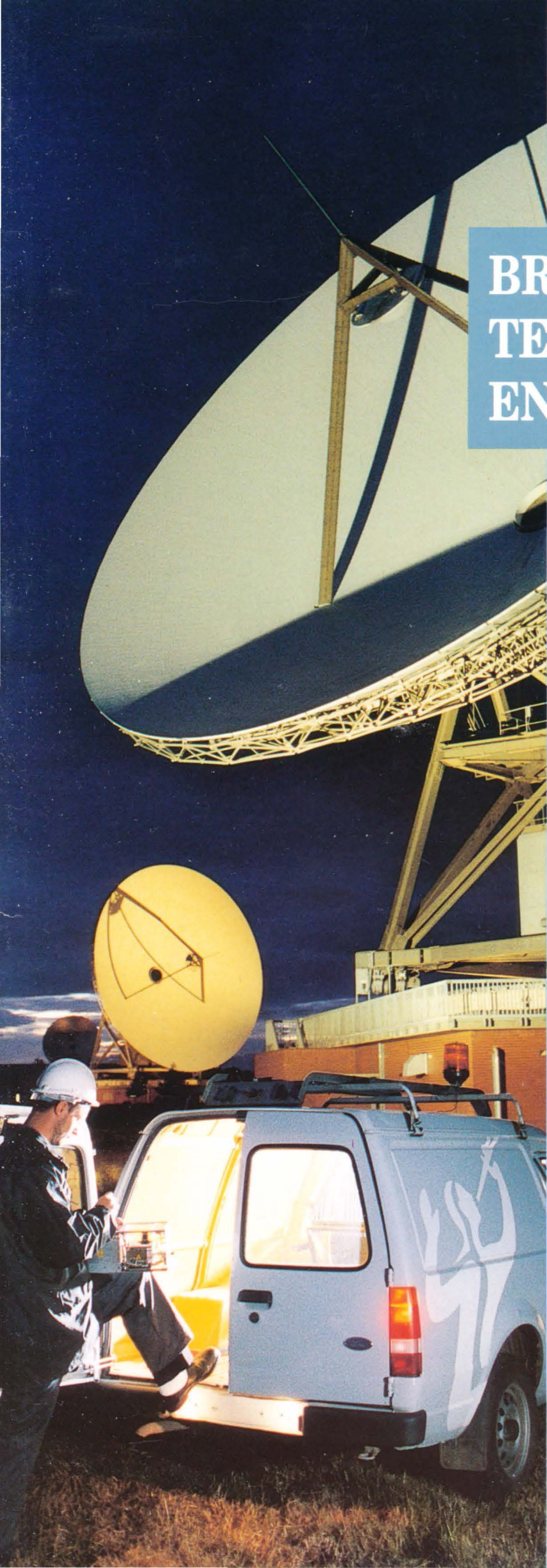

VOLUME 12 PART 3 OCTOBER 1993

BRITISH TELECOMMUNICATIONS ENGINEERING

The BT Global Network

Caller Display and Call Return

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The Journal of The Institution of British Telecommunications Engineers

BRITISH TELECOMMUNICATIONS ENGINEERING

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Regular Features

GUEST EDITORIAL

Mike Read

Supporting BT's Global Vision

BT's outlook has become a global one in a relatively short space of time. This is being driven partly by the need to seek out new markets because of competition and the relatively slow growth in the UK market. More significantly, however, it represents a move to meet the needs of customers who themselves operate on a global basis, and to take advantage of other opportunities overseas as markets open up due to liberalisation.

In support of BT's global vision, the Global Networks Directorate handles BT's global network activities in the UK and around the world. Its mission is to satisfy customers' requirements for world-class networks and services by planning, providing, managing and, where appropriate, maintaining and operating BT's global network.

I am pleased to be introducing the series of articles which begins with two articles in this issue of the *Journal* (see pages 162 and 165) and which will describe the various components of that global network and the activities of the Directorate. With people working throughout the world, BT is aiming to create the definitive global network that customers require.

Mike Read

Senior Vice-President Worldwide Planning and Operations,
BT-MCI Joint Venture

[*Editorial Note*: At the time of writing, Mr Read was Director, Global Networks, BT Worldwide Networks.]

Mike Read

The BT Global Network

An advanced well-coordinated global network platform will be a key element for BT to achieve its goal of being a major player in the global telecommunications market. This article introduces a major series of articles on the theme of the BT Global Network which begins in this issue of the Journal and will continue in subsequent issues.

