure 2—ClickDial schematic



create a mass market for CTI-enabled desks. The telephone will be an integral part of the desktop with the BT brand clearly displayed.

Business Case

The business case for a ClickDial service includes the following strands, explained in detail below:

- saving time when dialling,
- improving personal productivity,
- effective utilisation of private networks,
- pulling CTI out of the call centre, and
- placing the BT brand on the desktop.

It takes, on average, 10 seconds to read a telephone number from a screen, pick up a telephone, dial and hear a tone. Across the office-based BT population this equates to around 40 000 working hours a year simply dialling calls, with an impressive annual cost to BT of around £1¼ million in unproductive time. The current ClickDial service eliminates around 90% of this cost, thus saving BT over £1 million annually. Research, development and installation costs are insignificant in comparison.

Impressive figures, but do they make any sense? The answer is 'partly'. The calculation is accurate but the saving is only true if the compounded hours are used effectively elsewhere—a far harder calculation to make. It is certainly true that on-line directories have saved the cost associated with paper-based publications, and are more readily kept up-to-date. More significantly they have enabled very effective teamwork throughout the company. ClickDial is simply another element in that efficiency chain. It enables people to teamwork more effectively while saving time.

Future ClickDial services concentrate exclusively on effective teamwork, and with a target of 20 000 internal users there is potential for significant impact.

The majority of office-based telephone users within BT have an internal BTnet number as well as an external number. By maximising the usage of the existing internal voice network, public switched telephone network (PSTN) capacity would be freed for revenue generating calls. This would also allow them to take advantage of private network supplementary services such as ring back when free. Innovative graphics could draw users towards the internal numbers; a more draconian approach would see the removal of the ClickDial service for calling BT colleagues via external numbers or the automatic use of internal numbers.

For BT customers, similar manpower savings could be achieved and the utilisation of internal networks improved. The majority of customers initially purchase CTI for call centre environments and struggle to extend benefits beyond. ClickDial provides that step from call centre to office desktop. It provides a solution that integrates intranet-based directory services with voice services and repositions voice with e-mail and access to the Web. A user can now use the same interface to make a call or send an e-mail.

BT has a strong brand for both voice and data services. Within the office environment BT's voice brand is often visible on plastic telephones. ClickDial places the voice brand at the browser level as well as the plastic. It presents the BT brand to callers each time they think about making a call.

Operation and Security

This section describes the way the ClickDial service works, for both first- and third-party users—see panel. Registration, dialling and security issues are covered. Figure 2 portrays a schematic description. An initial registration associates a particular PC with a particular telephone. In Figure 2, the first-party user on the left

First and Third-Party CTI

CTI can be considered to come in two different flavours—first- and third-party—analogous to insurance!

First-party CTI users monitor and control only their own telephone line, using local software and hardware. They have no knowledge or control of any other telephone line. An example of a first-party application is BT's Callscape.

Third-party CTI users have their telephones monitored and controlled by a server acting on their behalf as a third-party. For example, they can be informed when a particular colleague's telephone is ringing and not being answered, and can opt to instruct the telephone layer (for example, a PBX) to move the call from the colleague's desk to their own, thus enabling a customer's call to be correctly handled.

See Reference 1 for fuller descriptions.

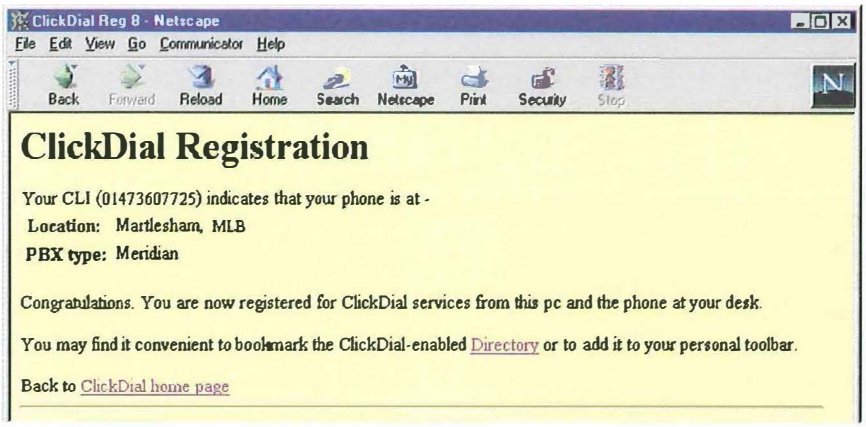


Figure 3—A successful registration notification

has a local application and telephony hardware that controls his/her telephone line. For example, BT's Callscape[2] product sits between the telephone line and the PC's serial port. Other first-party applications include: video telephony cards, which will automatically make video calls where applicable, modems, PC interface cards in special telephones (for example, Nortel's Meridian Communications Adapter (MCA) card) and *softphones* (that is, telephones implemented by software on PCs).

On the right in Figure 2 is a third-party user. His/her telephone line is connected to a PBX which is controlled via a web interface. This particular PBX is shown as a 'traditional' PBX, with discrete wiring to each user's telephone. However, web-enabled PBXs now come in both the 'hard' and 'soft' varieties, and both offer the same control to the ClickDial service. Whether a user wants to talk over a standard wired 64 kbit/s connection, or use a voice-over-IP telephone link using just the Web[3] makes no difference to the ClickDial service. (Here the term *web-enabled PBX* is used to mean a PBX that is controlled and monitored by a CTI server over a web interface. A 'soft' PBX is one implemented in software, typically for voice-over-IP use).

Dialling

For first-party ClickDial, the dial request goes from browser to server and back to the originating browser to invoke the dialling process via a local browser helper application. Although an external server is involved, its only function is to relay dialling information from the client's browser back to the helper, with information about which first-party application to use. This allows the HTML page containing the telephone number to have exactly the same format irrespective of whether it is used by a first- or third-party client. There is no security risk here because the dialling process is carried out on the same machine that initiated the dialling request and the PC user has legitimate access to any telephone connected to the PC by the first-party interface.

Third-party ClickDial is not so straightforward. The dial request goes from browser to server where it must be passed on to the right PBX, together with the number of the right telephone from which the call is to be dialled. The information required to select the right PBX and number is passed to the server in a *cookie* (see panel) which is set up by a registration procedure that associates the PC with a particular telephone. The security of third-party ClickDial depends crucially on the registration procedure and the structure of the cookie.

Registration

A third-party registration attempt is initiated when a user accesses a World Wide Web (WWW) page from a browser where the user has legitimate access to the PC and a telephone. This page gives a telephone number, a nine-digit random number, and instructions to dial the number and enter the random digits on the telephone keypad. A CTI application answers the call, plays an announcement, reads the nine digits using the interactive voice response (IVR) unit shown in Figure 2, determines the calling line identity (CLI) of the user, and passes the digits and CLI to the ClickDial server.

If the server receives a valid CLI and a nine-digit number which matches one that has recently been sent out to a browser, then the CLI identifies the telephone to be associated with that browser. The user has been forced to use the browser and telephone simultaneously, thus prohibiting bogus operation. A database allows PBXs to be identified from BT's internal CLIs. Any subsequent requests from the same browser also need to be recognised, and this is done by including a temporary registration cookie on the initial page, containing the nine-digit random number.

When the user clicks the 'Next Step' button on the registration page, the request to the ClickDial server includes the temporary cookie which has just been set, containing the nine-digit number. If a valid CLI has been recorded against this number, the server returns details of the PBX and telephone number (Figure 3). If ClickDial services from that PBX or number cannot be offered, this is also explained on the page and the registration cookie is removed. If registration is successful, the registration cookie is replaced with a long-term ClickDial cookie.

First-party registration is much simpler. An HTML form listing a variety of supported applications is completed by the user in order of preference, and any extra leading digits entered (for example, a '9' may be required when dialling via a modem on a PBX line, but no prefix is required when dialling via Callscape on a PSTN line). This information is coded into the cookie.

Security

A ClickDial cookie contains a name and password, but the user does not

Cookies

A cookie is a small block of information sent from a web server to be stored in a web browser. Whenever that browser makes a subsequent request to the same web server (or one in the same domain) the same block of information is returned to that server. By this means a server can attach an identity to each of its clients, which not only distinguishes between them but allows details of their peculiarities to be passed to the server with each transaction.

need to be aware of either of these. The name is constructed from the PBX and telephone number of the user (determined at registration time) and provides a pointer to the user's details, which are stored on the ClickDial server. The password is a 32-bit random number generated by the ClickDial server and stored with the user's details.

If a user attempts to register with several telephones, each new registration generates a new cookie which overwrites any previous one, so that only the last registration is effective. Several users may register with the same telephone, but in this case ClickDial treats them all as if they are the same user.

When the ClickDial server receives a request to make a call, it expects to receive a cookie and the number to be dialled. If the cookie is absent or cannot be interpreted, a page is returned to take the user through the registration process. If it is found to be a first-party cookie, the number to be dialled is passed back to the user's browser, which ends the transaction. Otherwise, the received password is checked against the password stored against the received name and if there is any discrepancy a registration page is returned, otherwise the name is decoded to give the PBX and originating phone, and the dialling request is passed on.

The strength of this method is that it can be made as secure as required against forgery by increasing the size of the password, but it offers no protection against copying cookies. To the ClickDial server, the only evidence of the user's identity is contained within the cookie. A check could be made against the IP address of the browser making the request, but this would fail in the case of dynamically-set IP addresses (using dynamic host configuration protocol (DHCP)). In this case a PIN could be used as additional security.

Normal PC security precautions should minimise the risk of allowing a cookie to be copied, but even if a cookie did fall into fraudulent hands, the perpetrator could not benefit from the call (unless physically at the telephone in which case he/she could dial it directly), although there would be the expense of a premium rate call or the nuisance value of a call to someone inappropriate.

There are several defences against fraudulent activity, one of which is the transaction log which records the timestamp and IP address from which each request originated. A user who suspects someone else is attempting to use his/her telephone can access the 'Cancel Registration' WWW page, which will immediately invalidate all existing cookies associated with the telephone. If the user is not registered to the telephone, this will not work—the user must first register to establish his/her own bona fides. A fast-track de-registration is being incorporated in which a call from a user's telephone to a publicised number immediately cancels all cookies associated with the telephone. After de-registering, a user may then re-register in the certainty (to one in 4 billion!) that the new cookie is now the only valid cookie for the telephone.

In summary, ClickDial registration requires simultaneous use of both browser and telephone. Thus, ClickDial gives even greater security than either telephones or PCs give separately.

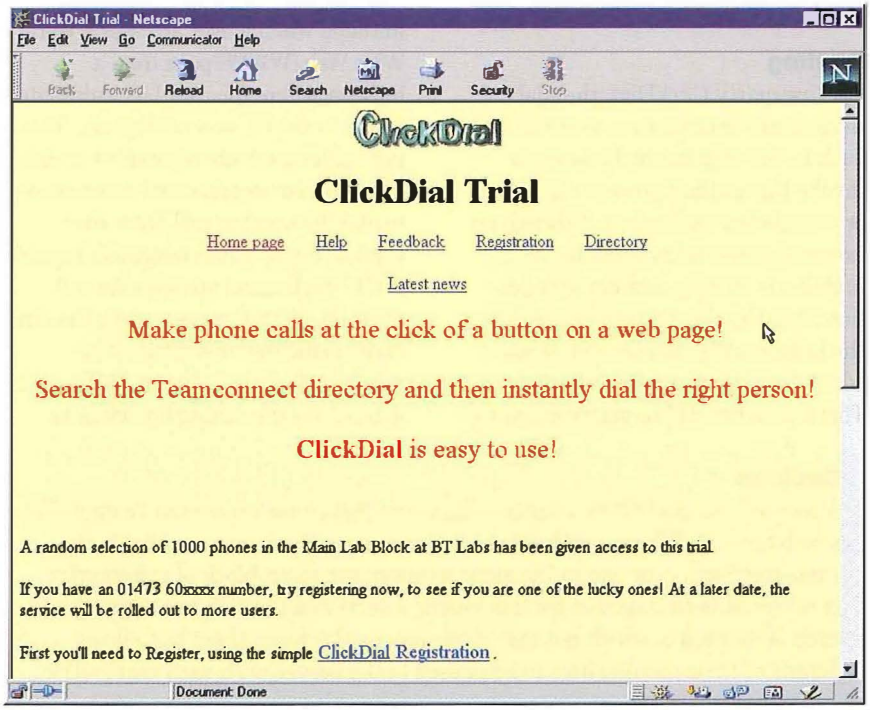
ClickDial Trial

With any new service, assumptions have to be made about how people will react and use the service. The purpose of the BT Laboratories' trial of ClickDial was to test those assumptions, verify service launch and maintenance processes, and understand the impact on voice and intranet services.

During development, ClickDial was used by a small select CTI-aware group on development PBXs, the impact of which could be controlled.

Prior to trial launch, access to live PBXs and use of Directory Service information were negotiated. Professional voice recordings were required for the registration process and well-designed web pages with consistent use of language and clear instructions (Figure 4 shows the home page). A clear and attractive

Figure 4—ClickDial trial homepage



ClickDial button and logo were designed. Target users were identified and their telephone sets enabled for CTI. The biggest challenges were to predict registration volumes and hence system load, and to protect the PBX from any unexpected CTI overload conditions. Feedback routes were provided for users, and statistics maintained and analysed on how users registered and used the service.

Over a period of six working days the target audience of 1000 users was gradually informed by e-mail of the trial. To test ClickDial fully, including its ability to detect line and PBX characteristics, a very small number of users who would not be able to register were also informed. When they attempted to register on first usage, ClickDial responded with information describing fully why they were not able to take part (for example, non-enabled telephones or PBXs). The project team experimented by changing the number of e-mails sent each day, settling at 200. As registration consumes scarce resources, which after the initial launch would be used infrequently, only one person could register at a time. This process takes less than 20 seconds, during which time others' calls are queued, giving them ringing tone.

Within 10 days over 300 people had successfully registered for ClickDial—a figure that now stands at 500 spread across three Meridian PBXs and two BT sites, Eaton Court and BT Laboratories. Individual use varies widely, from some making an average of less than one call a day to others who have made over 15 a day. Those employed at BT Laboratories to develop systems focus on progressing deliverables and appear to make fewer calls than those in organisational jobs. So calling rates and savings will differ elsewhere in BT. Over 58% of users at BT Laboratories make less than one call a day using ClickDial. At the other extreme those within the Customer Centre arranging customer visits make on average 15 calls a day and represent 2% of the user base.

The trial experience and results have been directly fed into the architecture design for a 20 000 user system to be deployed gradually throughout BT supporting various browsers, with appropriately dimensioned registration resources, call profiling, and overall system performance.

Where Next?

So far this article has discussed the basic operation of the ClickDial service that makes telephony calls from a mouse click, by associating the PC with the telephone. However, this is just the start of what is possible. The whole architecture of ClickDial has been created with the aim of making it expandable and able to carry more and different services.

The basic ClickDial button sends a dial request to the server, which determines which web-enabled PBX or application to use, and forwards the message in a suitable format to the appropriate destination. Other CTI requests can be made in a similar way (for example, Clear, Answer, Hold etc. can be sent), making the web browser a softphone in its own right. It was noted during the trial that users with headsets (generally people who are on the telephone a lot) found it disruptive to their work to have to clear or answer a call manually on the telephone instrument, while dialling is done from the screen. Part of the development work therefore concentrated on giving such users an enhanced interface, with extra buttons on the web pages for these other facilities. These were tested with selected users and went down very well, being regularly used.

Growth to cover additional switches as they become web-enabled merely entails updating the ClickDial server's PBX configuration database and adding extra drivers. Handling new services is achieved by the addition of extra cgi scripts on the web server which then run different processes.

All the services discussed so far use basic browser technology—they do not need enhancements such as Java

Figure 5—E-mail with ClickDial shortcut

or JavaScript. By adding in these extras, a variety of new services can be created that build on the simple dialling service. Once registered with ClickDial, the system knows the PC/telephone association and can use that knowledge in a variety of ways. For example, if an incoming call is received by the telephone, then the CTI layer will spot this, pick off the CLI if available, consult a reverse-search directory to determine the caller and relevant information, and then pop a window (via Java in the browser) with the full details of the call. Once again, there is no software resident on the PC apart from the browser. This is readily extended to include details of missed calls, so that they can be returned later.

One persistent problem in businesses is having the right telephone numbers to hand. Hard copies at a desk or filed on a PC are all very well if one is actually at the desk. However, visit another office location and the data is out of reach. To get round this, the concept of central personal directories comes to the rescue. By storing the data centrally, and accessing/editing it via a web browser (with appropriate password protection where necessary), it can be viewed from anywhere. Adding ClickDial to this directory means that the data is now diallable from anywhere.

Through ClickDial, telephone numbers become more than just digit sequences—they can be seen as URLs and can be included (like any other URL) in an e-mail or document, either as a basic URL, or as an Internet shortcut as shown in the open e-mail in Figure 5. Clicking on the shortcut will 'fetch' the URL, in

this case requesting a call to the URL's telephone number, using the user's browser (and cookie information) to place the call. Thus contact information can be readily passed around.

A 'floating' ClickDialler has been trialled, comprising a browser mini-window containing a text entry box for the telephone number, and a drop-down list of past calls. Any number can be cut-and-pasted into the box and quickly dialled, and previous calls redialled. This allows telephone numbers from any application to be dialled. Taking this further, ClickDial can be integrated with proprietary contacts databases, to allow first- or third-party CTI users to dial any number swiftly.

Acknowledgements

All trademarks acknowledged.

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Glossary

BTnet BT's internal telephone network
cgi Common gateway interface
CLI Calling line identity
CTI Computer telephony integration
DHCP Dynamic host configuration protocol
FAQ Frequently asked questions (plus answers!)
HTML Hyper-text markup language
IP Internet protocol
IVR Interactive voice response
MCA Meridian communications adapter
PBX Private branch exchange
PC Personal computer (used in this article as a generic term for any user computer terminal)
PSTN Public switched telephone network
URL Uniform resource locator
WWW World Wide Web

Biographies

Robert Brockbank
Networks and Information Services, BT UK

Robert Brockbank joined BT in 1975, after graduating from Oxford University with a First in Engineering Science, to work on analogue and then digital submarine cable systems. He was involved in laying and testing the world's first optical-fibre submarine cable system and was a member of the team that was awarded the Queen's Award for Technology in 1990 for designing and building the ultra-high reliability optical receivers for international submarine cable links. From 1990–1992 he was seconded to BT&D, the joint venture set up by BT and DuPont for the manufacture of optical communication components, to develop production line test equipment. He moved back to BT Laboratories and joined his present CTI Team, part of the Middleware and Applications Unit, where he specialises in the applications, architectures and capabilities of CTI. He has filed patents on various aspects of CTI, is a Chartered Engineer and a member of the IEE.

Gary Crook
Networks and Information Services, BT UK

Gary Crook joined BT as an apprentice in 1981 within the Oxford Telephone Area. After graduating from Essex University with a B.Sc in Electronics and Communications he joined the London Software Engineering Centre where he worked on PBX systems integration and Radiopaging call control developments. He joined his present team, the CTI Team, part of the Middleware and Applications Unit, in 1990 specialising in call centre applications, architectures, capabilities and standards. Developments now focus on personal productivity and web access to CTI-enabled switches with a team of 10 engineers. He now hosts customers from the industry sector to BT Laboratories, presents and develops the future of CTI and has represented BT at international CTI industry bodies. He has a Diploma in Management Studies.

Derek Emerson
Networks and Information Services, BT UK

Derek Emerson is now in the CTI Team, part of the Middleware and Applications Unit, where he has worked on several computer-telephony applications since 1995. Before that he worked on antenna design, forward error correction and radio propagation. He joined BT in 1975 with a D.Phil. from Sussex University where he studied magnetic properties of dilute alloys.

Dennis Sheat and Stephen Thompson

Intelligent Transport Systems Applications for the Future

Intelligent transport systems (ITS) comprise a wide range of novel tools for managing transport networks and providing services for travellers. Future applications for ITS can be broadly grouped into five main areas: transport information, future vehicles, vehicle monitoring and control, transport infrastructure management and payment. This article describes a vision of the future exploring the use of IT and telecommunications in the transport industry with the objective of identifying new opportunities in this market sector.

Introduction

This article describes a vision of the future exploring the use of IT and telecommunications in the transport industry. The objective is to use technology forecasting in a market environment to establish and identify new opportunities in a particular market sector. This links the research and development of new technologies with the future applications that will use them.

In recent years, use of public transport in general has declined with an increasing dependence on cars. In the UK alone, it has been estimated that routine traffic congestion costs some £15 billion per year[1]. Currently, an average of 15 major incidents occur every day on the motorway network involving at least two lane closures and lasting for at least an hour. There is likely to be increased demand to travel with continued economic growth, increased urbanisation in the UK and more distributed friends and families. For the UK, the Department of Environment, Transport and the Regions predicts that car ownership will grow by 50 per cent over the next 30 years to some 33 million cars, and traffic will increase by 60 per cent[2]. Without a substantial shift in the travelling habits of the public, this will lead to increased congestion. Concern over the environmental impact of traffic is also increasing.

Intelligent transport systems

Telecommunications has a key role to play in substituting for travel. Home shopping, the use of electronic commerce, teleworking and teleconferencing are among the telecommunications technologies which may well reduce routine domestic and business travel. However, it is clear that the desire to travel for business and leisure will continue.

Telecommunications can also be used in a wide variety of ways in the field of intelligent transport systems (ITS). Intelligent transport systems, or transport telematics, comprise a wide range of novel tools for managing transport networks, as well as services for travellers. ITS tools are based on three core features: information, communications and integration. The collection, processing, integration and supply of information is at the heart of ITS. Whether offering real-time information about current conditions of a transport network, or on-line information for journey planning, ITS tools enable local authorities, operators and individual travellers to make better informed and more intelligent decisions.

The European Union recognises that ITS will:

- make driving safer and easier with fewer delays;
- provide logistical and management support to transport service providers and fleet managers;
- allow highway authorities to make more efficient use of the infrastructure;

- give policy makers an alternative to road building; and
- have a positive effect on the environment by encouraging the use of public transport.

Future Application Areas for ITS

The future applications for ITS can be broadly grouped into five main areas: transport information, future vehicles, vehicle monitoring and control, transport infrastructure management and payment. The following sections expand on these areas giving illustrative examples of the key applications.

Transport information

Transport information can be categorised into two main areas: in-car information and public transport information.

In-car information

There is considerable momentum behind the provision of in-car information. The radio has traditionally been used to provide traffic reports to the driver. Unfortunately, radio tends to give wide-area travel information most of which is not relevant to the individual driver. It does not have the capacity to deliver the large amount of local information that is currently gathered. The introduction of next-generation traffic data services such as RDS—TMC (Radio Data Services—Traffic Message Channel)[3] and TPEG (Traffic Protocol Expert Group)[4] over digital audio broadcasting (DAB) is likely to improve the relevance of the information.

Recent services such as Cellnet's Traffic Line[5], which provides real-time information on the state of the main trunk network (motorways and major A roads) over a cellular telephone, have shown the latent demand for these types of services. This gives congestion information based on data received from the Trafficmaster network of sensors[6]. The system uses the global system for mobile communications (GSM) cell-location identifier to determine the position of the telephone making the call so the information is up-to-date and personal. A device in the car warns of congestion ahead to allow the driver to make the call and avoid the hold up if possible.

Applications such as dynamic route guidance, local points of interest and information services will be available inside the car of the future. The majority of car manufacturers are investigating systems linking GPS receivers with GSM modules and a display built in the car. For example, the new S-Type Jaguar, launched in March 1999, is one of the first to have dynamic traffic information displayed on a digital map. In the future, it is predicted that route guidance will become personalised. Individuals will receive unique advice designed to optimise the route to their destination. This will be linked to the traffic management of the system to allow traffic levels to be balanced across the whole road network.

Perhaps most significant in this area is the development of the *Auto PC*[7]. The Auto PC is an in-vehicle computer integrating navigation, audio, cellular telephony and e-mail, and potentially vehicle diagnostics—all fitted into a single DIN standard slot in the dashboard. The Auto PC uses Microsoft's Windows CE platform and provides considerable promise for the ITS industry. This is partly because it is an open computing platform for vehicles that is supported by many computer and in-car entertainment manufacturers, although some manufacturers have voiced doubts over its robustness. However, Microsoft's entry into the marketplace will undoubtedly increase consumer awareness of ITS products and services. The Auto PC is available now in limited areas of the US, with full US availability expected later in 1999. The French car manufacturer PSA (Peugeot and Citroen) may be the first to offer the Auto PC as an option in its vehicles. It could be 2000–2001 before the units are fitted during production.