Introduction

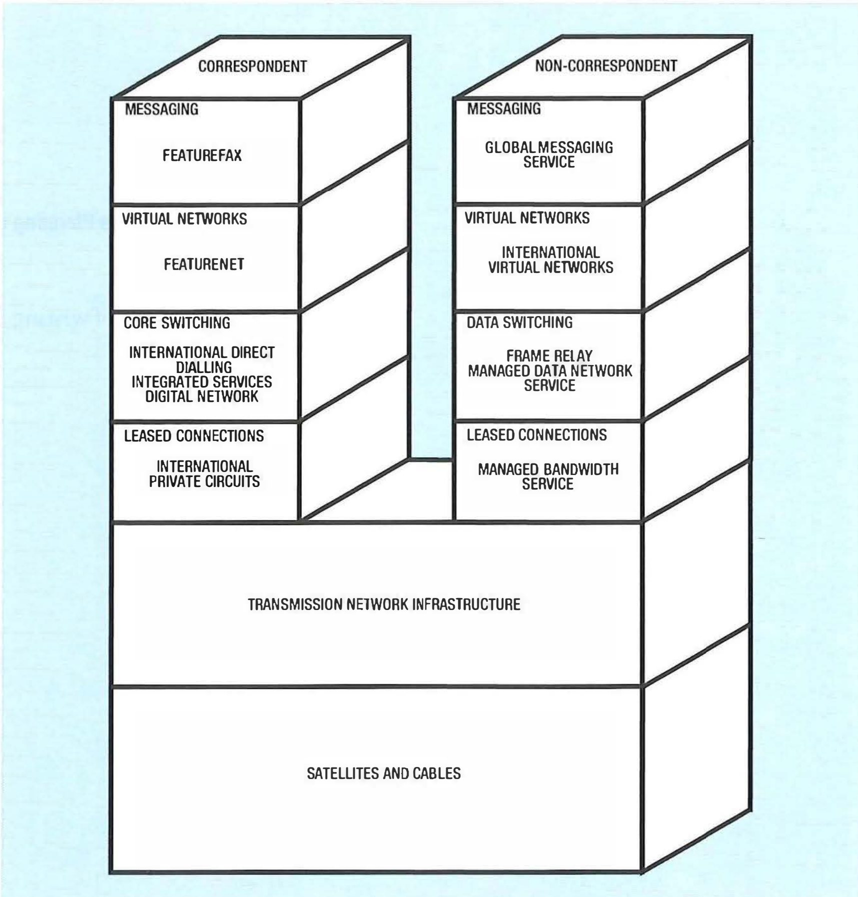
The global telecommunications network is probably the single, most complex entity created by human-kind. BT has one of the largest international networks in the world, providing direct access to over 200 countries. The enabling elements for this network are multi-million pound investments; highly intelligent switching nodes; satellites some 36 000 km above the earth's surface, and subsea cables on the seabed.

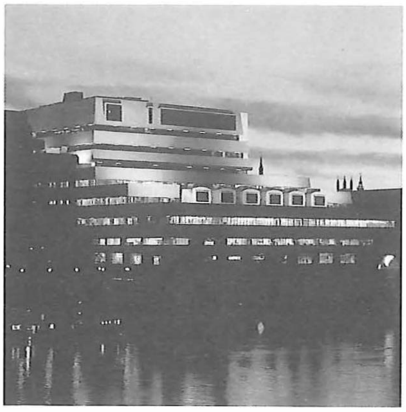
In the current environment of increasingly global enterprises, deregulation and competition, it is important to focus the development of this infrastructure to meet global customers' requirements and to provide the appropriate quality of service and mix of features at a competitive price. BT intends to ensure that its global network is well-positioned to meet these needs. This article provides a brief overview of BT's global network to serve as the introduction to a series of subsequent articles, each covering a specific aspect of the network in greater depth.

A Model of BT's Global Network

BT's global network is formed from a number of complex individual network components. The relationships and functions of this extensive telecommunications infrastructure can be best understood by reference to a simple architectural model. Figure 1 shows

Figure 1—A model of the BT global network





London Mondial international exchange

correspondent and *non-correspondent* networks, which are used to deliver an extensive range of services to global customers. These are supported by a transmission network infrastructure utilising capacity provided by subsea cables and satellite links.