In-car information is predicted to be an important area for future applications and services. There is an opportunity to provide a wide range of high-value services based on the provision of points of interest information, real-time data and services such as e-mail and Internet access to the vehicle. In the long-term, in-car devices are likely to be based on standard mobile technologies, and it is expected that these will be used in all forms of transport. Imagine a journey in the future where your car guides you to your destination avoiding congestion. You can book a local hotel and restaurant and visit the local tourist information centre to plan your visit, all without leaving the comfort of your car.

Public transport information

It is widely suggested that comprehensive public transport information is key in encouraging a shift from the car to collective transport. It is, of course, important that information is accurate, reliable and widely accessible. The UK Government White Paper on Integrated Transport[8] has stated the aim of a national public transport enquiry service by 2000. This will probably build on the existing services such as the National Rail Enquiry Service (NRES), 0345 48 49 50. Initially the information provided will be static timetables, but it is predicted that this will migrate to become dynamic, real-time and cover all modes of transport in the near future. The NRES number is the most heavily called lo-call number attracting about 50 million calls a year. Similarly the Railtrack journey planner web site[9] is also proving popular with 650 000 enquiries per week growing at some 15 per cent per month (as of June 98)[10]. This illustrates the demand for public transport information.

The Superoute 66 Live web site (Figure 1), developed by BT, is a good example of real-time public transport information services. The delivery of real-time bus information via the

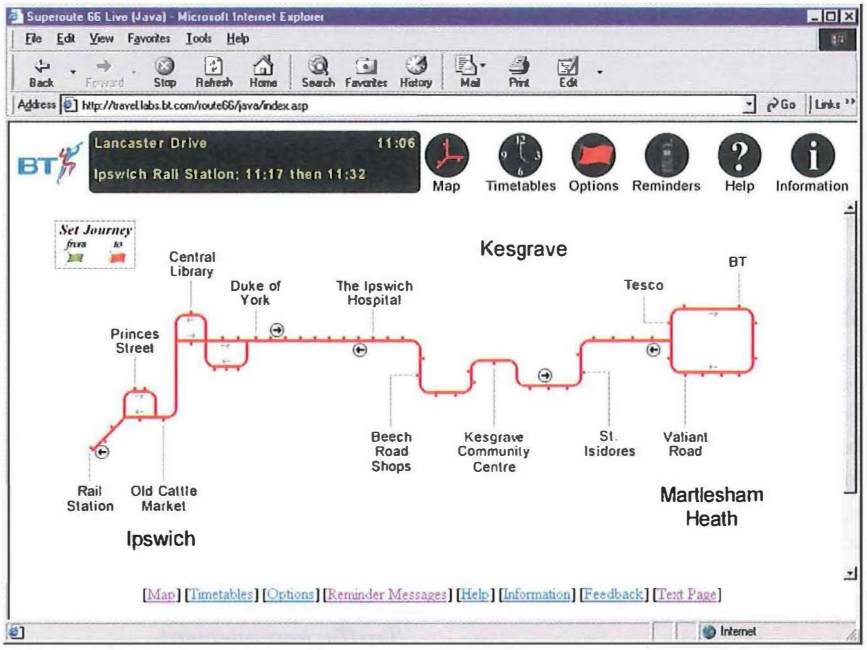

Figure 1—The Superoute 66 Live Java web page (http://travel.labs.bt.com/route66/)

Internet, to mobile telephones using the short message service (SMS) and smart messaging, to pagers and over the telephone with interactive voice response[11] have been illustrated. The provision of the information has been shown to be useful and has reduced waiting times at bus stops. Similar real-time information systems for buses are installed or planned in a number of cities around the UK. Evidence from these shows an increase in bus patronage.

Opportunities exist to provide the infrastructure for the national public transport enquiry system. As the information becomes dynamic, new services providing real-time travel planning and guidance will become viable. Public transport information could guarantee journey times and make delays and cancellations become a thing of the past.

Future vehicles

Car manufacturers are increasingly putting advanced electronics and computing into their vehicles. Currently 8–10 per cent of the vehicle cost is in the electronics. This is predicted[12] to double by 2010. A range of automated systems designed to assist the driver is likely in the future. It is predicted[13] that some 1·2 million cars in the US will have some form of ITS service by 2003. In the US, FCC regulation requires the position of a mobile telephone making an emergency call to be passed on to the emergency services by the year 2001[14].

Automatic emergency alerts

Since September 1996, purchasers of GM's luxury cars in the US have been able to equip them with OnStar; a cellular telephone, onboard electronics, combined with global positioning system (GPS) technology to link the driver to the OnStar Centre where operators can instantly locate the car and respond to any number of emergencies[15]. For example, when an airbag deploys, the car's system automatically notifies the centre. An operator can check on the occupants' condition and alert the local emergency teams. The system can also detect unauthorised entry and track stolen vehicles. Subscribers can get immediate remote diagnostics of the vehicle's engine, transmission and brake system. Drivers who cannot find their car in a large car park can call the OnStar Centre who will activate the car's horn and flash its lights. Similarly, if the owner locks himself out, the centre can issue a remote command to unlock the doors.

The short-term opportunity for cellular telephone companies is clear. However, opportunities to offer value-added services based on the use of the GPS to give the vehicle position and the GSM technology for communications will develop. Once an installed base of vehicles exists they could provide further valuable information on the state of the road network.

Intelligent speed adaptation

Intelligent speed adaptation modifies the speed of the vehicle dynamically depending on the road conditions or local speed restrictions. While it is perceived to be unpopular from the driver's perspective, there is considerable evidence that reducing speed would reduce the level of accidents. The EU is looking at the use of intelligent speed adaptation across Europe. Recent trials in Sweden with radio transmitters linking the local speed restriction to the car and an active accelerator pedal have shown very promising results. Drivers responded favourably. Interestingly, there was also a three per cent fuel reduction and 15 per cent CO emission reduction owing to reduced speeds and smooth acceleration. The work is continuing and is now looking at GPS-based technology to remove the need for expensive infrastructure.

Intelligent cruise control

Intelligent cruise control allows the driver to set a cruise speed, the car will then maintain this but also take account of other road users—the speed will decrease if the car in front gets too close. This system relies on detecting the road vehicles around the intelligent car but does not require communication between them. Early systems are being proposed for top-of-the-range luxury models. The new Mercedes-Benz S Class will have an adaptive cruise control system which automatically keeps the car a constant safe distance from the car in front. This will be launched initially in Europe.

On commercial vehicles, Daimler-Benz is soon to offer a lane tracker recognition warning system. This will recognise an unplanned lane departure and warn the driver with an alarm. Recent studies by the National Highway Transportation Safety Authority estimate that 32 per cent of highway fatalities in the US were associated with single vehicle road departures.

Automated highways

These are systems that allow the maximum capacity of the road network to be realised. Several

vehicles are linked together using wireless communications. The automated nature of the 'road train' allows much closer spacing and smoother speeds than would be possible under human control. Several trials of such systems have been carried out with cars and lorries; however, it is likely to be some time before this kind of system is in mass use.

Vehicle monitoring and control

Fleet management

It has been shown that significant advantages can be gained with the use of intelligent fleet management. BT has developed Pinpoint, a system using GPS location devices transmitting over the GSM network. This area has considerable potential as it is predicted that most large fleets of vehicles will be equipped with systems to allow management.

Emergency vehicle control

Improvements in efficiency have been gained by the introduction of an automatic vehicle location system to several ambulance fleets. Whereas the Manchester Ambulance Service previously achieved 60 per cent of activations of its fleet with three minutes it now achieves 99 per cent of them. The response of the service has also improved, from 58 per cent to 68 per cent within eight minutes (the target is 50 per cent).

Vehicle and load security

Many of the vehicle tracking systems currently allow vehicle and load security. BT's Webtrack[16] product allows a vehicle or load to be tracked anywhere in the world using satellite communication and for the results to be accessed securely over the Internet or an intranet from any location.

The use of vehicle monitoring and control could be extended to buses. A personalised bus service of the future might use sophisticated IT to provide collective transport on an individual basis. The bus could pick you up at your home or an agreed close location and take you to your destination all at a time to suit you. The onboard tracking and guidance system would direct the bus driver along the optimised route. Similar systems could be developed for dynamic car sharing. Key to these would be the underlying telecommunications and IT infrastructure.

Transport infrastructure management

Traffic management

Most large cities now operate linked traffic lights and central traffic management. Networks link the signals at junctions across the road system and traffic management algorithms control the phase and timing of the signals to maximise throughput and minimise congestion. Systems such as the SCOOT[17] traffic control system have been shown to give significant improvements. For example, application of a SCOOT traffic signal system in Aberdeen produced a 38 per cent reduction in total delay and 32 per cent reduction in the number of congested intervals.

Networked variable message signs can be used to inform and direct road users. For example, application of a regional inter-urban variable message sign system in Central Scotland has led to savings of £85 000 for road works on the Forth Road Bridge and over an eight-month period savings in vehicle operating costs and driver time amounted to over £200 000.

Such has been the success of local traffic control centres in cities that the Government wishes to extend the principle to the trunk network. The Highways Agency is currently evaluating bids for the traffic control centre (TCC), a central control facility to monitor and inform traffic on the English trunk network (Scotland and Wales have already implemented similar centres). It is anticipated that considerable improvements in traffic flow could be achieved. The opportunity to run the TCC as a revenue generating concern is being actively explored. The sale of real-time traffic information from the trunk road network could be lucrative.

Congestion monitoring and pollution control

Local authorities in the UK are increasingly expected to control the level of traffic-related pollution in their areas. This will require the real-time monitoring of pollution levels coupled with system, to reduce traffic on high pollution days. Increasing congestion charging, varying routes and even banning traffic could be used. Telecommunications might be necessary to inform communities within identified high pollution risk areas.

Payment

Road tolling

There are now two main approaches to electronic road tolling. Traditionally, a dedicated short-range communications (DSRC) system has been used to detect the passage of the vehicle. This requires a gantry over the road with the relevant equipment installed. Now GPS or differential GPS with some form of dead reckoning is being suggested. This removes the need for costly infrastructure installation and allows for more flexible tolling regimes. Road tolling is seen as a powerful weapon in the fight against congestion. The UK Government is about to start funding two major trials of tolling in an urban environment.

Smart ticketing

The use of smart cards in public transport is now generally accepted. It is estimated that there are some 135 schemes in public transport around the world. Transport applications already account for half of all turnover on stored value cards. There is no doubt that smart cards offer several advantages over the traditional systems. These include the speed with which passengers can be processed, reduced fraud, improved management information, flexible fare structures and an efficient reconcilia-

tion process. However, it is not clear that the use of smart cards alone is sufficient to attract larger numbers of additional passengers. Of course, additional functions like car parking charges can be added. This is probably desirable anyway. It is important that the smart card becomes the general travel card paying for parking, car tolling and so on, as well as being used on public transport. This maximises the number of cards in use and encourages people to make a comparison between public and private transport.

In 1999, all 14 000 coin operated parking meters in Hong Kong will have been replaced by a pay-and-display system that accepts smart card payment. The benefits are reduced maintenance, greater reliability and payment in advance. London Transport has initiated a major project installing smart cards across the tube and bus network.

Conclusions

The use of ITS is expected to bring great benefit to all forms of transport.

Imagine the year is 2017, ITS is everywhere, integrating seamlessly all forms of transport. Transport is more pleasant to use, safer and more efficient. Services are accessible, choices are easy to make, journeys are easy to plan and predictable. There has been a 15 per cent increase in accident survival rates thanks to in-vehicle automatic emergency call systems. Road safety has dramatically improved; ITS contributes to the reducing trend in road fatalities. ITS reduces travel time by 25 per cent, improving the overall quality of life. City centre pollution is halved due to enhanced urban traffic management and public transport priority measures reduce delay by 50 per cent. Automatic debiting and tolling systems save travellers over 40 hours every year, and freight and fleet operations are more efficient, cutting costs and supporting home shopping.

Acknowledgements

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Biographies

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Dennis Sheat graduated with a B.A. honours degree in Natural Sciences from Cambridge University in 1987, and gained an M.Sc. in Lasers and their Applications from the University of Essex in 1988. Since then he has worked at BT Laboratories, Ipswich. Recent work has included managing the Intelligent Transport Systems project and developing future application visions for the area. He is now managing the Customer Application Programme helping to evaluate solutions by working with external customers. Dennis Sheat can be contacted at dennis.sheat@bt.com

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Stephen Thompson joined BT in 1995 with an M.Eng. in Computer Systems and Software Engineering from the University of York. After working in configuration management for large software systems and call centres, he has been researching the applications of telecommunications in intelligent transport systems. The focus of this work has been on advanced traveller information systems, with demonstrations including the Superoute 66 Live real-time bus information system. He is a member of the Clear Zones Working Cities group, part of the Foresight programme, and has taken part in a DTI International Science and Technology Mission on Intelligent Transport Systems to South Korea. Stephen Thompson can be contacted at stephen.m.thompson@bt.com

Alwyn Lewis and Graham Cosier

Whither Video?—Pictorial Culture and Telepresence

This is the third of five articles about the future role of pictures in telecommunications. Part 1 described the invention of television and its contradictory character today—clear and close but reduced and remote[1]. Part 2 outlined the history of videotelephony and reviewed human behaviour in telecommunications, concluding that the signals do not always match the sentiments[2]. This third part discusses how video pictures can be made more appealing for telecommunications.

The Paradox of Video

Videotelephony is a paradox. It has succeeded in specific applications like teleconferencing but has failed to appeal to a mass market. Technical and economic limitations are often suggested to explain this failure. But the authors believe that larger pictures with higher quality at lower cost are not the entire solution to this paradox.

Our most frequent contact with pictures is for entertainment. Television has become so successful that it defines our expectations of what video pictures can do. It may seem obvious to adopt the pictorial culture of television as a guide to the development of videotelephony and telepresence. The authors believe this assumption is wrong and partly responsible for the historical unpopularity of videotelephony. Success can become a handicap, if it creates a tangle of unconscious assumptions.

Technology is not the only problem. Creating natural presence means more than attaching a high-quality camera and display to a telephone[3]. Conveying the behavioural aspects that simple telephony conceals has been equated with eye-to-eye contact[4], yet non-verbal human communication involves more than facial expressions. To study how video pictures can be made more appealing for telecommunications, some physical and artistic issues in the taking, making and viewing of pictures will be discussed.

The Power of a Picture

Every parent knows the importance of picture-making in childrens' development. Drawings are our natural approach to organising and understanding the world (Figure 1). Graphs, figures, sketches and mind-

Figure 1—Children's drawing about modes of transport

maps are important tools for adult thinking and for working collaboratively. The success of facsimile depends, in part, on our natural empathy with hand-drawn notes and sketches. Pictures are a major part of cultural richness in society.

Adult thought is traditionally text-centred and dominated by words, especially in higher education. Linear means of expression have encouraged linear ways of thinking, in what has been termed the *left-brain* or *logical* mode of thought. This has been to the detriment of a more flexible and creative outlook, often termed the *right-brain* or *pictorial* mode.

Chomsky and Piaget have, in different ways, argued that language skills are innate. But is the making of language more innate than the making of pictures? Young children make marks on walls and paper that describe objects not words. If we are so good as children at making and interpreting pictures, why do we neglect these skills in adulthood?

Kress suggests[5] that the growth of multimedia technology implies reasserting the importance of picture-making in education, to foster the creative imagination. Cochrane suggests a reorganisation of schools and universities[6], to exploit interactive multimedia technology for immersive, self-driven and self-questioning education.

Cinema Classics

Today's teenagers do not seem to think that old films, like 'The Thirty Nine Steps' or 'Casablanca', are wholly passé and boring. Children whose grandparents were born after these films were made can be captivated by them, despite spectacular competition from modern productions, with their fast editing, agile camera movements and bright colours. What attraction have these slow, staid and monochrome old films got?

The answer may well be natural presence. Classic cinema productions could afford to pay great attention to picture composition, choice of angle of view, depiction of body language and to environmental context, through careful planning of camera movements and subtle control of lighting. There is a sense of quality and meticulousness about these old films that is expensive to achieve today. Perhaps that is why modern teenagers can be moved by a film like 'Casablanca'. For a short while they too are in Morocco, in wartime and in love.

It is significant that the cinema industry calls the creation of pictures cinematography not camera work. Careful attention to the creation of pictures can be found in television too, in travel programmes and high-budget dramas. Even a small picture can be captivating, if skilfully created.

Why are Stills Moving?

Questions of presentation, perspective and perception strongly influence our sense of natural presence in pictures. One black-and-white photograph can sometimes capture an event more evocatively than several minutes of colour video footage. A great photograph can have a deep emotional impact, making us gaze and ponder. We have a strong cultural adaptation to expressions of the world in a frozen moment. Because the image does not move, it allows detailed inspection and introspection. Photographers know they have one chance to put all their knowledge into an image, from technical issues through to deeper levels of artistry and emotion.

Realism in Perspective

Advances in electro-optical and electronic technology have made video cameras much lighter and smaller. Shoulder-mounted cameras, with the lens at eye level, are now often used in broadcast television. Many amateur camcorder enthusiasts follow this style. It seems correct to duplicate the eye-level viewpoint of a surrogate observer. But we do not see perspective in an image the same way that we do in life.

If the camera axis is horizontal, the top half of the frame is wasted or the lower part of the subject is excluded (Figure 2(*a*)). Tilting the camera downward shows the whole body but makes the perspective unflattering (Figure 2(*b*)). To avoid this conflict, the cinema often uses cameras with the lens at chest or waist level. For the same reason, still photographers often crouch down when taking pictures of people—the results look more natural (Figure 2(*c*)). When judged

Figure 2 (a), (b) and (c)—The effect of optical perspective

by results, the eye-level camera position common in today's television seems to be a sacrifice of realism for convenience.

Making an Impression

A close-up view of the face can be a powerful expression of character. But the development of powerful zoom lenses and body-worn cameras has tempted television into an obsession with close-up pictures. This is most obvious in soap operas and sporting coverage.

A cup at a sporting event is presented to the victor. With an exultant yelp, she lofts it above her head. In television today, the common practice would be to zoom in and sacrifice body language for the sake of the greater impact of facial expression. Pictures that are 'in your face' seem like a good way of being right there, close to the action.

Classic cinematography would choose the opposite course, zooming out and sacrificing facial detail to show the athlete's arms and legs. The pulse of exultation that was born in her knees when she touched the cup, that rippled up her spine and threw itself out of her outstretched finger-tips, was the full measure of what it felt like to be right there.

Ever so Close

Sacrificing the subtle emotion of body language for the obvious drama of facial expression may be attractive in entertainment. But it is surely the wrong approach for telepresence and videotelephony. Stills photographers know that a close-up view is not automatically the best one. Figures 3(*a*) and 3(*b*) are two versions of the same picture of Winston Churchill. The close-up view might well have been taken at a happy family gathering. The wider view is unmistakably that of a tired but resolute war leader. Very similar facial expressions can accompany quite different states of mind.

Close-up views mean dicing with the devil. Used occasionally, such views are powerful and impressive. Used permanently, they deny our natural tendency to look around and can create a sense of ambiguity, remoteness or even alienation. Feeling involved in a distant place means sharing an awareness of the seemingly inconsequential surroundings (Figure 4).

Figure 4—Wide-angle immersion in the VisionDome (copyright British Telecommunications plc)

drunk are expressed more revealingly by their body language than by their dialogue or through their stereotyped expressions.

Even at quiet moments, body language is an important part of human communication and a vital aspect of creating a sense of surrogate presence in a remote location. It allows us to empathise with other people, so we can use our imagination to put ourselves in their place. Body language helps to make face-to-face contact scalable, so that communication is almost as easy in a group of 30 people meeting face-to-face as in a group of three.

Even at quiet moments, body language is an important part of human communication

All about Bodies

Classic cinema made selective and sparing use of close-up views, limited to points of high drama or significance. Medium- or wide-angle views were used frequently to show body language and the surroundings. John Ford's film 'The Man Who Shot Liberty Valance'[7] is a good example of this tradition. The diffident turmoil of James Stewart's lawyer or the rough diamond of John Wayne's

Visibility of body language can be more important than lip synchronisation, especially in a 'pending interjection' situation in group interactions. If all members of a group are shown in permanent close-up view, it is difficult to signal a pending interjection without seeming rude, unless the users know each other well. The alternatives are silence or interruption, degrading the effectiveness of social interaction.

Putting Ourselves Across

There are two kinds of body language. The absolute kind, such as

Figure 3(a) and (b)—Two views of Winston Churchill

gesture, which means the same from any angle and the relative kind, whose meaning depends on the angle of view. Conversations held face-to-face are not always held body-to-body, with people sitting or standing directly opposite each other. When people do meet in this way, it often signifies that the participants want privacy, perhaps because of argument or confidential conversation.

Photographs of people taken 'square on' to the camera tend to signify formality or a position of authority. We usually face computer screens at nearly zero degrees, giving our whole attention to the display as if to a document. If videotelephone users adopt this same frontal disposition, the resulting pictures can imply a formal or authoritative social position, or a private social interaction (Figure 5(*a*)).

Informality and relaxation in most photographs is signified by an angled disposition of body and limbs. In peer interactions, faces are often turned towards the talker but bodies are seldom set exactly 'square on'. When peer interaction or informality is intended, a slightly angled body position, with the head facing the camera, gives a more appropriate social impression in videotelephony (Figure 5(*b*)). The requirements of informal desktop videotelephony do not precisely match those of desktop computing on the same display.

Sounding Realistic

The introduction of sound in the cinema was a major challenge, in both technical and artistic terms. Multichannel sound is now a vital part of the cinema experience, emphasising the value of subjectively-accurate localisation and the reproduction of low-frequencies. NICAM coding and Dolby™ surround sound techniques have recently extended these techniques to television.

Telecommunications has traditionally placed more emphasis on clarity and intelligibility than on naturalness in sound quality. Many designs of videotelephone have followed this bias, to the detriment of a sense of natural presence. As Fluckiger says[8], pictures make telephone users less tolerant of technical and semantic distortions in the sound channel.

Our brains process sound and pictures in fundamentally different ways.

However, the effective use of high-quality sound requires care, since low-frequency background noise can become annoying. Videotelephony often uses handsfree speech, which needs good echo control[9].

Richness and Poverty

Our brains process sound and pictures in fundamentally different ways. Sound is always a single-stream process. Our hearing world is a cascade of transients, which are here then gone. Pictures are unlike sounds, because they are more than one thing at a time and more than one time at a thing. Our visual world is inherently parallel, multi-stream and enduring.

This difference has strong consequences for the creation of natural presence. We avoid information overload when listening to speech, preferring to hear one talker at a time. In pictures, we prefer information abundance. We like to come back for more and to be free to choose when to do so.

Pictures that are visually rich, that contain too much to see at one glance, seem closer to the real world. Such pictures can be compelling, creating of a sense of immersive involvement. Visually empoverished pictures, that give viewers little choice of where to look, can create a sense of distance or alienation. In videotelephony, such pictures risk being thought unrepresentative or irrelevant.

Points of View

A microphone hears all in a perspective that is a gradual function of distance. A lens sees partly, with a perpective that is an abrupt function of angle. Using one camera in a large videoconference gives all distant delegates the same view. This fosters an 'us and them' seating layout and might reinforce a sense of separation. For natural presence conferencing, multiple cameras could usefully give different delegates different viewpoints. Should such cameras be controlled locally, so that each delegate may 'give' their picture, or should they be controlled remotely by the distant delegates?

Figure 5—Body language in (a) frontal and (b) angled dispositions

Who's in Charge?

In telephony, the idea that I control your surrogate ears (microphone) but I do not know what you hear would quickly lead to confusion. Yet in videotelephony, the idea that I control your surrogate eyes (camera) but I do not know what you see is a common complaint. Users need to have as much control over how they are seen as over how they are heard. Only when the users can put themselves in the eye of the beholder will they feel almost as comfortable with videotelephony as with face-to-face conversation. Fixed cameras physically anchor and therefore mentally constrain users. Sometimes, no one is in charge of the composition of the pictures, which devalues their benefit.

Giving and Taking

Traditionally, photography is something done to us, or that we do to others. The phrase 'taking someone's picture' implies that the subject lacks control or even that some kind of theft is involved. In television, cinema and still photography, the visual representation of an actor is in someone else's hands. Only the theatre allows actors some immediate control over how they are seen.

Taking pictures is the wrong metaphor for videotelephony. Simple telephony is so successful and in such demand because its transactional and emotional metaphor is one of reciprocal giving, not reciprocal taking. This exactly matches our social motivation in face-to-face conversation—we like mutual giving.

Few people in Western countries think about 'giving my picture', but that is what ought to happen in videotelephony. The pictorial motive is to be seen by others as much as to see them. This is why the authors claim that the pictorial culture of television is fundamentally inappropriate to videotelephony. Successfully adding pictures to a telephone conversation means defining a new pictorial culture for communications, in both engineering and social terms, so that users are in control of 'giving' their pictures.

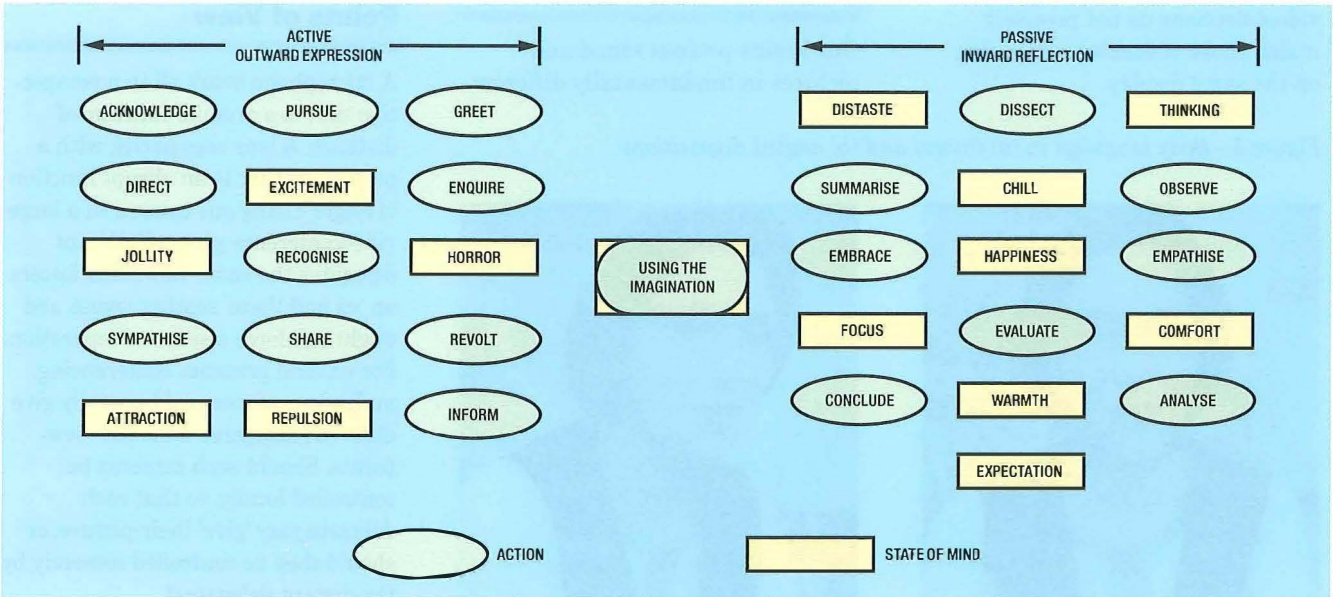
Taking pictures is the wrong metaphor for videotelephony.

Active and Passive

Listening is usually thought to be an active process, while looking is passive. This outlook is reinforced by the way that pictures now dominate entertainment. We produce speech but we consume pictures. This is why the videotelephone pictures have commonly been seen as adding passive emotional or social detail to the active speech channel[4].

But this divide is neither clear-cut nor logical when applied to two-way interaction of communication rather than the one-way flow of entertainment. In Figure 6 the active aspects of communication, that express attention, are grouped on the left with the passive aspects, linked with inward reflection, on the right. States of mind are shown in rectangles while actions are shown in ellipses. It is clear that actions can be involved in passive experience and that active experience can involve a state of mind. In particular, using the imagination can be active or passive and lead to a state of mind or an action.

Figure 6—Active and passive aspects of interactive communication



The use of pictures for communication has a different and more complex mapping of active and passive factors onto thought and expression than in entertainment. This puts pictures in a new light.

Gazing About in Groups

When attending a lecture or watching entertainment, we are a passive consumer. Our visual attention is mostly directed at the talker. This is the wrong model for communication with group videotelephony. When part of an interactive discussion, our visual attention is mobile. Even when listening, we are as likely to look around the room or at other listeners as much as at the talker. In face-to-face conversation and group discussion, we are not constrained to look fixedly at the head and shoulders of the talker.

We direct our attention onto relevant or deliberately irrelevant objects as part of the evolving cognitive interplay between hearing, thinking and observing. We are, in a cinematic sense, our own cinematographer and director. We are not only free to direct our gaze but we need to choose where, when and how to look around, in person-to-person and group interactions. The minimum standard of natural presence in videotelephony should therefore mean duplicating just enough of this freedom to be intriguing. In telepresence, relevance is not what it seems and too much choice is almost enough.

Questions

Supporting multi-modal interaction in telepresence, for person-to-person contact and for group discussions, means integrating pictures with other information such as spatially-localised sound, whiteboard, cordless pointer and computer data. Creating a strong sense of immersion or surrogate presence in such telepresence interactions raises difficult questions:

- What is the subjective value of bandwidth allocated to speech, whiteboard data, three-dimensional environments, spatial sound, computer data, pictures of whole rooms, pictures of whole people or pictures of faces?
- What is the relative value of close-up and wide-angle views, depending on the importance of emphasis and body language?
- What is the relationship between camera distance, overall magnification and display distance for optimum subjective effect in different applications?
- How does the purpose of the picture change with conversational interplay?
- Are there typical patterns in these changes?
- Should the choice of view be controlled locally, by the distant participants or by a combination of both approaches?
- Can user controls allow the socially-comfortable 'giving' of pictures?

Conclusions

Video technology can achieve a strong sense of natural presence, which is usually not an important aspect of broadcast television. That medium has an audience that can be instantly fickle, abandoning one programme for another. The commercial motives of television make it a poor exemplar for telepresence. The pictorial traditions of the theatre and cinema are probably more relevant to telepresence and videotelephony, because those media are free to exploit subtlety and slowness in building a sense of involvement.

Videotelephony faces complex issues, arising from its bi-directional and interactive nature. The strong difference of pictorial purpose that exists between entertainment and communication has a major impact on pictorial culture. This means looking at the art as well as the science of taking, making and viewing pictures. Videotelephone calls will never aspire to Oscar nominations for artistry, yet even ordinary pictures need not be artless. We choose our words with care, so why not do the same with our pictures? The technology of telepresence should make those choices easier than they currently are.

Coming Next

The next article in this series will examine the implications for the design of new videotelephony, telepresence and virtual-world multimedia communication systems, suggesting topics for further work.

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Biographies

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Alwyn Lewis is an advisor in Advanced Applications and Technologies, in Networks and Information Services, BT UK. He gained a B.A. from Cambridge University in 1971, and an M.Sc. from Essex University in 1972. After a spell with Plessey working on format-tracker vocoders, he joined BT Laboratories to work on acoustics, telephotonometry and telephone design. In 1984, he became head of a team developing a duplex hands-free telephone with a custom VLSI 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.

Graham Cosier
Networks and Information Services, BT UK

Prior to 1984, Grahama Cosier worked in the area of electro-acoustics and published several papers on auditory human perception which contributed to the British Standard for hands-free telephony. In 1986, he became involved with the emerging digital mobile radio system in Europe and was elected chairman of one of the technical groups that standardised GSM. In 1988, he became head of the group concerned with the assessment of coding methods, channel optimising techniques and echo control systems for increased utilisation of services using telephone networks. In 1994, he was appointed UK coordinator for ITU SG12, where he led the formation of the international standard for digital telephony. In 1995, he was appointed as the BT technical manager for the MIT Media Lab and was involved in establishing the UK Creative Art and Technology Centre. He is currently head of one of the units within the Applied Research and Technology Department at BT Laboratories where he leads several research teams looking into future telepresence systems, perceptual modelling, media environments, audio- and vision-based perception, gesture and affective communications. He is also the business support manager for BT Global marketing, championing a vision of 'through the screen telepresence'—the ultimate collaboration space, that will provide a 'better than real life' experience between remote locations with the vision that 'you don't have to be there, to be there'.

Shabir Azam

Immersive Virtual Environments

An Opportunity for Future Interactive Multimedia Retrieval Services

With the explosive growth of on-line interactive services just beginning, finding the required information is becoming increasingly difficult. User interfaces do not enable the majority of people to derive much benefit from these services. To entice mass appeal for such services an enhanced user paradigm is necessary which can be implemented on a diverse range of user platforms from PCs to television sets. This article examines a multi-user interface to on-line multimedia retrieval services that utilises a three-dimensional virtual world technology from Active Worlds[1]. This example is being developed as part of a BT Laboratories research project to develop a generic platform to support future interactive multimedia services, with delivery via a range of flexible end-user clients.

Introduction

Recent years have seen the emergence of numerous three-dimensional virtual environments connecting generally to a web-based server through some form of network access. Being new, there is still some uncertainty as to what the technology can offer above and beyond existing two-dimensional applications, and various possibilities are being explored. For example, in the area of entertainment several shared on-line games exist, such as BT Wireplay[2], in which users engage in games with others within virtual environments. Because of the great success of Wireplay, among others, several conventional computer games are also being considered for the creation of network-based multi-player versions.

Television provides a tried and tested outlet for a source of other experiments, such as *The Mirror*[1], in which a shared three-dimensional world was set up to run during the period of a television series devoted to the Internet—a place for viewers to meet those involved in the programme and other viewers. More ambitious still was *Heaven and Hell*, in which a live TV broadcast took place from within a shared world, for an hour in August 1997. Based on a typical television game format, some 150 users logged into the world and became part of the programme, which could be seen on a standard broadcast channel from various viewpoints by the conventional television audience.

However, this article is concerned with virtual worlds in which the primary aim of the world is to support on-line audio-visual and data retrieval services. A current research project is exploring ways in which the technology can be used to support future interactive multimedia services, concentrating on utilising emerging Internet tools. The approach being taken is to carry out investigations with leading-edge technologies to determine the problems that occur, prior to the design and implementation of a larger system.

As the physical world offers many metaphors that can be employed by three-dimensional interfaces to make access to underlying functions simpler, it is possible to take a very literal view of virtual spaces, with desks and chairs populating the space. In such virtual environments, however, awareness of other users, rather than representing complex applications, would probably be a better use of the spatial interface. This is especially true as many people are looking to work away from their traditional office: working either at home, or at a client site.

Technology Convergence

One of the major motivations underlying the current research is the technology convergence occurring within PCs, digital television and the plethora of multimedia games

† http://www.activeworlds.com
* http://www.wireplay.bt.co.uk

consoles. The processing power is ever increasing in the PC, and the general graphics capabilities are becoming really awesome. The new-generation graphics cards are extending the video rendering and playback capability of the PC as well as enhancing the general three-dimensional application performance. The next-generation television sets will be closely integrating much more of the set-top box and PC technology to aid interactive services; for example, Microsoft's WebTV. At the same time the enhanced functionality of standard PCs is increasingly able to adapt itself to offering interactive television services as well.

The phenomenal success of the multimedia games consoles on the other hand is largely due to the fact that they provide great processing power and capability, while still remaining very low cost. Furthermore, these consoles are truly 'plug and play' compatible along with user interfaces and paradigms being far more attractive than the usual WIMP/menu/click-on-link styles so prevalent in current on-line interactive services. The audio-visual capabilities of the current systems, such as Sony's Playstation, are really quite awesome, providing a highly immersive user experience. The major players in the console market are currently forging new alliances, such as the Sega and Microsoft's Dreamcast alliance. This increased competition in this hugely competitive market will ensure that the next-generation consoles will provide much more processing power as well as increased functionality, including enhanced network access, to enable the major players to maintain their market dominance or even increase their market share. The demographics shift has created a huge and still expanding market demand for these multimedia products.

In BT, some important technical lessons were learnt from the interactive TV trial[2,3] in Ipswich and Colchester, which ended in June 1996. Interactive TV is not much different from emerging on-line services, as far as users are concerned, and, at the systems level, many issues are already identical; that is, content management and the need to reduce operational costs.

The statistics for the Interactive TV system were:

- 2·2 Tbytes of on-line information;
- about 2000 hours of audio-visual material, each item a separate file;
- about 200 hours of material, churned regularly; and
- about 5000 stills per application.

Marketing colleagues estimate that, for a roll-out system, 10 times these figures would be necessary. Current web-based services (for example, BT WebWorld, TouchPoint, CampusWorld) also indicate that similar problems are emerging, even while the amount of audio-visual content is currently low (as the majority of users only have dial-up access).

There is certainly a huge expectation of an explosive increase in the demand for interactive services from the home as well as the business market. The domestic demand is for information and entertainment services, while the business demand is largely due to teleworking and emergent forms of virtual organisations, in which specific skills are required to be brought together to undertake particular projects for limited periods. These virtual environments lend themselves easily to explore opportunities to engage in informal communication especially in closed user-groups. Clearly, such encounters can occur only if the various distributed users are aware of each other's presence on-line, and can then initiate communication.

As already stressed, the systems need to be easily accessible to a mass market; thus it is important that the technology be relatively cheap and available on inexpensive, as well as on a variety of, end-user platforms, including PCs, television sets and possibly even multimedia games consoles. It is felt, however, that an interesting and novel candidate for a mass-market client platform of the future may well be an extensible multimedia games console, due to its versatility and the high level of user interaction offered. The display device in this instance for the home market would obviously be the television set. The PC would still probably remain the platform of choice for the business market at least for the medium term.

Linking Active Worlds and On-line Retrieval Services

As discussed above, it was decided to apply this three-dimensional shared-world technology as a means of assisting users in the access of on-line retrieval services, as well as being able to meet and talk to others. It is very important, however, to bear in mind that the motivation for any user using the system is to access content within it.

Active Worlds

Active Worlds is a shared three-dimensional-world technology that is also available over the Internet, and is typical of many of these technologies. Each user is represented by a figure, or avatar, which indicates their location and the direction of their attention; each user sees the world through the 'eyes' of his/her avatar. The avatars are moved through the world via the arrow cursor keys, although there is also a teleport and warp facility to get to distant areas very quickly. Participants can communicate with each other through text-chat, in the frame below the main three-dimensional-world display (see Figure 1) and there are various tools to help locate particular characters and to control other's access to oneself. There are many different worlds that the client

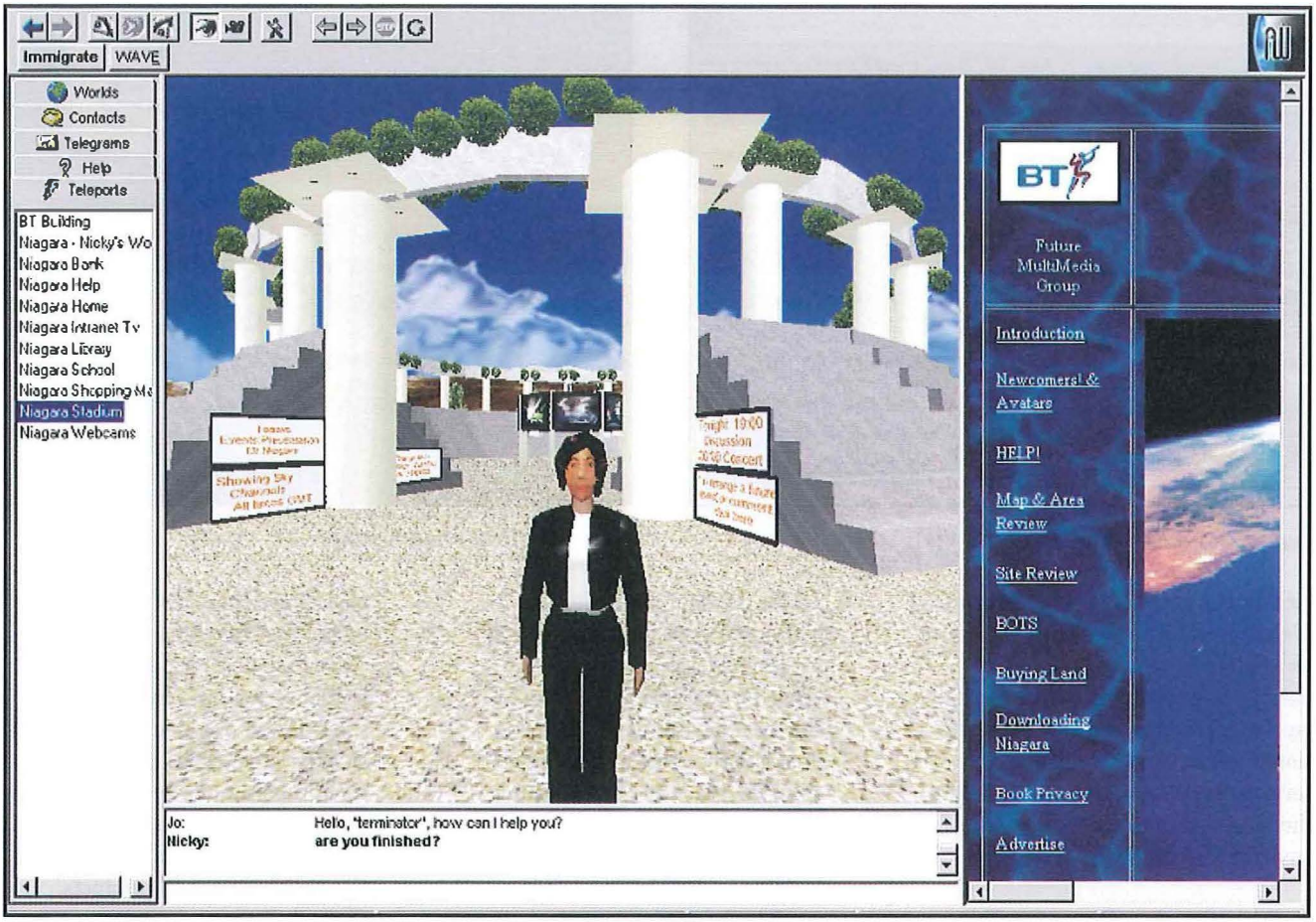


Figure 1 – External view of the Entrance to the World

browser can access, often based on cultural or fictional 'worlds'. The oldest and most popular, however, is AlphaWorld. There are two types of inhabitants in Active Worlds, 'fee-paying' citizens and 'non-fee paying' tourists, the major difference being that citizens are given rights to build in the world.

Active Worlds has a number of advantages over other systems, such as those from Blaxxun and Sony: it is one of the most complex and therefore more interesting and there is an existing kit of components which can be utilised to construct buildings in the world. One can either copy and move objects already found in the world, or select from a library of ready-made components, including floors, walls, roofs, panels (interior walls) and various household and office objects. The speed of construction that this facilitates allows for very rapid prototyping of design ideas.

Active Worlds also offers many features required to link effectively to on-line retrieval services, such as sound to enhance the user experience along with a low network bandwidth requirement to aid system scalability. Each object in the virtual world can be linked to existing web material, which appears in the associated web browser. Certain objects in the library allow for audio and video to be fed into them, and thus can be used to integrate such audio-visual tools into the world very quickly. Triggers can be set up in the world, which can then be used to activate sounds or images appropriately to enhance the immersive experience of the virtual environment.

The screen shot (Figure 1) shows the external view of the main entrance to the world, as seen through the Active Worlds browser. The automated avatar for greeting visitors is shown in the main window; below this is the chat box, in which the conversation between users within the area is displayed, as are messages from the system. Below that frame is a single-line frame in which the user types text to send to others. The frame on the right is an integrated standard web browser. Finally, the frame on the left is for user controls with functions for maintaining contact lists and teleports to various places of interest.

While the interface shown in Figure 1 is appropriate for the PC environment, it may not be suitable for the standard television set; therefore, more versatile and customised user interfaces will be necessary to maximise the appeal of these services to the mass market. These user interfaces may utilise the set-top box or possibly even the next-generation multimedia games consoles.

Sample application themes

The experimental server's virtual area was segmented into separate themes. Education club, real estates, e-commerce and business applications were chosen as appropriate themes for retrieval services. The basic idea was to link the objects in the virtual space to appropriate web-based content. That is, the content actually finds representation in the three-dimensional world. This ensures that users can easily access the web content without ever having to type in any complex web addresses. The secondary aim was to

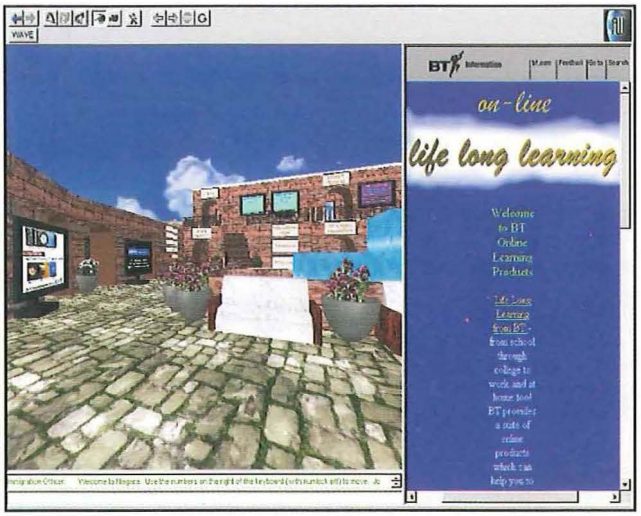


Figure 2—Education club

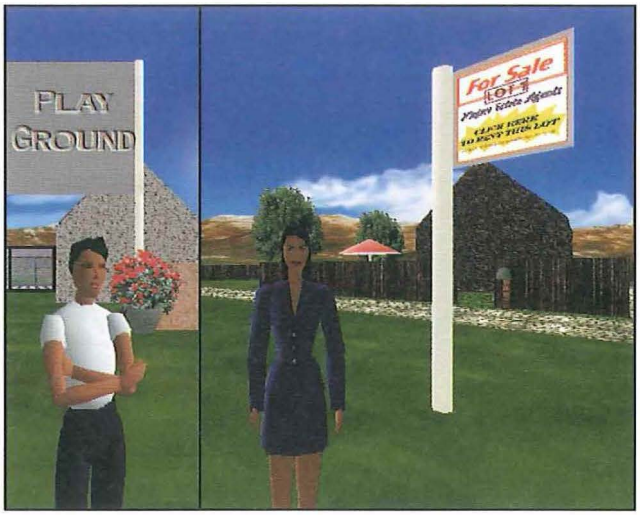


Figure 3—Real estate services

facilitate encounters between users of the system, the chance of encounters between avatars, and hence users, being mediated by the spatial layout imposed by the three-dimensional world. Some typical on-line services are chosen here to highlight the main features of this new user environment for such services:

- *Education club (Figure 2)* This space shows an educational establishment with various billboards on the walls of the buildings; these objects are then linked with the usual web-based content. The user can merely bump into the objects to see the relevant information. Automated *bots* can be used to help guide the users through their visit or just help with user requests for information in general. The bot is just an automated robot; in reality, it is a virtual avatar on the system and can perform the same actions as other users. Certain billboard objects in the world allow for easy integration of audio and video (for example, Web-cams) to enhance the user experience, and therefore the system offers great opportunity for distance learning applications as well. When users enter and move through the building to access content, it is possible that they might meet other users who are present and looking at similar content, leading to informal conversation regarding the common interest.

- *Real estate services (Figure 3)* The design of the layout is to ensure that the users get a feel for the environment in which they are in. The playground area allows people free access to experiment with building various objects to experience the ease with which it can be accomplished. These objects are then destroyed at the end of the current session. The commercial sector allows users to purchase various plots and build their dream place on it. These will then become owned by them and remain permanently on the system. These places could be leased by commercial organisations wishing to sell products through this novel medium. The look and feel of the place could be controlled by the organisation along with appropriate content.

- *E-commerce services (Figure 4)* Traditional applications such as on-line banking and shopping can also be given a new lease of life with this novel interface. This space shows various objects inside the bank, such as ATM terminals, a help-terminal as well as an automated 'bot'. The objects have links to other web content, to allow for integration

Figure 4—E-commerce services

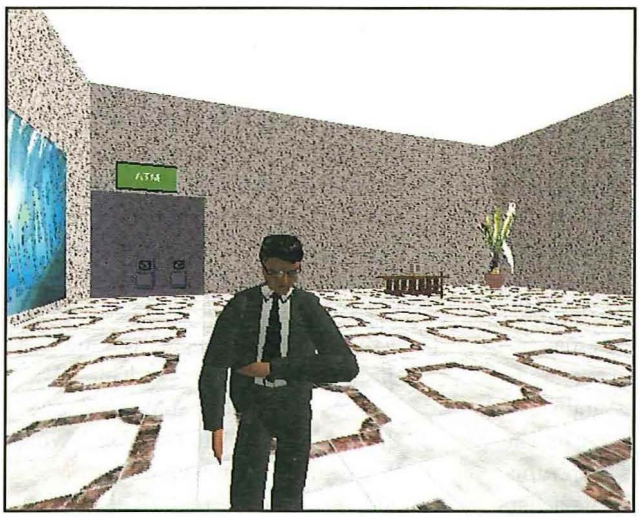


Figure 5—Business applications

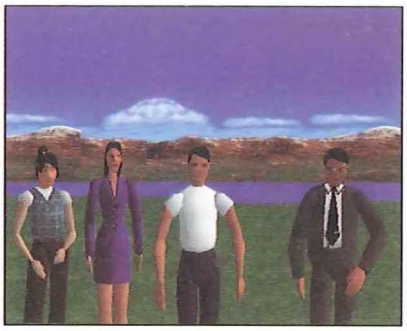
with back-end legacy servers. The automated bot is used to help guide the users through their visit or help with user transactions in general. Bank employees could replace or even work alongside these bots to provide the user with a superior service.

- *Business applications (Figure 5)* This space illustrates a typical office environment with the layout based upon the physical layout of a real BT office. The office was then populated with desks, chairs and PCs. These were then linked with appropriate web content, such as contact details, and finally web cams were installed in the actual offices of some people for the benefit of teleworking colleagues. This enhanced user interface led to more informal and unrestricted communication between the team as well as enhancing the overall team effectiveness.

Automated bots

As discussed above, bots are certainly one of the most powerful features of this virtual environment and lend themselves easily to enhance the user interface to on-line services. Bots are created using a computer program and can be placed anywhere in the world, to move around and even chat using a script. They can interact with other avatars and can even create or modify building objects. Since a bot is just a computer program, each one can be given unique characteristics to give them different personalities. These bots could be placed at strategic places in the world to act as greeters, helpers and even as peace-keepers to add to the overall user experience of the world (see Figure 6).

Figure 6—Selection of bot helpers



Conclusion

This article has been primarily concerned with addressing the role of three-dimensional immersive environments, Active Worlds in particular, for on-line multimedia retrieval services. These environments offer an attractive and highly immersive front end to existing and future on-line services, thereby making such services more fun to use as well as providing a service differentiator. Therefore, these shared worlds seem to have an important role for such services.

This article has argued that in order to entice mass-appeal for on-line retrieval services the user interface and platform are very important aspects of the overall service. The author strongly believes that the user paradigm offered by the current range of interactive services is the major obstacle to mass take-up of such services. In the future, these three-dimensional environments should also be designed to work with more intuitive end-user clients (possibly like the next-generation games consoles) as well, thereby increasing the appeal and access of advanced interactive multimedia services to this hugely expanding mass-market. In summary, it is felt that this has to be a strong contender for the way forward for advanced interactive services and entertainment of the future.

Acknowledgements

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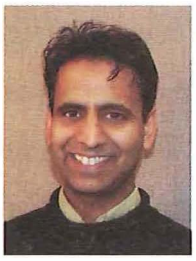

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Shabir Azam joined BT Laboratories in September 1984 after graduating with an honours degree in Electrical and Electrical Engineering from the University of Bradford. He joined the visual communications division and became part of the videoconferencing system development team. This team was responsible for developing the world standards for videoconferencing systems as well as ensuring BT would be the first to market with various standards-based conferencing systems. He then played a vital role in designing with specialised VLSI circuits to reduce the size of these systems such that today they can be found on single PC cards. He is currently working in the Applied Research and Technology department as part of the Interactive Multimedia Services Futures Campaign. The current focus of the research is to investigate leading-edge technologies to assess their suitability for advanced multimedia retrieval services of the future.

Wes Carter and Sathya Rao

ACTS: Testing the Strategies for Network Evolution

The range of technologies available to create networks is growing rapidly, as is the range of services to run on those networks. A major European research and development programme (ACTS) has been testing the emerging technologies in the field. This article reports on the results of those tests and how they can affect the way networks are planned.

The Forces on Network Evolution

We live in a world of constant change. In communications networks, the choice of technologies we can use is expanding. The same services can now be delivered via copper, coaxial cable, cellular radio or satellite. At the same time users are beginning to expect to access all services via all networks. Users will, for example, increasingly expect broadcast TV to provide interactivity (via links to the Internet) or, conversely, to receive broadcast TV programmes over their Internet connection.

If we look at the commercial environment which surrounds networks, we also see change pulling in different directions. Consumer choice is growing as the days of national monopolies running communications networks disappear around Europe. However, at the same time, the cost of the research and development to introduce new technologies or services to support that choice is beyond the reach of all but the largest companies. Even for them, the development cost often makes it difficult to justify the investment.

This article looks at the impact these changes are having on the options open to operators of telecommunications networks as they plan the evolution of their networks. It draws on the results of the European Union's ACTS programme. This is a major research and development (R&D) programme taking place across Europe which is showing how collaboration between operators, manufacturers, users and the academic world can help to increase the understanding of these options and make them more viable.

ACTS and its Role in Testing Evolution

The European Union (EU) is aware of the complexity of network evolution and is keen to ensure that European operators and other companies have a competitive advantage in the global economy. To make sure this happens it has, for a number of years, organised and partially funded major research programmes within Europe.

Advanced Communications Technologies and Services, or ACTS, is one such programme and runs from 1994 to 1999. It is the focus of the EU's research effort to accelerate deployment of advanced communications infrastructures and services, and is complemented by research in the related fields of information technology and telematics. ACTS builds on the work of the earlier RACE programme (Research into Advanced Communications for Europe, 1985–1995), which helped the introduction of broadband communications around Europe.

ACTS projects typically involve major network operators, equipment manufacturers, small specialist companies, end users and academic institutions. They work together to pool their knowledge and resources to provide a foundation for their future independent competitive activities. A project will have between five and 15 partners and usually cover at least three or four European countries. Non-European countries, for example, Japan and Canada, are also involved in some projects. The European Union helps to make all of this happen by partially funding the work (generally by about 50%) and setting up the support structure for the programme.

Within Europe, all the major telecommunications network operators, the leading broadcasters, cable TV operators and all the key European equipment manufacturers are in the ACTS programme. BT has been an active participant in these programmes since the very beginning of RACE, and is still a major player.

A major feature of the ACTS programme is that most of the projects are testing out their ideas through field trials. By doing this, the theoretical studies can be closely linked to practical experience. Because effective field trials often need the involvement of real users, trials which may be mainly focused on network technology are also providing information about the wider environment in which that technology will function.

The ACTS programme is making its results available in a number of ways, principally through reports from individual projects and through guidelines. These guidelines are on advanced communications topics and are co-authored by participants in several related projects. However, the amount of information available can be overwhelming, so the ACTSLINE project has been set up to help potential users and providers of the technology to get a more focused view of what the programme is achieving. The authors are members of this project team and are active in extracting information from the ACTS programme which is relevant to network operators.

Aspects of Evolution

Perhaps the most visible aspect of the way networks evolve is the changes in the technology available to provide the infrastructure. In the access network, we have moved from almost universal use of copper pairs to widespread use of optical fibre, radio and satellite as well as copper. In the core network, we have moved from analogue systems running over co-axial cables, through plesiocronous digital hierarchy (PDH) systems to synchronous digital hierarchy (SDH) systems running over fibre. Our switching systems have evolved from manual and Strowger, through crossbar and reed switches, to digital circuit and packet switching. Many of these changes have taken place within the last decade.

But, obvious though changes in infrastructure are, they are only one of the factors influencing network evolution. Changes to networks are driven by what users need them to do, by what operators need to control and charge for the use of the network, and by what the technology can provide.

Among these factors are:

- *Applications* Users increasingly expect multimedia communications, either for accessing information or for communicating with friends and colleagues. The growth in teleworking is one strong driver for this, but residential users are also becoming much more demanding.

- *Service control* As the services that users are offered become more sophisticated, so the need to be able to create, modify and manage these services will grow. Existing tools allow much of this need to be met, but still generally need the intervention of expensive specialists for protracted periods of time.

- *Network control* Communications network management tools are already capable of much that would have amazed network operators 20 years ago. However, there are still major areas where the tools are crude, such as cable TV network management. As the boundaries blur between different networks, network control tools need to keep pace with this change.

- *Network environment* Networks do not exist in a technological vacuum. Communications engineers need to take into account the effects of regulatory, statutory and standards requirements. The effect of many of these requirements on network evolution is not obvious until an attempt is made to introduce a new technology or service.

- *Commercial reality* As one of the pioneer privatised operators in Europe, BT is well aware of the need for any network changes to be financially viable. That viability hinges on many factors, including the ability of the network to charge customers for using it. The tools needed for this are, necessarily, becoming more sophisticated as the underlying networks become more diverse.

The list above is long, but each of the items in it encompasses a wide range of pressures on the way networks can or must evolve. This article can only present an overview of the work taking place around Europe to generate a 'road map', which will allow strategic planners to see the way their networks can evolve. This article concentrates on the evolution of the fixed network, but we must also be aware of the influence of increasing mobility on the way networks will evolve. The ACTS programme is testing mobile solutions as well as looking at many other aspects of advanced communications, such as service creation. More information on this can be found from the Web sites referred to at the end of this article.

Networks

The distinction between the different types of networks and the services they are most suited for is becoming more blurred each year. Within ACTS, many trials show how existing technologies can be extended to carry services which were formerly the province of another technology, such as broadcast quality TV over cellular radio.

In spite of the massive growth in mobility, the prime concern of many operators is still how to serve fixed locations through fixed networks. As stated earlier, this article concentrates on the options that are becoming available for the evolution of these networks. We must, nevertheless, bear in mind that mobile communication techniques are daily becoming more capable, and the need for interworking and flexibility between these two types of network is becoming more critical and more complex.

Individual ACTS projects are cited in this article simply to illustrate the type of work taking place. Many more projects are taking place in related areas and more information on them can be found by visiting one of the Web sites referred to at the end of the article.

Access network

Trials

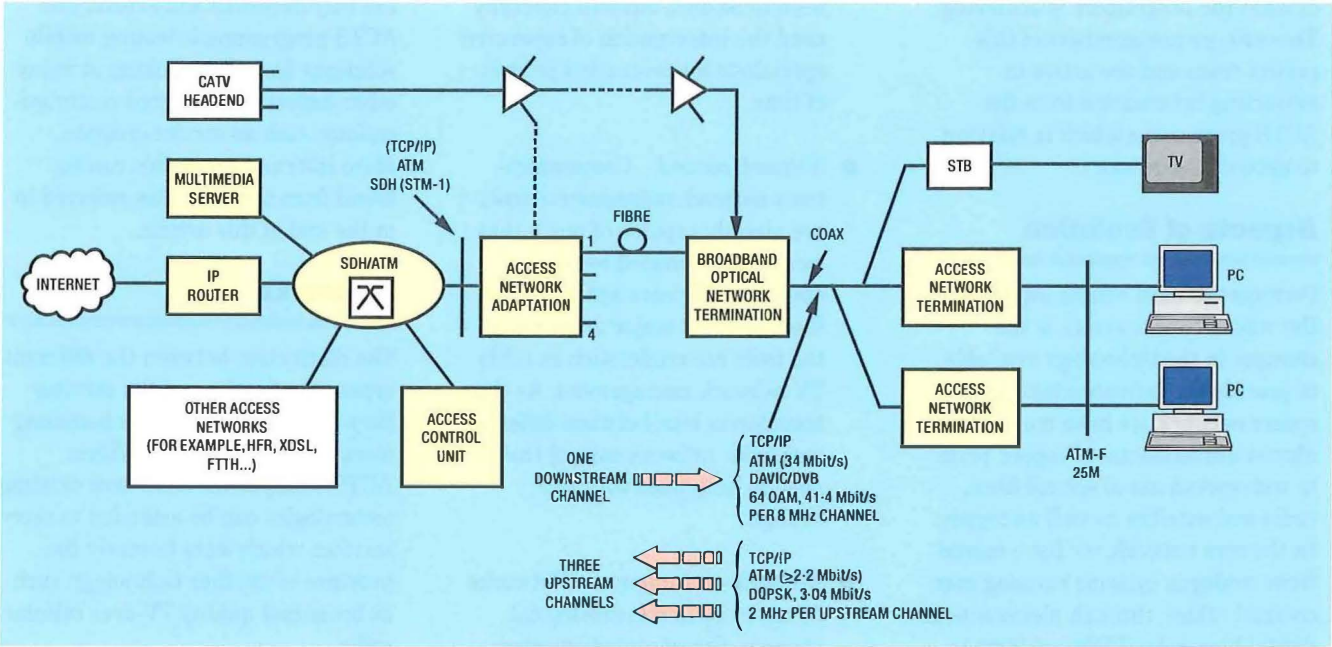
The ACTS programme has been using a wide range of access technologies in field trials to assess their usefulness as building blocks in future networks.

Around Europe, the existing communications infrastructure varies greatly, and we need to be aware of this when plotting an evolution strategy. The **BroadBandLoop** project is developing broadband access technologies which are suitable for either Western or Eastern European applications. In Western Europe, the existing telephone plant is being used as the basis for an overlay of ATM passive optical network (APON) systems. These are combined with very high bit rate digital subscriber line (VDSL) modems in the last copper drop to the user. This system is being tested in field trials in Denmark and in Portugal. In Eastern Europe, the telephone network has a lower penetration and the network being tested is a new SDH PON designed for the provision of narrowband services at low cost. In this case, the objective is to bring optical fibre close to the users, based on the initial demand for narrowband services, and then later to upgrade it to provide broadband services. The trials have involved a wide range of users and services to thoroughly test the network technology. For instance, in Denmark, the trial involves a public library, a factory and two schools.

Cable TV forms an important part of the existing access infrastructure in many countries and is increasingly covering the UK. The **ATHOC** project is showing how the existing cable TV infrastructure can be used for broadband access to residential users and small businesses (see Figure 1). The trials use a hybrid fibre coaxial (HFC) infrastructure to build a platform for both Internet protocol (IP) based and native asynchronous transfer mode (ATM) services and applications. Trials are being carried out in several European cities. For example, the Stuttgart ATHOC trial network is a HFC local network which is integrated with the core ATM network. It supports collaborative design between local engineering offices and large companies, as well as supporting telemedicine for a local cardiology unit, and interactive video and data for a consumer protection service.

Cellular radio techniques have grown enormously in importance over the last 10 years, mainly to serve mobile users. However, the ACTS programme has also been

Figure 1 – The ATHOC architecture



looking at how these techniques can be used to serve users in fixed locations. The **CABSINET** project, for example, is demonstrating a wireless broadband access network for covering the 'last mile' in both urban and rural environments. The benefits of the CABSINET approach over conventional systems include low-cost installation to homes/offices and portable reception using a 'nomadic' terminal which can be relocated around the home or office. Two different operating modes are proposed within this project: fixed reception with a rooftop antenna in direct line of sight with the transmitter antenna, at 40 GHz; and plug-free reception. In the latter case, the antenna is built into a portable receiver working at 5·8 GHz for use as a nomadic indoor terminal. Both modes provide a bidirectional path for the terminal.

Guidelines

The individual trials are themselves producing a mass of data on the usefulness of different technologies. These results are being brought together across the ACTS programme within guidelines, produced by groups of projects. These pool the expertise of the projects to give advice to potential users of the technologies, such as strategic network planners.

One of the most relevant guidelines is:

Access Network Strategies for Broadband Service Provisioning[1]

The guideline reviews the alternative access network solutions and highlights the capabilities of each. It covers upgrading a twisted pair network, upgrading a coaxial cable network, and the use of radio in the access network.

It concludes that the access network is developing two distinctive layers:

- The *primary distribution layer*, generally using optical fibres, has a reach of up to 100 km feeding flexibility points within a few kilometres of the customers' premises. The flexibility points may be active, rather than simple passive cross-connections.

- The *secondary distribution layer* is for the final few kilometres, using various technologies. The choice of technology will be determined by the operators' existing infrastructure and the actual demand for broadband services.

The ACTS projects from which this guideline was derived provided a number of pointers as to which option to choose and when:

- Very low demand for broadband is best met by upgrading existing copper with digital subscriber loop (xDSL) technology.

- All-fibre solutions only cost in when there is very high demand for broadband service or where copper can be replaced with fibre without digging up the street.

- A hybrid fibre-copper solution is likely to be appropriate in most residential and small business scenarios.

- Radio is becoming an increasingly attractive candidate for the secondary distribution layer of the access network.

The overall message from this guideline is one of caution. Even if operators select the best option for their circumstances, to 'go broadband' they will have to invest at least as much as they have already invested in their existing narrowband networks. The premium which customers are prepared to pay for broadband services will determine how soon we see broadband access and how much of it.

There are three other guidelines which are also relevant:

Advanced and Evolution Friendly Deployment of Fibre in the Access Network[2]

The central theme of this guideline is evolution scenarios for fibre-based access. Three audiences are addressed and specific messages are given for each:

- for network planners, the guideline discusses the evolution options and the demand/economic criteria for selecting between them;

- for component manufacturers, it presents a schedule of devices which are needed to implement these options; and

- for standards bodies, it identifies specifications (for example, wavelength plans) which need to be agreed to implement particular scenarios.

Sharing the Access Network Infrastructure in Next Generation Communication Systems[3]

The guideline looks at how PONs and mobile networks (UMTS/MBS) can profitably share common infrastructure at the feeder level of the access network. It describes how to plan and dimension a network with particular reference to:

- the wide variety of third-generation mobile services that need more bandwidth than is provided by current second-generation systems; and

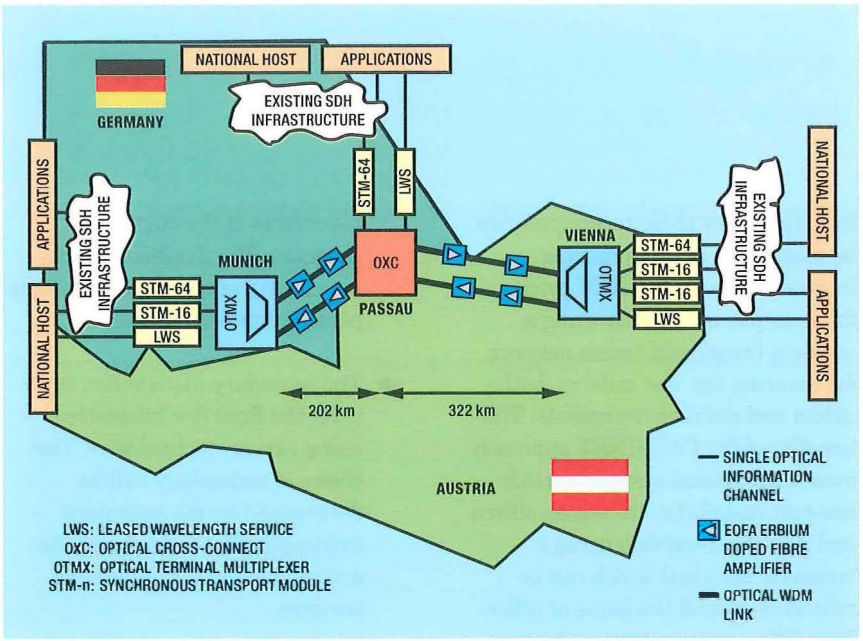
- the deployment costs, especially the civil works, involved in an access network in a highly populated metropolitan area.

Computer tools to support this planning activity are also discussed.

Open Access Network Interface for Broadband Network Deployment[4]

European regulators want to see an open marketplace where customers can mix and match the offerings of

Figure 2—The PHOTON trial network



various suppliers without, for example, having to worry whether A's access network will interwork with B's core network. To make this possible, open interfaces are required to define the boundaries of competing players' networks and to make sure that those networks can interwork.

The ITU reference model for telecommunications networks defines an interface, known as the *VB reference point*, between service nodes (for example, the local exchange in the case of telephony) and access networks. Different types of access are classified by number, and VB5 refers to a managed digital access network. It should allow:

- more competition in services—multiple access and core network providers interconnected at standardised interface points; and
- more competition in the supply of equipment—any access network can interwork with any service node.

Several projects within ACTS have helped to develop the VB5 specifications. This guideline has been produced by these projects and describes the principles of the interface and discusses the current state of standardisation.

Core networks

Trials

The ACTS trials have concentrated on making much more effective use of the optical technology that is currently available and on looking at how the technology may develop. The projects described below are just examples of the wide range of trials taking place.

The **PHOTON** project has demonstrated how wavelength-division multiplexing and optical cross-connects can be used to increase the capacity of existing fibres. The trial was based on existing fibres—a 520 km route from Vienna to Munich via Passau. (see Figure 2). Eight wavelengths in the 1500 nm band were multiplexed on to a single fibre. The German section of the link tested 400 GHz spacing of the wavelengths between the channels and the Austrian section tested 200 GHz spacing.

The channels were operated at 2·5 Gbit/s (STM16) or 10 Gbit/s (STM64) using recently developed SDH terminal multiplexers to assemble the bitstreams. Optical amplifiers were used to boost the signal at 70–100 km intervals along the route. An optical cross-connect was installed at Passau providing a flexibility point in the network and demonstrating the potential of all-optical networking. The network included an optical supervisory channel carrying management information (alarms etc). This was implemented as an in-band channel in Germany and as an out-of-band channel in Austria.

The trial has shown that advanced optical components can be used under operational conditions to multiply greatly the capacity of an optical fibre.

The **KEOPS** project has taken a completely different approach and has concentrated on a network for optical packet switching. One of their activities has been to investigate the design of a wavelength routing switch (WRS), intended to show how capable present-day technology is at enabling optical packet switching. In this case, the trial took place in a laboratory rather than in the field.

The WRS demonstrator is a 4×4 optical packet switch which uses dynamic wavelength conversion at the packet level, together with demultiplexers and multiplexers, to perform routing functions. Packets are made up of a header (encoded at 622 Mbit/s) and a payload (encoded at 2·5 Gbit/s). The switch is electronically controlled by data extracted from the headers. The switch can modify the header, thus allowing the creation of virtual channels (as with ATM).

As part of the project, KEOPS has studied how such a switch would fit into the network. They have defined a packet format which takes into account the hardware constraints, the needs of the client layers (ATM and IP) and the end-to-end packet network performances (packet delay and packet loss probability). They have also defined an interworking unit to act as the interface between the optical packet layer and the ATM layer.

Guidelines

ACTS has concentrated on placing the core network into the context of the network as a whole when writing guidelines. This means that the guidance on the evolution of the core network is covered by guidelines on end-to-end transport protocols, network management and network evolution. These are described elsewhere in this article.

End-to-end transport protocols

Trials

One of the issues taxing those trying to predict the future of communications is how important IP and ATM will be,

and how they will work together. Many of the trials within ACTS have made use of IP or ATM, or both. This topic is recognised as being of increasing importance and several of the projects which started in the final phase of ACTS are concentrating on the interworking of IP and ATM. Unfortunately, their trials do not generally start until the middle of 1999 and thus their results are not available yet.

However, the results from earlier projects are available. As an example, the **EXPERT** project provides a platform which can be used for a wide range of trials. The EXPERT platform, shown in Figure 3, contains:

- 14 ATM switches,
- ATM/N-ISDN and ATM/frame relay interworking units,
- medium adapters to enable cells to be transported over PDH transmission systems,
- the support of 2 Mbit/s circuit emulation,
- terminal adapters for the attachment of standard workstations, PCs, TV and video equipment (including three-dimensional), CD-audio and N-ISDN terminals,
- current versions of ITU-T and ATM Forum signalling schemes, and
- ATM access equipment (including an ATM PON) and an integrated services switch which have been developed within the project and integrated into the platform.

The platform has been used to test, for example, the best way to manage dynamic allocation of bandwidth to VPs (virtual paths in ATM) and the routing of connections to the least-loaded path.

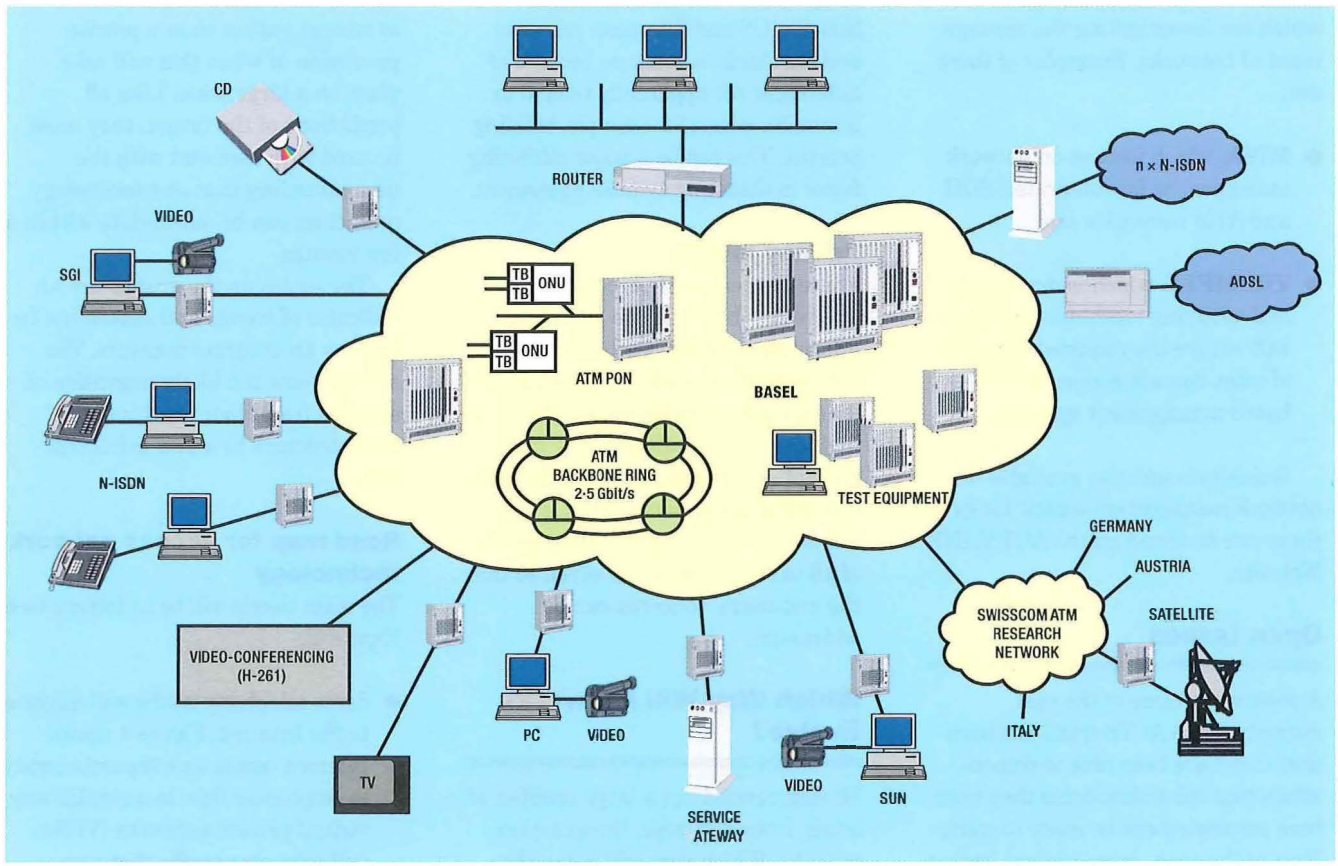
Much of the work in the projects that started in 1998 has been directed at how quality of service (QoS) on ATM and IP connections can be guaranteed. One such project, **DIANA**, started in March 1998 and is demonstrating resource reservation and traffic control, which seamlessly interoperates between ATM and IP networks to achieve a specified end-to-end QoS. The protocols currently used to exchange this control information are reservation protocol (RSVP) or ATM signalling. However, the design of the trial platform is intended to be generic enough to investigate several solutions for the convergence of IP and ATM.

Although it is outside the scope of this article, it is worth noting that ACTS has carried out research into how charging and accounting for the use of ATM networks can be managed.

Guidelines

As with other areas of research, the ACTS projects have pooled their experience to produce guidelines

Figure 3—The EXPERT project environment



which are aimed at helping strategic network planners. One of the most relevant guidelines is:

IP and ATM Compatibility[5]
This guideline is intended to help network strategists evaluate the competing IP/ATM architectures and technologies, by describing and explaining the state of the art. It discusses the potential opportunities and threats of a large number of different strategies, and gives guidance towards appropriate solutions. It gives an appreciation of the cost/benefits of the new technologies and advises on the upgradability and compatibility of various scenarios.

The guideline is currently only available in draft form, but the draft gives detailed guidance on some of the more important scenarios.

Management of networks

We are concentrating on the underlying network infrastructure in this article. However, the ACTS programme contains many projects which are investigating the management of networks. Examples of these are:

- **MISA,** which focuses on network management for integrated SDH and ATM networks; and

- **TRUMPET,** which is developing and verifying mechanisms which will ensure the required integrity of inter-domain access to TMN-based management systems.

Guidelines are also available on network management topics. Links to these can be found on the ACTSLINE Web site.

Open Issues

A positive outcome of the vast majority of the ACTS trials has been that they have been able to demonstrate that the technologies they have been employing can be made to work. Most of the open, or unresolved, issues which remain are not related to pure engineering but to the environment in which networks have to work. Among the unresolved issues are:

ATM networks in Europe

ATM networks are becoming more widespread in Europe, but it is still not possible to get a trans-European ATM connection for a short period of time at a price which is acceptable. This severely inhibits trials but is also a barrier to trying out innovative commercial services.

Network management interfaces

Manufacturers are still reluctant to offer non-proprietary management interfaces, although ACTS projects working with manufacturers have seen this attitude gradually changing. Without standard interfaces, the creation of management systems to control overlaid or interlinked networks is very difficult.

USA versus Europe

There are still considerable differences between US and European practices and standards, sometimes because of differences not apparently related to communications; for example, building practice. This can be a major inhibiting factor in obtaining suitable equipment.

Privacy issues

There are real, and perceived, differences between the privacy of information being carried by different types of network. In some cases—for example, medical information—a high degree of confidentiality must be kept at all stages. When setting up new interlinked networks, it is important to be aware of the security of all of the networks involved so that the end-users' concerns can be addressed.

Which Way Will Networks Evolve?

Having carried out a large number of trials around Europe, the question must be 'Which way will networks evolve?' Unfortunately, there is no single answer to this. It is apparent that network planners will have a much wider range of technologies to choose from, especially in the access network.

The ACTS networking project teams have pooled their experiences to develop road maps for how the new technologies could be rolled out over the next few years. These road maps provide guidance to network planners about when individual technologies will be mature and robust enough for use in operational networks. Planners can then decide when and where a particular technology offers an economic solution to their specific network requirements.

The road maps (see Figures 4 and 5) show the declining need for services to be carried on dedicated networks and highlight technical developments which will enable and influence the migration of services. These developments should be interpreted as opportunities for services to migrate (or for networks to merge), rather than a precise prediction of when this will take place on a large scale. Like all predictions of the future, they must be used with care and with the understanding that any technology prediction can be out-of-date within a few months.

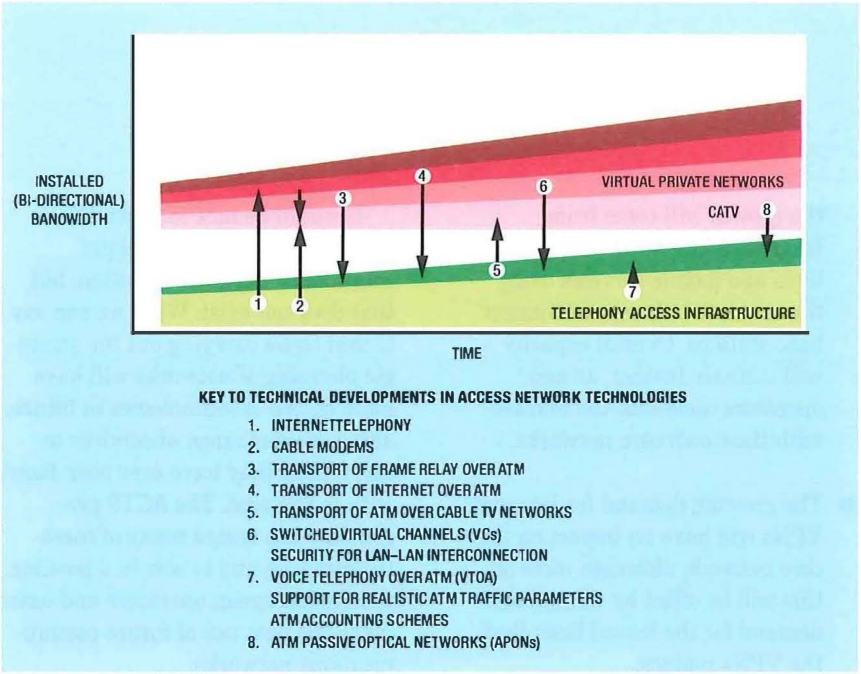
The scales on the graphs are an indicator of trends and should not be used as an accurate measure. The arrows show the likely migration of services from their traditional infrastructure to a new infrastructure.

Road map for access network technology

The main trends will be as follows (see Figure 4):

- Some telephony traffic will migrate to the Internet. Figure 4 shows Internet access as a separate entity to emphasise this. In a similar way, virtual private networks (VPNs) will take over traffic that was

Figure 4—Trends in access network technology



previously carried by leased lines or dial-up connections.

- Mobile traffic (particularly digital cellular) will continue to grow as competition reduces prices and new entrants to the market use mobile technology to serve remote users.

- CATV growth will be driven by the demand for more TV channels, faster Internet access and cheap telephony. Once it is digital, the existing infrastructure can also be used for interactive services, such as video on demand (VoD). One factor inhibiting this growth will be the need for the successful management of large, complex interactive networks—a skill that is traditionally only associated with public network operators (PNOs).

- The capacity of existing telephone cables will be increased as PSTN connections are gradually converted to N-ISDN. Further increases in capacity will be created by the use of xDSL technology.

- Fibre to the home (FTTH) and fibre to the curb (FTTC) offer a highly future-proof infrastructure for both broadcast and interactive services. In principle, capacity is almost unlimited and, in a few years time, up to 20 Gbit/s could be delivered per customer. The technology can be economic for telephony traffic alone where there is either a green-field site or relatively high population densities and service demand.

- The growth of demand for the Internet will force access capacities to be upgraded. One possible path is from modems over telephone lines, through N-ISDN B-channels, to 2 Mbit/s lines (using N-ISDN primary rate, or xDSL techniques). For businesses and ISPs, 2 Mbit/s lines will be upgraded to 34 Mbit/s and 155 Mbit/s.

- VPNs are attractive to large organisations, especially international ones. These use high-speed switched connections (for example, frame relay or ATM) as an alternative to leased lines or dark fibre for interconnecting LANs. Their attractiveness will grow once the support of ATM switched virtual channels (VCs) becomes widespread, and reliability and security can be guaranteed. Demand for ATM-based access systems will grow to meet the need for seamless transitions from LAN–WAN.

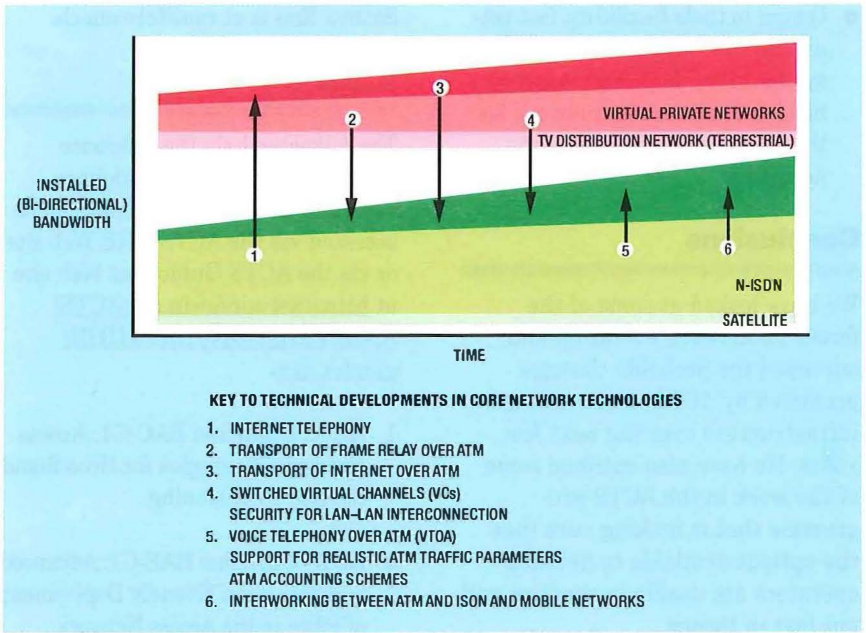
- The availability of compact, low cost and easily installable satellite transceivers could have a significant impact on broadband access networks.

Road map for core network technology

The main trends will be as follows (see Figure 5):

- The telephone service will remain the major source of traffic in the core network. However, most of

Figure 5—Trends in core network technology



the growth will come from Internet access over telephone lines and mobile services using the core network to interconnect base stations. Overall capacity will increase further, as new operators come into the market with their own core networks.

- The growing demand for intranet VPNs will have an impact on the core network, although some of this will be offset by the reduced demand for the leased lines that the VPNs replace.

- TV distribution is not likely to create much extra traffic. New programmes are more likely to be distributed by satellite, either direct to the home or to cable TV head-ends.

- ATM will be used increasingly for the high-speed transport of a variety of different services. There will also be a demand for ATM WAN circuits reflecting the growth of ATM access systems. However, the installed base of ATM is currently very low and existing forms of transport (for example, SDH) will continue to be a major feature of the core environment.

- Owing to their flexibility, fast set-up and cost effectiveness, satellite systems may play an interesting niche role in the core network for the deployment of broadband networks.

Conclusions

We have looked at some of the forces on network evolution and surveyed the probable changes predicted by ACTS in the network infrastructure over the next few years. We have also outlined some of the work in the ACTS programme that is making sure that the options available to network operators are usable in practice and not just in theory.

It would be nice to finish this article by describing a unique solution for network evolution, but that does not exist. What we can say is that those carrying out the strategic planning of networks will have more choice of technologies in future, and a greater range of services to carry, than they have ever been faced with in the past. The ACTS programme has tested many of these technologies and is now in a position to help European operators and users make the best use of future communications networks.

Where to find more information

The ACTS programme has two World Wide Web sites which are a good starting point for further information. The ACTSLINE Web site (http://www.actsline.org) is a good place to start if you are looking for information specifically related to network operators. The InfoWin Web site (http://www.uk.infowin.org/ACTS/) is a major repository of information on individual projects and the guidelines which are produced by groups of projects. Alternatively, either of the authors would be happy to help you find the answers to your questions:
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References

The following lists the reference numbers and titles of Guidelines described in this article. They can be accessed via the ACTSLINE Web site or via the ACTS Guidelines Web site at http://www.infowin.org/ACTS/ANALYSYS/CONCERTATION/glindex.htm

1 ACTS Guideline BAC-G1: Access Network Strategies for Broadband Service Provisioning.

2 ACTS Guideline BAE-G1: Advanced and Evolution Friendly Deployment of Fibre in the Access Network.

3 ACTS Guideline BAM-G2: Sharing the Access Network Infrastructure in Next Generation Communication Systems.

4 ACTS Guideline NIG-G2: Open Access Network Interface for Broadband Network Deployment.

5 ACTS Guideline NIG-G3: IP and ATM Compatibility.

6 ACTS Guideline NIG-G1: Broadband Deployment.

7 ACTS Guideline NIG-G8: Glossary of Telecom Acronyms and their Definitions.

Glossary

The definitions are taken from a comprehensive ACTS guideline of acronyms and definitions[7].

ACTS Advanced Communications Technologies and Services
API Application programming interface
APON ATM-passive optical network
ATM Asynchronous transfer mode
CATV Cable TV
EU European Union
FTTC Fibre to the curb
FTTH Fibre to the home
HFC Hybrid fibre coax
IP Internet protocol
ISP Internet service provider
ITU-T ITU Telecommunication Standardisation Sector (formerly known as CCITT: Consultative Committee on International Telephony and Telegraphy)
LAN Local area network
MBS Mobile broadband systems
N-ISDN Narrowband integrated services digital network
PDH Plesiochronous digital hierarchy
PNO Public network operator
PON Passive optical network
PSTN Public switched telephone network
QoS Quality of service

RACE Research and Development of Advanced Communications in Europe
RSVP Reservation protocol
SDH Synchronous digital hierarchy
TMN Telecommunications management network
UMTS Universal mobile telecommunication system
VC Virtual channel
VDSL Very high bit rate digital subscriber loop
VoD Video-on-demand
VP Virtual path
VPN Virtual private network
VTOA Voice and telephony over ATM
WAN Wide area network
xDSL (Any variant of) digital subscriber loop

Biographies

Wes Carter
Martel GmbH

Wes is managing Martel's activities in the ACTSLINE programme. Martel GmbH is a Swiss company which specialises in advising companies about their participation in collaborative European Union funded telecommunications research and development programmes. He has a degree in Physics, and is a Chartered Engineer, a member of the British Computer Society and of the IEEE, and an associate member of the IEE. He spent much of his earlier career working for BT. During that time he was involved with the specification of international exchanges, the development of System X switches and was involved in ATM from its pioneering days. Before leaving BT, Wes managed the activities to improve the relationship between people who were planning and developing the network and the managers responsible for operating the network. He was involved with RACE from the definition phase into the main phase and managed a project which investigated the way that networks would have to evolve to introduce ATM. Since joining Martel he has been involved in ACTS, providing a link between the trials and the key decision makers who are potential end-users of ACTS technology.

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Sathya Rao
Telscom AG

Sathya has degrees in electrical communication engineering from Bangalore University and the Indian Institute of Science. He moved to Switzerland in 1980, where he gained his doctoral degree. In 1986, he joined Ascom, where he led much of the work on ISDN systems and broadband communications. He was one of the core members of the team responsible for defining the European research framework on advanced communications; that is, RACE and ACTS. He participated in many RACE projects and has been active in contributing to ATM standards and system development. In 1995, he founded Telscom, providing consultancy services and support to advanced communication research work. Telscom has grown ever since into a company which is involved in ATM system development and Internet and ATM solutions for business needs. Sathya has published three books on broadband networking issues as an editor and is the editor-in-chief of the journal *Interoperable Communication Networks* (ICON). He has many patents and publications to his credit. Sathya and his company have an established record in organising international and European conferences. Under the patronage of the European Commission, he has organised many international workshops, as well as distributed seminars using the ATM networks and applications across European centres.

Ann Wiggins, Tim Green and Verrill Baldwin

Year 2000 Engineering in BT

Along with other companies and organisations worldwide, BT is tackling the computing challenges posed by the Year 2000. BT's Engineering Directorates have been dealing with the issue for a large number of BT's computing systems. This article examines the engineering issues and how the challenges were met.

Overview

The arrival of the Year 2000 presents the world with a unique computing challenge. For once there is absolutely no flexibility in the delivery date, and all systems across the globe are potentially at risk. What is more, once Saturday 1 January 2000 has been safely negotiated there is the minor matter of the '400 year rule' leap day on Tuesday 29 February 2000 to deal with. The scale of the task is huge.

BT has been focused and methodical in its response to this challenge. A strategic Year 2000 Programme was launched in November 1995 with the clear business objectives of

- zero loss of revenue,
- zero downtime,
- no loss of commercial or technical credibility,
- fix at lowest cost, and
- fix everything by the end of 1998 (a full year early).

This article examines the software engineering issues behind the millennium rollover, and how the then BT Systems Engineering Directorate (SE), in close partnership with the Information Systems Directorate (IS), now Advanced Communications Engineering (ACE) and Information Systems Engineering (ISE), responded to the challenge. The various possible technical solutions are explained, and the risk analysis that led to the line adopted is covered. The current status of the project (in April 1999) is that all remediation and testing is complete and the emphasis is now on the maintenance of compliance in the run up to the century date change.

The Year 2000 Problem

The Year 2000 is now widely recognised as a critical challenge to the technological infrastructure of the world. Our increasing reliance on computers, or more strictly the software applications that they run, means that the dependency is all pervasive and deeply rooted. Some airline companies have already opted to take an operational timeout for two days over the most safety critical period—and who is likely to want to risk flying then anyway? But timeouts do not remove the need to fix systems since everyone will need to be back in business as soon as the tail end of New Year's Day has rolled through the world's time zones.

So just what does the century date change mean to BT? And what are the engineering issues? And what have the SE and IS Directorates been doing about it? And what are the critical risks to BT's corporate business?

This article aims to answer these questions, but strictly from an engineering perspective. It is also confined to those systems actually engineered by SE and IS for BT. It is written largely in hindsight from the position of the remediation and testing of systems being complete. It is really an account of what was done rather than what needs to be done. You will read how, at the outset of the strategic programme, the challenge was set of having everything complete well ahead of time. And you will see how, for the systems concerned, this goal has been achieved.

But this account is a story with a sting in the tail. At the time of writing the critical clock tick has yet to be faced. Detailed professional measures are, of course, being taken to ensure that no-one drops the ball in the run up to the moment of truth, but that moment is still to come. New systems are subject to compliance

testing, and everyone is on alert to ensure that the good work of the last year is not undone.

The root of the problem

The core issue with the Year 2000 is that computers were once a very expensive luxury and great care had to be taken to minimise costs and squeeze the maximum possible from limited resources. For date handling, until recently, there has been very little benefit to be obtained from defining, manipulating and paying for the storage of the CC century value since for most purposes it has invariably been 19. A common practice, strongly encouraged by budget managers, has been to use only the shortened YY year value to save costs. Now, of course, the falling price of computing has really kicked in and the balance has shifted enormously. Even so, many systems that were constrained by costs to use compact data schema are still operational today—in some cases unexpectedly so. The world is therefore faced with many defective software applications that, unless fixed, will see the rollover from 1999 to 2000 as a step backward in time to 1900—with chaotic results.

Before tackling some of the engineering detail, it is important to emphasise that the position for BT at the outset was no worse, or indeed no better, than any other large company in the world. One common factor was, and still is, that no business writes software unnecessarily. We all routinely buy huge volumes of commercial off-the-shelf (COTS) components—operating systems, compilers, database managers, communications drivers, user interface packages, run-time libraries and so on. We all therefore suffer equally from the defects that these components contain, including Year 2000 bugs.

The only software that is actually under BT's direct control are the specific applications constructed to run on top of the COTS components. For BT, many of these have been developed within the company by SE and IS and by other development units. Many others have been developed for BT by outside sub-contractors. All have needed checking by their various owners for Year 2000 sensitivity and appropriate remediation.

Setting up the Programme

John F. Kennedy once said, *'The time to repair the roof is when the sun is shining'*. From the outset it was clear that risk containment on timescales would be the key and that a disciplined systematic approach across the whole corporate infrastructure would be essential. The overarching BT-wide Year 2000 strategic programme was set up in November 1995 to coordinate action across the whole company. Within this context the Year 2000 engineering team was established.

The end-98 milestone

The first step in managing the millennium risk was to nail down a strategic position on timescales. The stringent goal of having all operational systems fully compliant by the end of 1998 was mandated. The target was unequivocal—compliant and live in service a full year early. A stiff challenge indeed, but why so early? There were five main drivers for this critical goal:

'The time to repair the roof is when the sun is shining'

- it gave a full year of contingency and stability to root out really tough issues;
- it ensured that the 99/00 financial year would start with fully compliant systems;
- it guaranteed that systems would have at least a year of future date capability to deal with customer contracts;
- it got the job done ahead of any chaotic dash for the line in the computing industry; and
- it ensured that customers would be able to tackle their own remediation projects with high confidence in their communications infrastructure.

Computing in BT

BT is a huge user of computer technology. It has an extremely diverse business of immense size with extensive automation. In fact there are around 1200 different sorts of computer system in the BT operational infrastructure, interconnected through some 3500 different electronic interfaces, utilising around 750 different bought-in COTS components from 280 suppliers. The systems range from vast mainframes dealing with immense volumes of core business, down to one-off desktop systems constructed to deal with a unique local issue.

SE and IS are directly responsible for the engineering work on some 700 of these 1200 systems. The remainder are a mixture of directly purchased systems with corresponding support direct from the supplier, systems developed and maintained by other parts of the business, and locally managed systems. This article is an account of what was done for just these 700 systems, though many other BT and joint venture teams are known to make use of the engineering information in the Year 2000 web site for their own work.

One stratagem adopted was to make a virtue out of a necessity. A process of system rationalisation was successfully merged with the Year 2000 work and the aim is to switch off some 214 systems and transit the millennium rollover with a little under 500 of the original 700 systems.

Requirements: the BSI definition of Year 2000 conformity

The Year 2000 conformity definition originally published by the BSI in January 1997 has achieved global acceptance in the computing industry. BT was one of several mainstream companies that participated and contributed to the original BSI review process.

The BSI definition of conformity states:

'Year 2000 conformity shall mean that neither performance nor functionality is affected by dates prior to, during and after the year 2000. In particular:

Rule 1 No value for current date will cause any interruption in operation.

Rule 2 Date-based functionality must behave consistently for dates prior to, during and after Year 2000.

Rule 3 In all interfaces and data storage, the century in any date must be specified either explicitly or by unambiguous algorithms or inferencing rules.

Rule 4 Year 2000 must be recognised as a leap year.'

These criteria form the backbone of the BT programme and have been fully enacted in the Year 2000 system testing criteria described later. They are freely available as DISC PD2000-1:1998 'A Definition of Year 2000 Conformity Requirements' from the BSI at http://www.bsi.org.uk/disc/year2000.html

Project management

Within the scope of the work featured in this article, a significant challenge was to deal with the fact that there were far too many systems for the project to be run by central command. Instead the Year 2000 requirement was treated as a completely-normal business-as-usual requirement to be processed through the existing engineering organisation. The view was that the only way to be sure of success would be to **empower** the project teams by providing sharp guidance and high-quality information about the issues, but deliberately leave the final decisions on how best to enact compliance to the individual teams themselves.

This approach has been a big success. Project managers have remained in control of their own patches, no resistance has been encountered because of people being told how to do their job, advice and guidance has been welcomed, and the key strategic engineering goals have been correctly implemented with little complication.

Year 2000 Engineering Policy

The BT operational infrastructure is the life-blood of the business. Raw network components provide the basic communications capability but they need to be bound into marketable and sustainable services before they can generate revenue. This complex and diverse mapping between the network and customers is the task of the operational infrastructure. It was clearly understood that whatever was done the integrity of this huge jigsaw of computer systems must not be jeopardised.

So how do you touch every system in the business without putting the overall infrastructure at risk? And how do you keep the costs under control? And how do you fit all of this into an absolutely inflexible timescale? And how do you use this unique opportunity to rationalise the way that the company operates to reduce overhead costs in the future? These tricky questions led to some important strategic engineering threads:

The containment mandate

Any computer system can be treated as a black box. Its functionality is bounded in the sense that its electronic interfaces can be unambiguously specified, and the capability it presents to the user can be completely described. If you nail down this behaviour then you should in principle be able to lift out an old version of the system, modify its **internal** behaviour, and drop it back into place to fit exactly into the space it left behind—with no adjoining system being able to detect that there has been a change at all.

From the outset this is precisely what was done for all Year 2000 remediation work—not just for a few of the systems, but for every single one. Containment allowed compliance to be implemented with minimum infrastructure risk and least cost. From day one this principle of 'containment' has been the cornerstone of Year 2000 engineering policy.

The policy was most strongly evident in the requirement that the date behaviour of all inter-system interfaces would be frozen. It was also pursued strongly when it came to the data schema underpinning the applications. It was imperative that well-intentioned, but fatally-flawed, date changes were not allowed to ripple out across the infrastructure, possibly passing through several systems before finally causing a problem. Some awkward bureaucratic impediments were deliberately set in the path of anyone wanting to bend this rule. In fact, of the 3500 known inter-system interfaces, none at all were granted authorisation to change their date behaviour.

COTS standardisation

The professional management of our dependency on COTS software presented, and continues to present, a huge challenge in the run up to the Year 2000. Virtually all systems needed upgrade to achieve compliance, and there were therefore an enormous number of on-site installations that were needed.

The key point remains that there is insufficient time or human resource for each system to be

configured as a one-off special. The view from within an isolated system team might be that their system's exception was only a minor ripple, but the full picture would be a stark contrast. There was a significant risk that these individual ripples could result in a tidal wave that would swamp the available resource. There was an urgent need to keep diversity in check.

To address this risk, IS launched a policy of officially supporting only a few specific versions of core mainstream commercial components—such as operating systems and databasing products. Usually IS nominated just the most recent version for their official blessing. It was also made mandatory to seek approval for deviations from the preferred versions, and around 15% of systems in fact sought exceptions. Most of these were agreed without difficulty because project managers readily accepted the need to avoid diversity and only applied for an exception when there were strong business drivers dictating otherwise.

The result has been a significant reduction in the use of older COTS versions, and substantial savings in the prior version support charges paid by BT to vendors.

Desktop 2000

The essential requirement that all of the business computing systems are millennium compliant includes the huge number of desktop and laptop PCs throughout the company.

Desktop 2000 was the name of the deployment project that addressed this need. It delivered a package of compliant hardware and software components to all registered users. The standard Desktop 2000 installation was a Pentium PC running Microsoft Windows 95, Microsoft Office 97, and Microsoft Outlook 97. Other components were added according to individual needs. Specialised engineering PCs used for purposes other than routine office automation activities were dealt with separately by the associated system team.

System testing in SE

Very early in the project it was decided that an unsupported assertion of compliance by a project manager would not be accepted as sufficient proof that the remediation work on that system had been successful. This was not an issue about individual trust but a simple consequence of the scale of the undertaking and the importance of clear-cut and consistent measures of success. It was decided that it would be mandatory for each system to be put through a standard set of Year 2000 tests to demonstrate its compliance conclusively.

A comprehensive set of Year 2000 tests was therefore defined to act as a formal quality gate between the Year 2000 engineering remediation work and the deployment of the system back into the field. These tests have a dedicated set of pages on the web site. There are 19 mandatory tests, and 29 optional tests. The most important mandatory tests, of course, focus on the system's ability to survive the millennium rollover clock tick—by turning the system clock forwards and allowing the rollover to occur while the system is running. But the full scope also checks the correct handling of 21st century dates in normal operation, the success of data archiving and restoration, recovery from system failure, performance and operability, interface robustness, system security, and day-of-week integrity.

Since the tests were deliberately defined to be performed on the system as a whole and not on just the individual embedded applications, the compliance test process required a full stand-alone system to be constructed. This consequentially required project managers to integrate their application/s with their chosen run-time COTS platform and had the benefit of forcing the pace on what transpired to be the greatest risk—late compliance dates for COTS components.

Year 2000 compliance testing was normally conducted using the business-as-usual test facilities of the individual systems. In addition to these, IS purchased specific captive testbeds to deal with cases where this was not possible. These extra machines have now been redeployed into conventional operational use.

Integration testing

For any change, once individual stand-alone system testing is complete, a further stage of so called *integration* testing might be needed to check that different systems interoperate correctly and that there are no end-to-end or pan-infrastructure issues. This type of testing can be extremely difficult to execute, and consequently very expensive and very time consuming.

The stance of the Year 2000 programme on integration testing was clear-cut from the outset. If the date behaviour of the interfaces of a given system was unchanged by the remediation work, then whatever was regarded as satisfactory as an integration test before the changes were made ought to be acceptable afterwards as well. In other words, the Year 2000 team consciously set out to have no adverse impact on the need for integration testing. The fierce strategic policy decision described earlier to contain all Year 2000 date remediation changes within systems was an absolutely vital risk management weapon for this issue. Many projects finally bit the bullet during this period and decided that they should increase their level of integration testing. But none of these were forced to do so by the SE Year 2000 Programme.

Technical Solutions

The Year 2000 remediation of a software application is not intrinsically a complex matter. The hardest task is often just finding the sensitive lines in a sea of code. The choice of

solution is limited and the following categories are pretty much all there is. Of these there is absolutely no doubt that the date-windowing solution with its reduced risk of side effects is very strongly preferred for almost all circumstances in BT's domain. This is borne out by the near universal adoption of windowing by large corporations.

Date windowing

This method interprets a two-character YY date field to deduce the intended CC century value. If YY is greater than a designated 'pivot date' then it is treated as 19YY, otherwise it is treated as 20YY. The pivot date can be a hard coded number (fixed window), or can be set relative to the current year (sliding window). This logic solution is strongly favoured owing to its greatly reduced risk of side effects. The fundamental principle behind this approach is that 'The information is in the data—so write a smarter application'. Computers, after all, are very good at the task of computing.

Switch off

All computer systems eventually reach the end of their useful life. Consolidation of applications and the controlled proactive decommissioning of a system can obviously be used to avoid the Year 2000 problem. This approach has been a very important aspect of the work with a great many systems scheduled for shut down.

Date expansion

This method expands a two-character YY date field to accommodate the full CCYY date. It is an obvious knee-jerk reaction to the Year 2000 problem, and like most instant reactions it is a mistake because it has an exceptionally high risk of side effects. The approach is extremely unfavourable for most circumstances and has been forcefully discouraged.

Dates that span an interval so broad that an expansion solution is required are extremely unusual in BT. But two exceptions exist where the full format date is preferred: for personnel systems where dates of birth are manipulated, then date expansion is the norm, fortunately these are a small minority of the total; and for green-field developments where everything is new it is obviously now mandatory to implement a full format date.

The information is in the data—so write a smarter application

Space reuse

Various compression methods can be used to fit a full representation of the date into the space previously occupied by a short format date such as DD-MM-YY. But this too has an exceptionally high risk of side effects and is extremely unfavourable for most circumstances and has also been forcefully discouraged.

Time warp

The final weapon of last resort is to turn back the operating system clock and wrap the system in a time warp cloak to add and subtract the chosen interval on all interfaces. The interval normally quoted is 28 years so that the days of the week and the leap years re-align. This approach ducks the Year 2000 issue completely, but at the expense of considerable complexity. The method is really only appropriate if an essential component is not available in compliant form. None of our systems have yet needed this extreme treatment—it would be a very unsatisfactory outcome.

Communications

The resolution of the Year 2000 issue has undoubtedly been made easier by

Dealing with Leap Years

The Gregorian Calendar decrees that leap years are triggered when the year is divisible by 4, except for century years, except when the year is divisible by 400. The year 2000 will therefore be a leap year. The 400-year rule is sometimes overlooked, so all applications needed checking for this too.

The leap year rule can be defined in formal algorithmic terms as...
It is ***not*** a leap year
if there is a remainder when you divide the year value by 4 ***or***
if there is no remainder when you divide by 100 ***and*** there is a remainder when you divide by 400

Expressing this full leap year algorithm as a mathematical formula in the language 'C', we get the following (non-optimised) function:

```
/* This function returns a non-zero value (TRUE in ANSI/C) if
the supplied "ccyy" target year is a leap year, and zero
(FALSE) if it is not.
*/
int is_leapyear (const int target_ccyy) {
      return !((target_ccyy % 4) ||
      (!(target_ccyy % 100) && (target_ccyy % 400)));
}
```

Which can be used in the following way:

```
if (is_leapyear(2000)) then print ("2000 is a leap year");
```

the emergence of the Internet. Without this it would have been much harder to find out the latest problems across the globe, exchange information with vendors and other businesses, and communicate with the geographically dispersed BT engineering teams.

The Engineering Zone

One important use of the web was the Year 2000 Engineering Zone on the BT intranet. The goal of this site was to achieve a consistent standard of Year 2000 compliance engineering by explaining the technical policy to be applied and the key issues to address. The site contained:

- a set of core Year 2000 engineering 'frequently-asked questions' (FAQs) giving factual advice on a wide range of topics;
- an official Year 2000 design guide giving an authoritative explanation of how to set about the remediation of systems and why some methods are better than others;
- a set of database FAQs explaining how best to tackle database applications, and the pitfalls to avoid;
- a set of component management FAQs explaining how to find out which versions of the principal bought-in software components are approved for use into the Year 2000, and what to do if there is a need to use a non-approved version; and
- a third-party components list giving the Year 2000 compliance status of a large number of bought-in software components and other vendor products known to be in use in BT.

The data capture tool

The data capture tool (DCT) was the on-line database used to track progress. It consisted of a simple intranet WWW front-end onto a Microsoft® Access database. The decision was made to go on-line because it was recognised early on that manual methods of gathering progress information were going to be inadequate and unmanageable. Project managers used the DCT to enter and review their key milestone dates and to log any pertinent notes about risks. The DCT was invaluable in that it allowed risks to be monitored, tracked and spotted in the progress of all 700 applications.

Behind the scenes, the DCT became increasingly sophisticated at using or turning the raw data into an ongoing picture of how well compliance was being achieved. As 1998 progressed, attention shifted from dates such as initial impact assessment, through start and end of system test and on to deployment dates. Data from other sources, notably from IS and Systems Integration, were loaded so that interdependencies could be determined and focused actions launched.

As with all things computational, the final information was only as good as the raw data, and there was a need for a consistent management emphasis on the currency and accuracy of the updates on the DCT.

The advantages of the DCT were:

- project managers could update the DCT whenever something changed, so the latest progress was instantly available to everyone;
- projects that were at risk could be swiftly identified and directly contacted by the core team before these risks became critical;

A Quick History of Gregorian Calendars

The bones of the modern calendar stem from 715 BC when Numa Pomplius, King of Rome, decreed a year consisting of 12 lunar cycles containing 355 (sic) days. Discretionary days were arbitrarily added to approximate the balance of the solar year. In 46 BC Julius Caesar abandoned this inconvenient and corruption-prone lunar calendar completely and adopted instead a solar year consisting of 12 months alternating 31 and 30 days—except for February which had 29. He also instituted the idea of a leap year by adding a day to February every four years *without exception*. This yielded a year with a nominal length of 365·25 days against an actual of about 365·24219 days—an excess of 11·246 minutes relentlessly pushing back the start of the Julian year.

Shortly after Caesar's death the emperor Augustus tinkered with the neat symmetry of the Julian months by stealing a day from February to add to his own month of August. He also inverted the 30/31 day alternation from September to the end of the year to avoid having 3 months in a row with 31 days. This established the quirky pattern of months and days we still recognise today. But it was not until much later that the Council of Nicaea adopted the Julian calendar as the standard for the Roman Church. The epoch was adjusted so that the then current year was deemed to be 325 AD, and the BC method of reckoning was instituted with no year zero.

By the 15th century it was recognised that since Easter was linked to the vernal equinox, and the Julian calendar was still marching inexorably forward, that eventually Christmas would overtake Easter. Pope Gregory XIII therefore modified the calendar to skip the leap day in century years—unless the year was also divisible by 400. The accumulated excess days of the Julian calendar were also removed when, in most of Europe, the 4th of October 1582 was followed immediately by the 15th, much to the consternation of the general public who believed that their lives were being shortened. This, the Gregorian calendar, survives to the present day and generates a nominal year length of 365·2425 days, an average error of just 27 excess seconds.

- it provided a very accurate picture of overall progress;
- it was used to remind project managers automatically of key goals; for example, if their system testing completion report had slipped beyond their system testing end date;
- it provided data to other parts of BT to allow them to construct their own strategic plans on a strong basis;
- it was used to capture positive confirmations of live deployment—the key milestone; and
- it provided the simplest means possible of collecting tracking information from project managers—all other methods would have involved a more costly and time-consuming level of manual labour.

compliance changes must not be accidentally undone

Conclusions

At the time of writing this article in April 1999, all of the systems engineered by the ACE and ISE Directorates on behalf of the BT business have now achieved live operational service in tested Year 2000 compliant form.

In the run up to the Year 2000, however, maintaining compliance will need very careful attention. Most of BT's operational systems are subject to active enhancement in support of improved customer service, and most of the COTS components upon which systems are built are being enhanced by their respective vendors to respond to market demands. All new features must be compliant, and existing compliance changes must not be accidentally undone. The Programme is actively tracking and enforcing Year 2000 regression testing standards to ensure that no exceptions slip through the net.

Acknowledgements

Many people throughout the BT engineering community have made an important contribution in achieving the strong position now enjoyed, and due credit is fully acknowledged. The Applications Delivery team is a closely integrated part of the pan-BT Year 2000 Programme from which the business strategic position is defined.

Biographies

Ann Wiggins
Networks and Information Services, BT UK

Ann Wiggins joined BT in 1971 and began her career in project and programme management with the team managing building and engineering contracts for new computer centres. She later moved to work on BT's Customer Service System, initially managing implementation of the Cardiff pilot site and then project manager for customer acceptance testing. After a period as project office manager for one of the London based engineering centres, Ann returned to CSS to set up a formal programme and delivery management system. A two year assignment with the Churchill House management team followed. Ann then accepted the challenge of managing the Year 2000 Applications delivery programme, ensuring compliance or cessation of some 700 key business systems by 31 December 1998.

Tim Green
Networks and Information Services, BT UK

Tim Green joined BT in 1981 with a B.A.(Hons.) in Philosophy from York University. He started work as a systems analyst, progressing onto a wide variety of projects, specialising in income accounting and billing. In 1993, He became project manager on ONEBILL, successfully delivering four major releases of BT's premier consolidating billing system. In mid-1997, Tim joined the System Engineering Year 2000 Applications Delivery Programme. As part of a small expert team he defined and implemented policy for the management and tracking of BT's Year 2000 objectives for 725 of BT's key computer systems.

Verrill Baldwin
Networks and Information Services, BT UK

Verrill Baldwin joined BT in 1973 with a B.A. (Hons.) in Solid State Physics from Oxford University and a background in mathematics and software, including the IBM Schools' Computing trophy for 1969. After 10 years as an electronics engineer and delivery manager on TXE4, System X and AXE10, he returned to software in 1982 to form the OMC development team, leading it until 1989. Extensive resource management, systems analysis and strategic engineering responsibilities then followed, culminating in the Dallas Engineering Centre and the Advanced Intelligent Applications unit in 1997. Since then he has acted as a senior IT consultant and principal engineer on a number of corporate infrastructure projects, most noteably the Year 2000 programme, and more recently the EMU project. Verrill Baldwin can be contacted at verrill.baldwin@bt.com

Jackie Jones and John Angrave

Assessment of Network Performance: The ISDN Performance Analyser (Part 3)

Earlier articles[1,2] introduced the ISDN performance analyser (IPA) system that has been developed to provide an indication of the performance of data calls carried within BT's basic-rate integrated services digital network (ISDN). This article provides a summary of the enhancements that have been made to the IPA system to support performance monitoring of the BT Highway service.

Introduction

BT launched its integrated services digital network (ISDN) basic-rate service, known within BT as *ISDN2*, in January 1991 and has rapidly rolled-out this service across its network.

Part of the ISDN launch process involved the development and deployment of a test call sending system which was intended to provide an indication of the performance of data calls in terms of what ISDN customers would tend to experience when using the service. The system, which was developed at BT Laboratories, became known as the *ISDN2 performance analyser* (IPA).

In September 1998, BT launched BT Highway, a new digital communications service to transform a customer's existing telephone line into a high-speed Internet and multimedia connection, and which offers customers a choice of using a combination of analogue and digital connections. This article describes recent changes made to the IPA system, sponsored by the BT Highway Programme and under the project management of the Cardiff and Swindon Systems Engineering Centre, to support the testing of the ISDN and PSTN aspects of the BT Highway service.

System Overview

Previous articles[1,2] have described the IPA system in detail. This section is provided as an overview of the IPA system to aid understanding of the enhancements made to support BT Highway call performance measurement.

The IPA system was originally developed in anticipation of a regulatory requirement (ETR138[3]) and provides the facilities to assess ISDN2 end-to-end call performance both nationally and internationally using the following parameters:

- call establishment delay;
- call establishment failure;
- call early release;
- signal propagation delay;
- 60-second periods error free;
- bit error, errored second and severely errored second performance;
- call release delay; and
- failure to release.

The IPA measures the ISDN network performance parameters by acting as a network user. Measurement results are loaded on a weekly and monthly basis into a mainframe application, called the *exchange performance information collection (EPIC) system*, for reporting purposes.

Forty IPA units are deployed within the ISDN network and controlled from one central PC, called the *data collection unit*

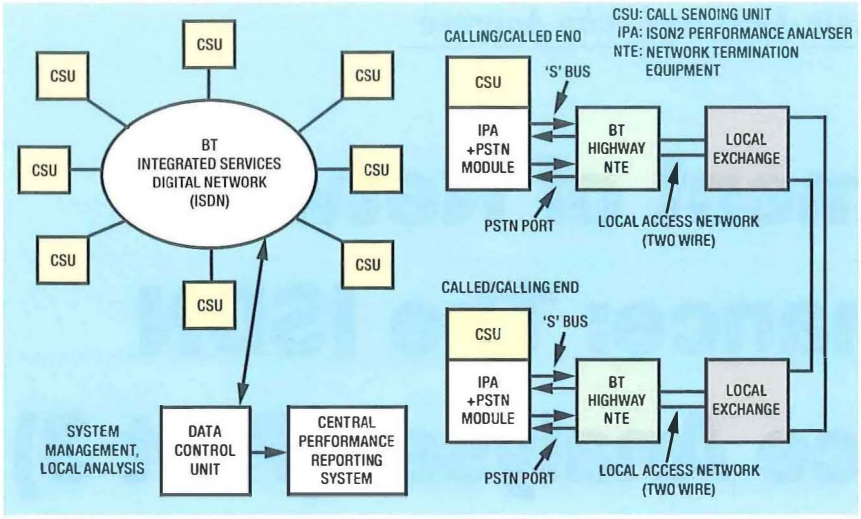


Figure 1 – IPA system overview

(DCU), and an administration IPA (see Figure 1).

An IPA unit is usually located within an exchange with a local loop connection to simulate normal customer wiring. This IPA is referred to as a *call sending unit* (CSU). A test program is loaded by a configuration call from the central (DCU) controller. This test program carries the definition of the time, duration and destination of each test call to be made by the IPA. At the defined time, the IPA makes a bit error rate test (BERT) call and stores the results in a ring buffer. Once a day the ring buffer contents are transferred to the DCU in response to a data upload call. The IPA ring buffer contents include detailed timings of all test call protocol events as well as the results of the BERT calls.

New Technology

BT Highway call performance measurement required a hardware modification of the existing IPA unit, providing a PSTN connection to mimic BT Highway ISDN and PSTN simultaneous call usage. The PSTN module (see Figure 2) was developed by Systems Integration at BT Laboratories to provide this additional connection and was designed as an add-in module to the original IPA. Its function is to handle measurements for the PSTN connection on BT Highway with minimum interruption to the original IPA hardware. The design of the PSTN module employs a high-density programmable logic device (PLD) featuring a 40 000-gate complexity, the majority of which was required to provide:

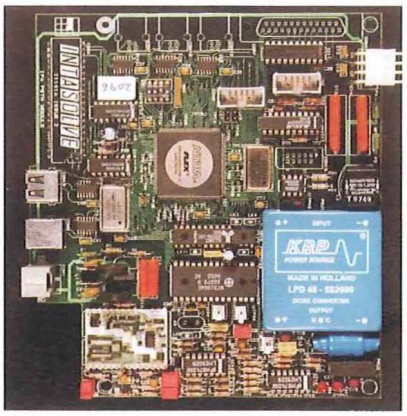


Figure 2 – IPA PSTN module

- serial access to the IPA 'B' channel interfaces,
- sequencing of analogue test calls,
- a real-time clock,
- data formatting for the DCU interface,
- storage of measured call parameters for the analogue domain,

Programmable logic device (PLD) design process and benefits

The PLD design approach is a departure from the traditional microprocessor-based solution allowing fast multiple-state machine implementation and avoiding the need for high processor clock rates. From the PSTN module project work, it became apparent that more sophistication is possible using a higher density PLD with very little subsequent impact on the base equipment, a host IPA in this case. Of potential interest is the availability of downloadable digital signal processing (DSP) functions that would allow more exhaustive checks on analogue line conditions and open up the possibility of generating non-intrusive call measurements. Such a device could be envisaged as being part of customer equipment to drive, for instance, a viewable call quality indicator. The indicator output could be extracted and made visible to the exchange to give a customer view of line quality. With PLD densities exceeding 20 times the one used here now being available, this is feasible, and, with the universal serial bus (USB) interface activated, a simple PC or network interface can be easily driven. The USB interface in the current design was, however, the first sacrifice to be made owing to the lack of PLD density, which proved to be a problem as the design matured.

High-level languages such as VHDL and the Altera AHDL as used in this project ease the design process, although the essential accurate timing simulation and analysis before running prototype designs can be tedious. It was found that designing for efficient simulator operation was important, especially where long counter chains or large state machines were implemented.

For this project, the majority of time spent in the early stages was on the generation of accurate state diagrams produced from other available standard software tools. AHDL is particularly useful for implementing state machines, and so provides an easy link to the state diagrams. Much of the process can, however, be made to suit personal designer preferences.

PLD design modules in this project have migrated to other projects and vice versa. The results of one design effort can potentially be put to use many times over with the benefit of continued refinement and verification being available to all projects. More and more functions are becoming publicly available for PLDs, although a licence to use the function is not always cheap. Use of verified designs can often be justified in the subsequent reduction of development time.

- time stamping of analogue call events,
- detection of test tone signal quality,
- some signal conditioning of line signals,
- automatic adjustment for 2-to-4-wire trans-hybrid loss,
- a universal serial bus (USB) interface, and
- other administrative tasks.

The module includes a single-chip integrated digital telephone circuit (IDPC) and a line interface isolation circuit, digital access arrangement (DAA) with non-transformer 2-to-4-wire conversion and line-voltage protection components.

New IPA Measurements

The programming complexity of the PSTN module has much to do with having to store and transmit results in the format already used by the IPA. PLD size had precluded the use of digital signal processing (DSP) techniques in this version of the IPA logic design. However, some work was initially done using DSP in the decoding of multi-frequency digits. The new measurements developed to support BT Highway PSTN call performance (in addition to the existing ISDN measurements) are:

- *call set-up delay*, the time from sending the last digit to receiving ring tone;
- *call connect delay*, the time from receiving ring tone to receiving test tone;
- *tone loss count* as an error indicator, which is the number of tone breaks greater than 15 ms in duration during the call;
- *round trip propagation delay*, the time taken for the receive signal to disappear after turning off the send signal;
- *call duration*; and
- *call time of day*.

The call connect delay includes the first ring tone duration and receiver recovery from ringing voltage, so the network delay element of this time is only one component. PSTN module delay contributions are known so the network figures can be derived. The delays within the PSTN module circuits are always more significant than delays within the IPA ISDN paths. The uncompensated analogue measurements, therefore, do give an indication of what is typical as experienced from the customer side of the NTE.

An accurate method of measurement of the call release delay for PSTN calls has proved more difficult to provide using the PSTN module. The only available indication for a network clear comes via the NTE ISDN port. This requires alignment of IPA and PSTN results within the DCU; this functionality has yet to be developed.

The effect of BT Highway 128 kbit/s working as PSTN calls are generated or received is to be judged by correlating results from two IPAs both working into a third IPA at the time of bandwidth switching. Bandwidth switching is currently not performed during live BT Highway calls, so PSTN and 128 kbit/s ISDN call overlaps do not yet occur. The scheme is capable of giving error rate figures for 128 kbit/s bandwidth ISDN calls without affecting the original IPA design.

IPA Resets

Problems have occurred in the IPA system requiring occasional reset of the units. The BT Highway IPA takes advantage of the two PSTN ports available on the BT Highway connection (NTE9) to provide a means of remotely resetting the IPA, thus alleviating the need for an exchange visit to perform a manual reset. The DCU can now provide a reset call via a specially modified IPA.This is one of several recent improvements made to the original DCU. Further DCU enhancements are detailed below.

DCU Enhancements

The DCU is a PC-based application, the purpose of which is to control the IPA network, retrieve the data stored in the IPA units and produce data files that can be loaded into the EPIC mainframe application to provide information about the performance of the ISDN2 and BT Highway network.

Principally, the DCU application software has been modified to enable the collation of BT Highway call records from the IPA network for uploading to the EPIC system. However, the opportunity has also been taken to provide the following additional enhancements:

Trans-hybrid loss

An analogue telephone line is a 2-wire full duplex link. The transmit and receive signals are two wires each so a 2-to-4 wire converter is required between the line and the telephone equipment. The converter needs to cancel the transmit signal from the receive path to avoid interpreting this signal as that received from the far end. The measure of the ability to cancel this signal is known as the *trans-hybrid loss* (THL). In the PSTN module this cancellation requires good line impedance matching which cannot be easily achieved. For this reason, a measure of the receive signal component owing to poor THL is made at the start of each test call and this component is subtracted within the PLD signal detector circuitry.

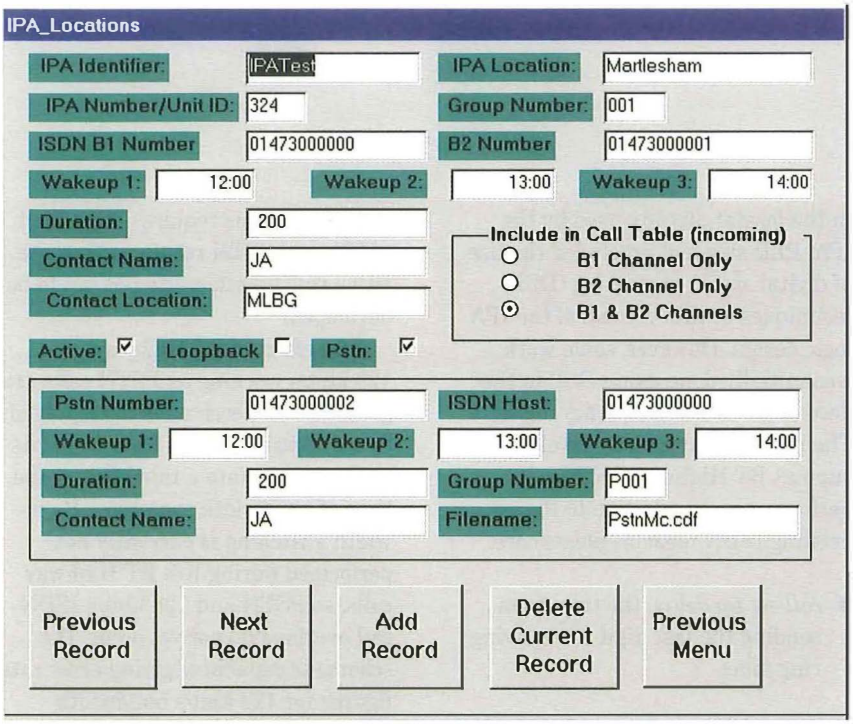


Figure 3—DCU data record

Improved IPA record input

Figure 3 shows the Edit IPA Records screen, which has been enhanced to allow easier updating of information relating to each IPA in the network, such as IPA location and setup.

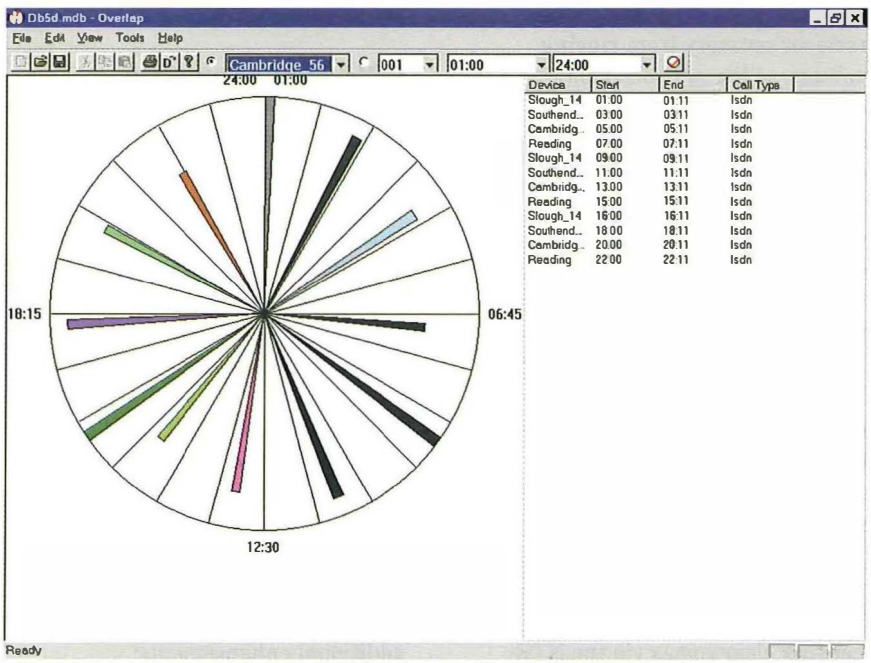
Enhanced system administration facilities

One of the main problems experienced with maintaining the IPA network has been the setting up of the test calling patterns, to ensure that there are no 'overlaps'; that is, IPA units becoming 'engaged' because of call attempts being made while other test calls are still in progress.

A new system administrator facility has been developed (see Figure 4) which provides a pictorial representation of the IPA calling pattern, together with the ability to fix automatically any calls that overlap. The amended calling pattern can then be downloaded to either one or several IPA units at the press of a key.

The Error Viewer (see Figure 5) is another useful IPA network management facility that has been recently introduced. This tool provides a means of easily viewing errors that have occurred within the IPA network that require the attention of the system administrator; for example, an IPA unit that needs to be reset. The fields to be viewed from the errors file can be configured by the system user, and error types can be highlighted in different colours for emphasis.

Figure 4—DCU call overlap display facility



Enhanced results viewing

A new option has been provided on the DCU application to enable flexible analysis of network performance results. Results for call setup delay, call connect delay and call release delay etc, can be viewed graphically, as shown in Figure 6.

Ad hoc testing

Although the main function of the IPA system is to provide national network performance measurements, the IPA units can also be used to perform repeat test calls to help identify and resolve problems that have been experienced on a particular ISDN2 or BT Highway line. Indeed, when used in this way the IPA can often identify the reason for call failures to be a fault with customer equipment, rather than a fault on the BT network.

The DCU application has been modified to ensure that the results of such ad hoc tests are collated and held separately so as not to contaminate the 'national' performance results.

Unit Deployment

Prior to the development of the BT Highway IPA units, an internal BT study[4] was commissioned to provide an answer to the question of how many IPA units should be deployed in the ISDN2/BT Highway network, and how many test calls would need to be made to meet the confidence and accuracy requirements of the emerging EU ISDN ONP legislation[3]. This study provided the following recommendations that were incorpo-

The IPA system enables BT to assess the call performance of its basic-rate ISDN and now BT Highway, in anticipation of regulatory requirements.

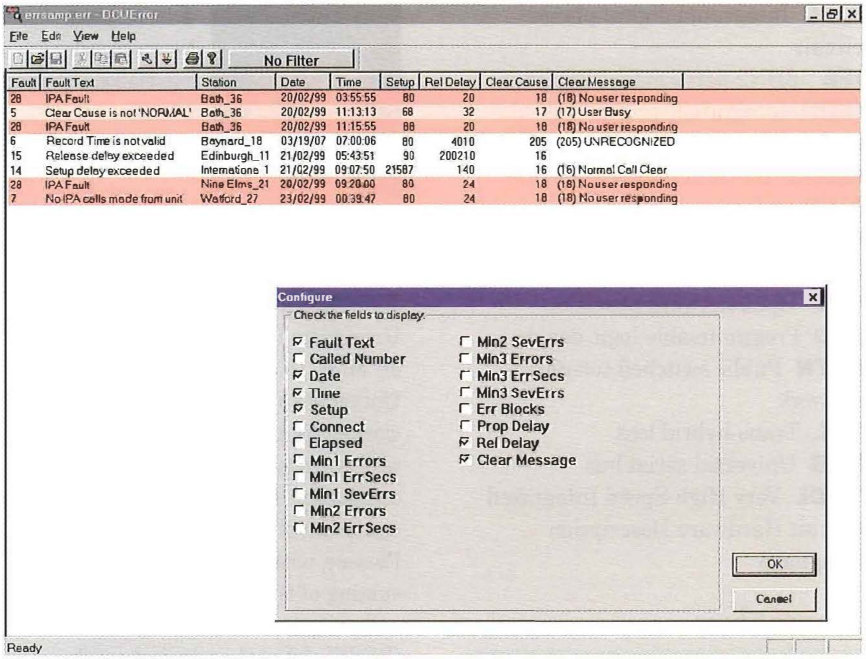


Figure 5 – DCU IPA error display

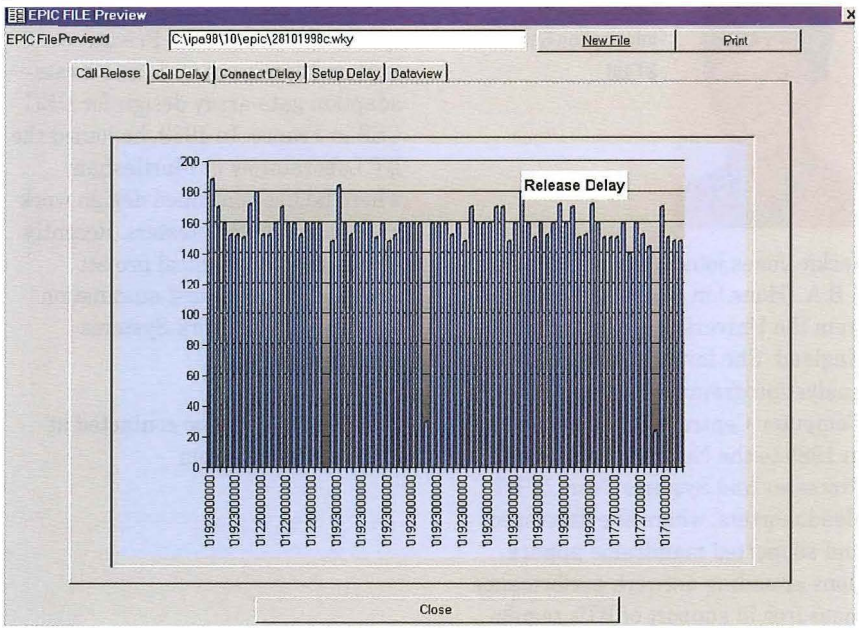


Figure 6 – DCU EPIC file display

rated into the redesign of the IPA system to support BT Highway:

- 20 IPA units should be deployed for ISDN2 measurements with a separate group of 20 units providing the BT Highway measurements;
- 19112 test calls should be made per annum for both ISDN2 and BT Highway, these test calls to be shared among several different call durations;
- test calls should be generated from a representative population of local exchanges, and directed to a representative population of traffic-weighted terminating exchanges; and
- test calls should be scheduled to reflect accurately variations over the hours of the day, the days of the week, and the months of the year.

Conclusion

This article has explained how the IPA system has been enhanced to provide BT Highway performance measurements.

The IPA system enables BT to assess the call performance of its basic-rate ISDN and now BT Highway, in anticipation of regulatory requirements. The system provides an independent source of call performance assessment from which the following benefits can be derived:

- visibility of the network performance which customers will be experiencing;
- an indication of when quality of service is falling below acceptable levels so that remedial action can be taken;
- ability to establish reasons for call failures, be it a fault on the network or faulty customer equipment;
- ability to defend challenges to BT's quality of service, by providing supporting information in the form of performance measures; and
- information on quality of service levels that can be used for marketing purposes.

To support the BT Highway project, the DCU software has been rewritten, which has made it more stable and user friendly, and has significantly improved the quality of the IPA data provided for reporting on the EPIC system. The technology designed for the IPA PSTN module has also been reused to the benefit of other projects.

In conclusion, the IPA system is a reliable and effective indicator of ISDN2 and BT Highway end-to-end call performance, due to the improvements made as part of the redevelopment to support BT Highway.

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Glossary

AHDL™ Altera Hardware Description Language
BERT Bit error rate test
CSU Call sending unit
DCU Data collection unit
DAA Digital access arrangement
DSP Digital signal processing
EPIC Exchange performance information collection system
ETSI European Telecommunications Standards Institute
EU European Union
IDPC Integrated digital phone circuit
IPA ISDN2 performance analyser
ISDN Integrated services digital network
ISDN2 BT term for its basic-rate ISDN service
NTE Network termination equipment
ONP Open network provision
PLD Programmable logic device
PSTN Public switched telephone network
THL Trans-hybrid loss
USB Universal serial bus
VHDL Very High Speed Integrated Circuit Hardware Description Language

Biographies

Jackie Jones
Networks and Information Services, BT UK

Jackie Jones joined BT in 1986 with a B.A. (Hons.) in Business Studies from the University of Central England. She initially worked as an analyst/programmer in the Midlands Computer Centre before transferring in 1989 to the Network Performance Processes and Systems Team in BT Headquarters, where she developed and supported mainframe applications providing network performance measures in support of BT's regulatory commitments. In 1996, Jackie moved to the Cardiff and Swindon Systems Engineering Centre in BT becoming the project manager for the development and support of network performance systems, including the IPA system. She has recently completed a strategic review of network performance systems within BT on behalf of the BT Network Engineering Programme.

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John Angrave
Networks and Information Services, BT UK

John Angrave graduated from Hull University in 1971 and then gained an M.Sc. in circuit design from Aston University in 1972. Since then he has worked as a freelance engineer for a wide variety of both large and small companies. In 1979, he started a 4-year involvement, via STC and Plessey, with the design and commissioning of the BT System X digital subscriber switching subsystem (DSSS). After this, project work included the first trial implementation of the digital access signalling system (DASS) for the Private System Division of GEC and a rate-adaption gate-array design for DEC CSS in France. In 1989, he joined the BT Laboratories at Martlesham where he has continued design work mainly on network testers. Recently he has been a technical project manager for some test automation work for the Network Systems Integration team.

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Andy Denhard

BT Fusion—Fusing Voice and Data for Smaller Customers

BT's Business Systems has entered the voice and data integration market with BT Fusion. *It is being marketed to small-to-medium-sized companies to deliver high-functionality voice telephony with data routing and Internet access. The system embraces voice and data capabilities to provide desktop control of the telephone system through the PC and allows the customer to share data and resources across its company.*

Introduction

BT Fusion (Figure 1) is an integrated office communications solution for small-to-medium-sized companies. It applies a new level of flexibility and sophistication to communications for small-to-medium-sized organisations, previously only available to companies with large budgets and specialist IT support. BT Fusion integrates local area network (LAN) and telephony communications in one modular, scalable solution, utilising integrated services digital network (ISDN) and leased line connections.

It is a breakthrough for small- and medium-size customers because technologies that were previously separate can be **fused** together to provide a highly functional, but cost-effective business solution. Integrating voice and data means that a company's communications capacity is increased at the same time as saving money by removing the need for separate telephone and data systems and the extra costs of circuits to service them, reducing the whole cost of ownership of a network. This is achieved by:

- *Dynamic use of ISDN* Voice, data and Internet applications all utilise the same ISDN lines, maximising the customers' return on this resource.
- *Reduced maintenance costs* A single, Windows-based administration tool is used to configure the voice, data, Internet and firewall capabilities of BT Fusion.
- *Productivity benefits* Users have the advantage of the familiar Windows interface, reducing training costs while allowing access to Fusion's powerful applications to improve productivity.
- *Industry-standard analogue telephones are used* These can include the new caller display service telephones, removing the need for expensive system specific featurephones.

Fusion was launched on 15 April 1999, following a six-month trial in Scotland and the South East. The customers involved in the trial were from a range of businesses as diverse as a group of florists to a company specialising in packaging. Customers on the trial liked the product, but because the way of working is so different, the system has taken some getting used to. The operations console is a screen rather than a telephone or switchboard. This means users can see how many calls are queuing on an inbuilt automatic call distribution system. Customers have been saying for some time that they want to see their call queue and

Business Systems

Business Systems is a 4200 strong team in BT UK's Products and Solutions Division. Business Systems specialises in providing service around voice, data and multimedia solutions for customers in the UK.

The team's vision is: 'Based on a highly skilled workforce, Business Systems will be the leading on-site provider of innovative, integrated solutions and services that will exceed the expectations of our customers and progressively move us into the IT arena'.

to be able to control their own voice mailboxes. Fusion allows them to do both.

Voice Telephony

BT Fusion provides all the functions customers expect to find on a modern telephone, for example:

- direct dialling in (DDI), allowing customers to call direct to the person or department they want;
- conferencing, allowing users to set up an audio meeting to share issues and ideas (these parties can be both internal and external);
- call forwarding—both internal and external—whereby users can control where the calls go if they are not at their desk so that no call needs to be missed;
- hunt groups, where departments can be contacted by one unique number saving time and customer frustration of calls being shunted;
- call barring, controlling who the users can call; and
- voicemail, giving a digital answering facility for every user or group of users, and ensuring the company does not miss calls and hence lose business.

BT Fusion goes one step further by embracing the voice and data capabilities to provide desktop control of the telephone system through the PC. This means that calls can be made, answered and transferred using the familiar Windows environment. It is fully compatible with Windows 95/98, Windows NT 4.0 and Windows NT Workstation 4.0 and takes advantage of many of Microsoft's in-built computer telephony features and facilities.

Data Routing

BT Fusion gives users the capability to set up a new, or integrate into their existing, local area network (LAN). This infrastructure allows users to transfer data and share resources like printers.

By using Fusion's Internet protocol (IP) router users can cost-effectively share high-speed ISDN access to the Internet. Internet security is provided through an integrated firewall. The firewall access software allows users to control who can access external resources, and when, while isolating their private networks from the Internet.

Voice and Data Integration

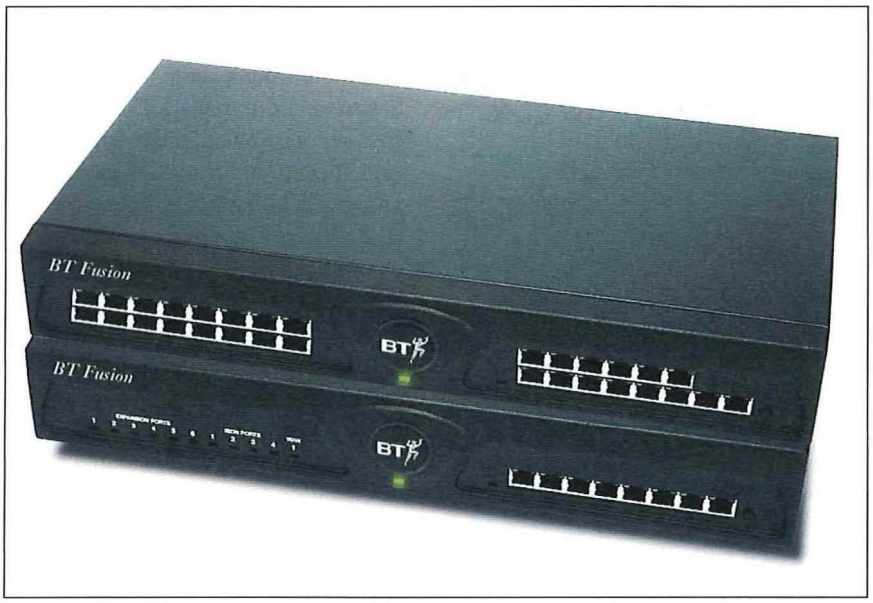
The fusion of voice and data is powerfully demonstrated by the messaging and desktop capabilities of BT Fusion. By harnessing voice and data at the desktop, user's time can be more productive; for example:

- Users can see who is calling them—on a display telephone, on the PC screen, or both. The display can include names on both internal and external calls.
- Advanced telephone features such as conferencing or call forwarding can be controlled from the PC as well as the telephone. This can improve productivity by maximising use of the system's features.
- Incoming mail messages (including voice and e-mail) can be delivered to an individual's PC (unified messaging).
- A single Windows-based management system is provided for voice and data administration.

Modular

Fusion's base unit incorporates an eight-port data hub. On top of this is a 30-port telephone system which can be extended, as the system is totally modular. Modules can be added easily and quickly, and can be shelf- or rack-mounted. Fusion is fed by a standard cabling patch panel connection, which means no extra cabling is needed by the customer. Because it is modular, BT Fusion can be fitted into any small, medium or distributed business environment, regardless of existing systems. It is ideal for both greenfield sites or for migrating from an existing discrete system to a fully integrated communications system as an organisation evolves.

Figure 1—BT Fusion



As an integrated communications solution, BT Fusion is ideally suited to BT's structured cabling infrastructure portfolio. This highly future-proofed cabling scheme is designed to offer one unified infrastructure for business customers, while allowing the flexibility, topology and applications supported to be managed by the customers themselves. The fusing of voice applications, data applications and cabling infrastructure really is a powerful business tool.

Business Systems engineers provide and maintain a vast range of current and older systems and solutions across the UK. The skills these engineers already possess can easily be extended to working with data. They are highly trained in customer empathy skills, customer familiarisation and technical expertise, all ensuring that the customer is able to get the most out of their new system from day one. The service is further backed up by the product technical centre adviceline remotely clearing faults where feasible and advising customers on how to use their new switch to its full potential.

Fusion is a completely new offering from BT, not replacing any other products, and it takes the company into the integrated voice and data market. This is how BT Business Systems sees the small- and medium-switch market growing in the next few years.

Biography

Andy Denhard
Business Systems, Products and Services, BT UK

Andy Denhard is one of a small team of product marketing managers in Business Systems responsible for a number of products in the small- and medium-switch market, the largest of them being BT Inspiration and BT Fusion. He has been in BT for 13 years. He was previously in Customer Service, looking after customer relations. In the City of London District he was responsible for setting up the customer service guarantee scheme. Before this he was in Group Finance. Andy has diplomas in Management Studies and Marketing.

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MESSAGE FROM MARTLESHAM

Peter Cochrane, Head of Advanced Applications and Technologies, at BT Laboratories, Martlesham Heath, continues his regular column in the* Journal. *In this edition he looks at the impact information technology has on our lives in the broadest sense.

No IT—No Life

At a recent meeting with students, a philosophy major asked me if we needed all this technology. I just asked him if he wanted to live! The reality is that our society now depends on information technology (IT) for its very existence. Switch off the networks and we all die. Strong words you may think—but consider the prospect of no heat, light, power, water, sewerage, automated manufacture, high intensity farming and logistics. Like it or not we live in a world where the bits now control the atoms. No bits—no anything.

Everything we eat, wear, use and touch is produced, organised, and delivered by machines and IT. Without technology and intensive farming the UK land mass would only support a population of around 10 million and not the 60 million of today. Should we worry about this? Well, our technology dependence started when ancient man threw the first projectile, and it has grown since that time. Today the fastest rate of change is most visible in IT. Faster and more dense chips, better displays and networks, the disintermediation of old businesses and the creation of new. Can you imagine travelling back a mere 20 years and trying to explain how an Internet business called *Yahoo!* would grow from nothing to $8 billion in four years? Or going back only 50 years with stories of mobile telephones!

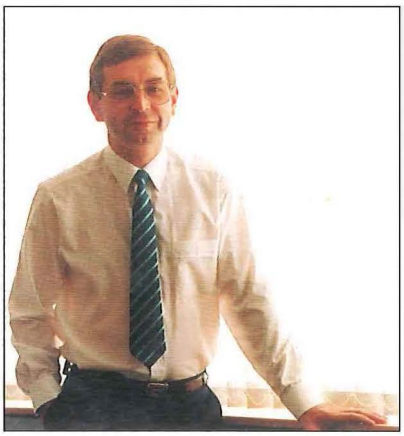
The science and engineering of technology is tough, challenging, fun, and extremely rewarding. Technology now totally underpins and supports human society and our existence. So, being in the ranks of the thousands of technologists worldwide means assuming the yoke of responsibility handed down from previous generations. And unlike most professions it is not acceptable to tackle complex problems and then be in a 'no answer—no solution' mode. We have to find solutions—fast. The difference is perhaps best epitomised by the following story:

A mathematician, physicist and engineer stay in three different hotels. There is a fire at each hotel at exactly the same time. Woken by the fire alarm, the physicist rushes into the corridor, sees the fire, sees the hose, works out the necessary trajectory, turns on the tap, puts out the fire and goes back to bed. The engineer rushes into the corridor, sees the fire, grabs a bucket of water throws it on the fire and goes back to bed. The mathematician strolls into the corridor, sees the fire, sees instantly that the problem is solvable, and goes back to bed.

When I joined this industry I soon began to realise what an incredible future lay ahead and how much I did not know. 25 years later I am still attending courses, still learning, and still having fun. My recent past was concerned with reasonably linear, well-behaved and probabalistic engineering. Today my life is full of non-linearity and ever more exciting and challenging problems. Although I started as an electrical engineer, I am now deep into biology, genetics, behavioural science and artificial life.

It is now essential to understand how future networks and systems operate, perform, and fail. It is essential to find solutions before customers are subject to the unforeseen impact of unexpected failures or responses. To do this has meant recruiting people from a vast range of disciplines. My team currently includes entomologists, geneticists, mathematicians, cosmologists, biochemists, linguists, physiologists, physicists, chemists, and engineers of all persuasions.

Why would a telephone company recruit such a wide range of people? Well, BT is no longer a telephone company, it is in the solutions business, it has to be 'the business partner' in a sector that is now



inherently complex chaotic. By and large there is no mathematical or physical understanding, or model, for a lot of what we do and engineer, or the market space we occupy. So we have to exploit all the techniques available from a multitude of disciplines to solve the problems that confront us.

It turns out that artificial life is a powerful modelling tool for econometric, network, company, competitor and people behaviour studies. In addition, we now use sexual reproduction and genetics in machines to create software, hardware and network solutions. How has this come about? From the simple observation that mother nature copes well with chaos, while human systems do not. It follows that copying nature might produce interesting results. When I first realised this, I coined the chicken scenario, where the chicken is a metaphor for anything. The story goes like this:

There are three approaches to understanding how a chicken works:

- Thousands of philosophers over thousands of years have sat staring at chickens trying to think how they might work. Frankly they have made no progress at all.

- Physicists and biologists just club chickens to death and take them apart. As a result they know vastly more about chickens than the philosophers ever will.

- Engineers, on the other hand, persist in trying to build chickens. From this route will come the

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most fundamental of understanding and ability, but on the way we will see some really weird chickens!

Now it is the software engineers who really worry me—all they want to do is specify a chicken!

More than ever I see a future of man, woman and machine. Men and women think and solve problems differently, as do different race, creeds, and disciplines—and long may that continue—it is what makes us powerful and creative. But we need a third approach—the machine with its ability to cope with vast complexity is now an essential partner.

A few years ago I was asked if I worry about dying. I replied that I do not, but I do worry about dying before my laptop computer is proud of me. At the time I was joking, but today I am deadly serious.

telecom focus

BT and Sega to Provide Subscription-Free TV Internet Access Across Europe

BT has announced that it has been chosen as preferred supplier by Sega, the global electronics company, to enable it to provide a pan-European subscription-free Internet access service for users of Sega Dreamcast.

The new Dreamcast games console, to be launched this September, will provide users with subscription-free Internet access through their televisions on a pay-as-you-go basis via BT's network of European partners. This is the first time that subscription-free Internet access has been made available across Europe in this way.

John Swingewood, Director BT Internet and Multimedia, said: 'We're delighted to have been chosen by Sega to provide pan-European dial IP access for Dreamcast games console users. One of our key objectives is to enable more and more people to get on-line and by working with Sega to introduce simple, low-cost access on games consoles we will take another step towards achieving this.

'Through BT's Internet expertise in the UK and its significant investment in a pan-European network launched early this year, BT is able to offer Sega a pan-European dial IP access service.'

The dial IP service will be available from BT in the UK and its European partners in France, Germany, Italy and Spain. BT and Sega expect to roll-out the service to other European countries at a later date.

Dial-up access based around local call rates will be provided to BT's server hosting facility in the UK via its pan-European network. In addition, BT will be providing e-mail and billing facilities. Similar to BT's innovative BTClick in the UK, the service will be simple to use and as the modem is included in the Dreamcast console, users do not even need a PC.

John Swingewood added: 'The free Internet access market in the UK has developed very quickly since last year but progress in mainland Europe has been much slower. This service is a very powerful demonstration of BT's capabilities resulting from its investments across Europe.

'By utilising the network capability and the local knowledge of its European alliance partners, BT and Sega have taken the initiative to develop this market.'

The new Dreamcast console will include a 33·6 kbit/s modem and a browser, and in addition to Internet access, it will enable customers to access e-mail, chat and on-line gaming services. Future plans include the offer of on-line shopping facilities.

BT to Trial Advertising on Calls

BT has announced plans for a new telephone service which will give customers free call time in return for hearing advertisers' messages during calls.

Called *BT Freetime*, the service will be piloted in Tyne and Wear and in the Bristol areas.

Once customers have registered they will receive a freephone number and PIN to use before making BT Freetime calls. They will hear an advertiser's message at the start of the call and further messages at regular intervals. Customers will decide on a call-by-call basis whether they want to use BT Freetime.

Tony Benfield, BT Freetime product manager said: 'This is an innovative and exciting service which we believe will appeal to many of our customers and to a wide variety of advertisers.

'Customers will have complete control over how they use the service and will benefit by receiving free call time, while advertisers can target specific markets.'

Tony Benfield added: 'Among the people we believe BT Freetime will be attractive to are young people including students and cost-conscious households. A number of major companies have already expressed an interest in buying advertising time on the service.'

When customers join BT Freetime they will be asked to complete a lifestyle questionnaire to ensure the messages they hear are relevant to their interests and buying habits. Customers will use their existing telephone line and telephone for the service.

BT is working with Swedish company GratisTel, who pioneered the service in Sweden. The concept has been taken up in a number of countries, including Denmark, Italy, Norway and the United States. GratisTel will be providing hardware and software to enable the system to operate. This will be installed at BT premises.

New Voice-Over-Internet Service

BT Internet is making it easy for its surfers to speak to each other over

the Internet with its launch of a new voice-over-Internet service.

The service puts BT Internet customers at the forefront of the next communications revolution by enabling them to make and receive good-quality calls between each other while simultaneously surfing the net.

BT also announced that the service is being further developed to enable users of BT's free Internet access service—BT ClickFree—to speak to the helpdesk at local call rates. This sets a new price point for free Internet access services' helpdesk charges.

John Swingewood, BT's Director of Internet and Multimedia, said: 'By making it easy for BT Internet customers to speak to each other via the Internet, we are adding value and enabling them to explore further the massive potential of this incredible medium.'

The ability to talk and share visual information simultaneously over the Internet will form a vital part in the future of communications and BT Internet is encouraging its customers to test the possibilities.

The BT Internet homepage now features an icon that leads customers through setting up and using the voice-over-the-Internet service. Users will need a multimedia PC with microphone and speakers, which are standard with most modern PCs.

European Clearance for Global Venture

BT and AT&T welcomed the European Commission's clearance of their fifty-fifty global joint venture. This company is aimed at serving the complete communications needs of multinationals and the international calling needs of individuals and businesses around the world using an advanced worldwide network.

Approval from the US Department of Justice and the Federal Communications Commission is now required and this is expected later this year.

BT and AT&T announced the creation of the global venture in July 1998. It will combine the trans-border assets and operations of each company, including their existing international networks, all of their international traffic, all of their international products for business customers—including an expanding set of Concert services—and the two companies' multinational accounts in selected industry sectors.

The two companies will also develop an intelligent managed Internet protocol-based global network to be implemented by the venture, its parents and their partners.

AT&T and BT to Acquire 30% Stake in Japan Telecom

Japan Telecom, AT&T and BT have announced a ground-breaking strategic and operational partnership, aimed at further enhancing Japan Telecom's ability to deploy new services and technologies to serve customers in Japan. The companies have entered into a definitive agreement for AT&T and BT to acquire a 30% stake in Japan Telecom, one of Japan's largest telecommunications companies, for US$1·83 billion. The agreement is expected to be closed by the autumn.

Under the agreement, AT&T and BT will each subscribe for 15% of the equity in Japan Telecom. AT&T and BT will hold their interests through a jointly owned holding company through which they will adjust their economic interest. AT&T and BT will jointly manage their investment. Both companies will appoint executive and non-executive directors in the company and will be offered senior management positions.

Japan Telecom will also become the sole distributor of AT&T and BT global venture branded services and a preferred supplier of services to the global venture.

The company plans to develop rapidly its data, mobile and Internet businesses and has an advanced program to roll out a national IP-based network. This will be fully compatible with the IP-based network planned by the AT&T and BT global venture. Additionally, the global venture will use Japan Telecom's extensive network infrastructure to enhance its coverage and provide end-to-end services to customers.

AT&T's joint venture, AT&T Jens, together with BT's existing joint ventures, BT Communications Services and BT.NIS, will be integrated into Japan Telecom. This integration will enhance and expand two key Japan Telecom businesses: multinational corporation and large corporate sales, and data communications. These businesses will market and sell AT&T and BT's global venture services and other corporate services in Japan.

In addition, BT will take a significant stake in the Japan Telecom third-generation mobile consortium which, in the next year, will apply for a licence in Japan.

This is the first joint investment by AT&T and BT since the two companies announced last summer their intention to form a global venture to serve multinational business customers and international carriers.

Japan Telecom owns a leading Internet service provider (ISP) which will be combined with AT&T's and BT's Japanese ISPs in a new data division within Japan Telecom, to form one of Japan's top five ISPs with more than 400 000 customers.

Japan Telecom's planned implementation of third generation (3G) mobile services complements AT&T and BT's own strategy for the future of mobile communications. These 3G systems will provide high-speed Internet access and other broadband wireless applications.

Junk Fax and Telesales Calls Opt-Out Schemes

Oftel has appointed the Direct Marketing Association (DMA) to set up and run the new opt-out schemes for unsolicited direct marketing by telephone and fax. The schemes, known as the *Telephone Preference Service* and *Fax Preference Service*, were put in place on 4 May 1999 and there is no charge to register with the schemes.

Announcing the appointment of the DMA, David Edmonds said: 'For the first time ever the public have the right to protection in their

homes from the intrusion of unsolicited faxes and increased protection from direct marketing telephone calls. Oftel has worked closely with the DTI and the DMA to ensure that the scheme was in place for 4 May.

'Organisations that engage in unsolicited direct marketing by telephone and fax must not contact individuals and companies that have registered with the opt-out schemes.

'Telesales companies that breach the Regulations could face action by the Data Protection Registrar. Failure to comply could lead to fines of up to £5000.'

Welcoming the establishment of the opt-out schemes, Michael Wills DTI Telecoms Minister, said: 'I'm delighted that consumers will now have the ability to avoid unwanted direct marketing calls and faxes.

'For many, these calls and faxes constitute an irritating invasion of privacy, and for small firms in particular, unwanted faxes can be both costly and delay important business correspondence.'

The DMA was appointed following competitive tender. Those wishing to register with the schemes should call 0845 070 0707 for telephone preference registration and 0845 070 0702 for fax preference registration. Direct marketing businesses should call (01932) 414161 for an information pack on the TPS and (0171) 766 4422 for an information pack on the FPS.

Telecommunications Industry and the Millennium Bug

Oftel has announced the results of the latest assessment of the UK telecommunications industry's work to prepare for Year 2000.

90% of the UK's public telecommunications networks are now assessed as Year 2000 (Y2K) compliant. Using Action 2000's 'traffic lights' system, this means that 90% of telecommunications networks are 'blue'—the Y2K programmes have been monitored and no material risk of disruption identified. All the major fixed networks, all providers of 999 service and the four mobile networks are assessed as 'blue'.

The remaining 10% of the public networks are assessed as 'amber' which means that a Y2K programme is in place, which will make them compliant. Oftel expects all of the UK public telecommuinications networks to be 100% millennium compliant by September.

Commenting on the report, David Edmonds Director General of Telecommunications, said: 'This report reinforces public confidence that network operators will continue to deliver consumers business as usual into the new millennium.

'The industry assessment programme has shown good progress. Oftel will continue to monitor work on the millennium bug and industry progress throughout the rest of the year. The key responsibility of course remains with the companies but this review process has demonstrated great commitment on their part'.

Calling Line Identification Numbers

Oftel is proposing changes to the way that calling line identification (CLI) numbers are checked. Under the current rules CLI is only passed to the customer if the network can verify the number being presented. This safeguard was introduced to ensure that numbers displayed really did refer to the telephone from which a call was being made.

This means that many large organisations withhold CLI—not because they want to conceal their identity—but because the number displayed would be misleading to customers. The reason for this is that when a call passes through a large corporate network the number displayed could be a long way from where the call was originally made. The customer would then not have a useful number to call back. Up to now this has not been a big problem. But in future EU laws will give customers the right to have the option of automatically rejecting all calls where CLI is withheld. This could mean customers rejecting calls which they would want to receive. To overcome the problem, Oftel is proposing that the companies themselves should be allowed to insert a useful number which customers could use to call them back. Networks would vet companies which wanted to use this system, but it would not be the full verification that is currently in place.

Director General of Telecommunications, David Edmonds, warned that action would be taken against anyone misusing CLI numbers. He said: 'Companies misusing CLI would have their permission to provide their own CLI withdrawn. They may face prosecution under data protection and telecommunications legislation.

'These proposals balance the need for some security of the number being presented against the danger that full verification would lead to genuine calls being cut off. We are keen to hear views on our proposals.'

Electronic Signatures

An EU framework for using electronic signatures in secure transactions made through computer systems was agreed by the EU Telecommunications Council on 22 April.

Enabling users to 'sign' documents transmitted via the Internet, for example, these digital signatures are a key part of secure methods of electronic commerce. They can allow a recipient to check that the signed data has not been altered and that the source and identity of the sender are authentic. The Directive agreed by the Council would set out a legal framework for the use of electronic signatures and certification services, and promote compatibility between different systems by requiring certain requirements to be met. It is not intended to harmonise national contract law, nor would it cover electronic signatures used exclusively within closed systems. Member States would have 18 months to transpose the measure into national law.

field focus

On Christmas Eve 1998, engineers and managers in BT's North East and Cumbria Customer Service teams finished the day, rightly proud of themselves. They had put a considerable effort into ensuring that all faults reported by customers were cleared and no one was going into Christmas without service.

On Boxing Day the worst storm we had seen for some time hit the West Coast, passed through Cumbria, and went on to hit Durham, Northumberland and Scotland. The storm brought high winds and inflicted considerable damage to trees, buildings and of course the overhead network. Poles were brought down along with dropwires and aerial cable.

Customer reports started to flood in and the North East and Cumbria local service management units (LSMUs) were quick to gather information on the types of damage and where the damage had occurred. It soon became evident that the main problems were in rural areas and that scheduled staffing would not be able to cope with the amount of overhead work required to restore service to customers. Engineers and managers were contacted at home, with many volunteering to come in from their Christmas leave, and the customer service team areas that had been least affected moved people into the worst affected areas to ensure that all teams worked together.

By Tuesday morning the repair workstack had risen from normal levels of around 800 faults to over 2500 faults with over 1000 reports still expected. The resource teams arranged task forces from Yorkshire, East Midlands and the North West, with engineers volunteering to work away from home over the Christmas period—showing excellent commitment to customers.

Field managers came in to organise the task forces and arrange exchange keys, maps, and organise cash payments for the engineers in the task forces. One field manager had difficulties in obtaining cash and drew money from his own account to ensure there were no hold ups.

Large orders were placed for dropwire and aerial cable that were sent to suitable locations around the area. As a short-term measure, stores were taken from vehicles of absent engineers until they could be replenished. Additional elevating platforms were mobilised, operated by engineers who normally stand in for absent operators.

In the LSMU, engineers worked to prioritise the faults on the basis of dangerous faults first; for example, poles down or partly down (a pole in Northumberland was suspended by its remaining dropwires), trees fallen but lying on dropwires etc. Engineers put in a tremendous team effort to ensure that dangerous plant was quickly made safe.

The LSMU also checked the notes on fault reports looking for special priority cases; for example, sickness, disability. Over the Christmas period more people were home from hospital than at other times of the year.

The operating parameters of Work Manager were reset to give engineers their next fault closest to their current location, with priority being given to the oldest faults. This was more efficient with the abnormally high volumes of work. The appointment system for customers was temporarily suspended and all faults were dealt with as soon as possible. This meant that customers were not given appointments that could not be met. The Data Transfer and Enquiry team in Newcastle, along with the customer service centres, played a key role in explaining to customers what was being done by the task forces to clear their faults.

Through this tremendous team effort, over 1200 customers a day were returned to service and, by the New Year, the workstack was returning to normal levels. An exceptional achievement by all involved.

Dave Richardson, Customer Service Team Manager, Durham

forthcoming conferences

June 1999

Combating Telecommunications Fraud.
28–29 June 1999, St. James' Court Hotel, 45 Buckingham Gate, Westminster, London. IQPC Ltd., Tel: (0171) 430 7300; Fax: (0171) 430 7301; E-mail: fraud@iqpc.co.uk,
Web: http://www.iqpc.co.uk

Computer Telephony Expo 99. Exhibition and Conference
29 June–1 July 1999, NEC, Birmingham. Contact Miller Freeman UK Ltd, Tel: +44 1203 426 478; Fax: +44 1203 426 493; Web: http://www.ctexpo.co.uk

Networks Telecom 99. Exhibition and Conference.
29 June–1 July 1999, NEC, Birmingham. Contact Millar Freeman UK Ltd., Tel: (01203) 426 479; Fax: (01203) 426 503; Web: http://www.networks-telecom.com

July 1999

Customer-Driven Performance Metrics in Telecoms. 5–6 July 1999, Euston Plaza, 17-18 Upper Woburn Place, London WC1H 0HT. Information: Vision in Business, 41 Whitcomb St., London WC2H 7BT, Tel: (0171) 839 8391, Fax: (0171) 839 3777, E-mail: booking@visibis1.demon.co.uk,
Web site: http://www.visibis.com

Internal Audit in Telecoms.
6–7 July 1999, Regents Park Hilton Hotel, Lodge Road, London NW8 7JT. Information: Vision in Business, 41 Whitcomb St., London WC2H 7BT, Tel: (0171) 839 8391, Fax: (0171) 839 3777, E-mail: booking@visibis1.demon.co.uk

Planning and Managing the Transport of IP over WDM.
8–9 July 1999, Hotel Des Bergues, 33 Quai des Bergues, 1201 Geneve, Switzerland. Information: Vision in Business, 41 Whitcomb St., London WC2H 7BT, Tel: (0171) 839 8391, Fax: (0171) 839 3777, E-mail: booking@visibis1.demon.co.uk

xDSL Technology In Europe.
22–23 July 1999, One Whitehall Place, London. Information: Access Conferences International Ltd., 22-26 Albert Embankment, London SE1 7TJ, Tel:(0171) 840 2700, Fax:(0171) 840 2701, Web site: http://www.access-conf.com

August 1999

Networking the Future. 38th EuropeanTelecommunications Congress. 24-28 Aug. 1999, Utrecht, The Netherlands. Details: KIVI, Congresbureau, Postbus 30424, 2500GK Den Haag, The Netherlands. Tel: +31 70 391 9890, Fax: +31 70 391 9840, E-mail: congres@kivi.nl,
Web site: http://www.fitce.org/fitce99

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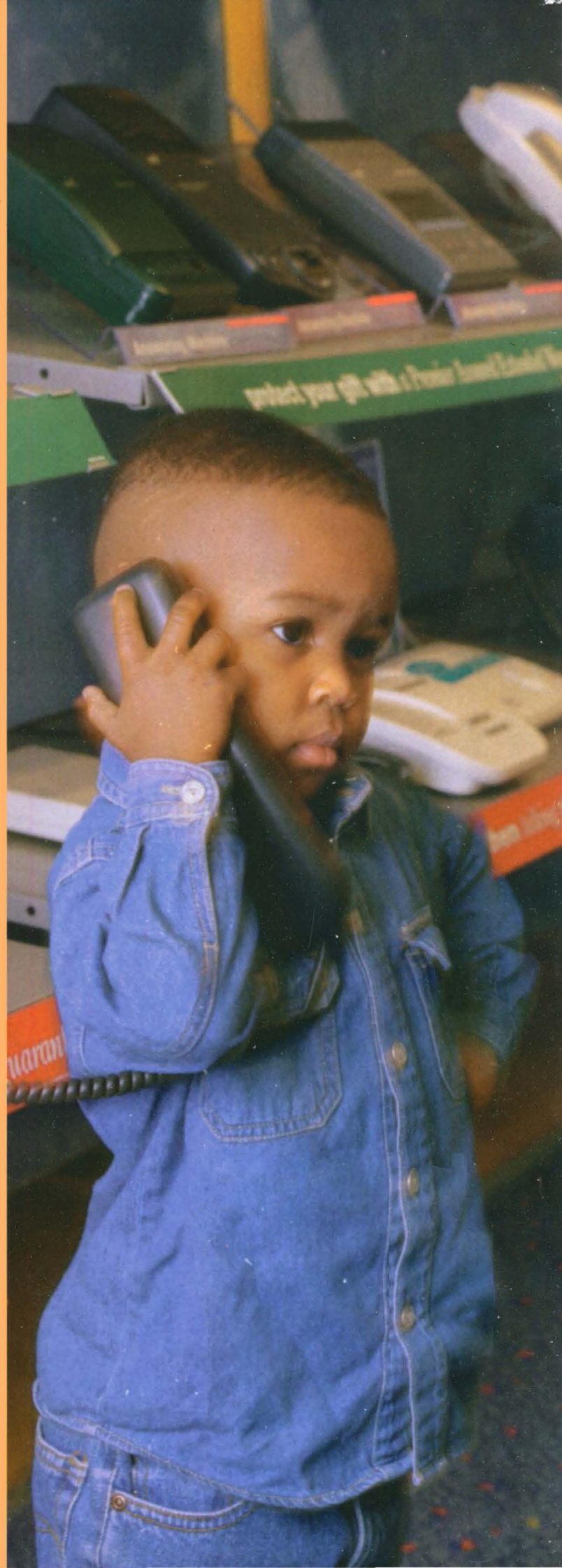

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