The correspondent network is one of two mechanisms used to deliver services to global customers. This is the traditional international service whereby BT and another operator (termed *correspondent*) jointly provide the infrastructure to deliver a service to the customer, and share the revenue by means of accounting rates. These networks support not only basic services such as international direct dialling (IDD) for voice and international private circuits (IPCs) for leased connections, but also more advanced services such as FeatureNet (a basic international virtual private network service) and Featurefax (an international store and forward fax service). These are shown on the left-hand side of Figure 1.

Historically, the correspondent network was the only method of

Goonhilly satellite earth station

BT Marine Cableship Sovereign

providing international services to customers and corporations which were largely based in a single country, by public network operators which were monopoly suppliers. However, the emergence of multinational corporations with advanced global telecommunications needs, the liberalisation of telecommunications services in many countries, and the technological advances which have produced dramatic cost-reductions for international connectivity, have generated pressure for changes in this arrangement. Corporations now wish to deal with a single supplier for all their telecommunications needs, which will offer a range of facilities worldwide, consistent levels of quality of service and flexible pricing. BT has therefore also been active in developing non-correspondent platforms to meet these requirements. The right-hand side of Figure 1 shows networks supporting a comprehensive range of voice, fax, data and visual services to global customers on an end-to-end basis. These services are offered through the operations of BT Syncordia and Global Network Services (GNS—formerly Tymnet).

Supporting both types of network is the transmission network infrastructure provided over an extensive digital subsea-cable and satellite network, as shown at the base of Figure 1. Advances in subsea-cable system technology have brought a 16-fold increase in capacity in less than 10 years. The digitalisation of the transmission network has also enabled the use of advanced voice compression techniques to further improve the utilisation of bandwidth. Transport networks provided and coordinated on a multilateral basis, based on high-bandwidth cross-connects, allow management and fast provisioning of this capacity and provide protection and monitoring capabilities to improve transmission availability and performance for all global service platforms.

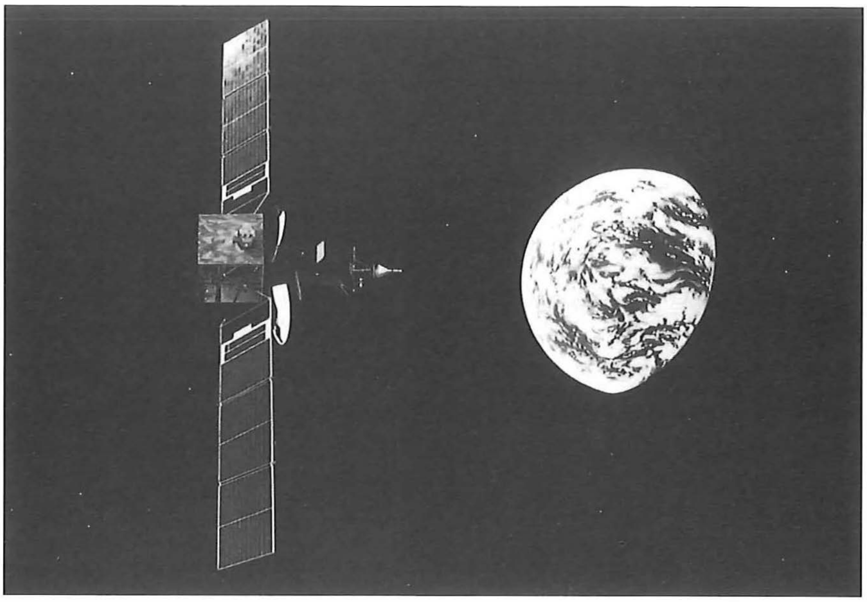
A fundamental challenge is to manage both correspondent and non-correspondent networks in a seamless fashion to meet customer needs and, in addition, reduce the operating and maintenance costs of the network platform. The evolution towards an integrated network management-and-control layer and the centralisation and coordination of network management and service management functions will be vital to achieve this.

Subjects of Future Articles in this Series

The global network consists of a number of complex components; each will be the subject of further articles in this series as outlined below.

The next article*, published in this edition of the *Journal*, will deal with how the network is planned and evolved in a consistent manner,

* LOWE, ALAN, and D' SA, DINO. Planning the International Network, *Br. Telecommun. Eng.*, Oct. 1993, **12** (this issue).



INTELSAT VII

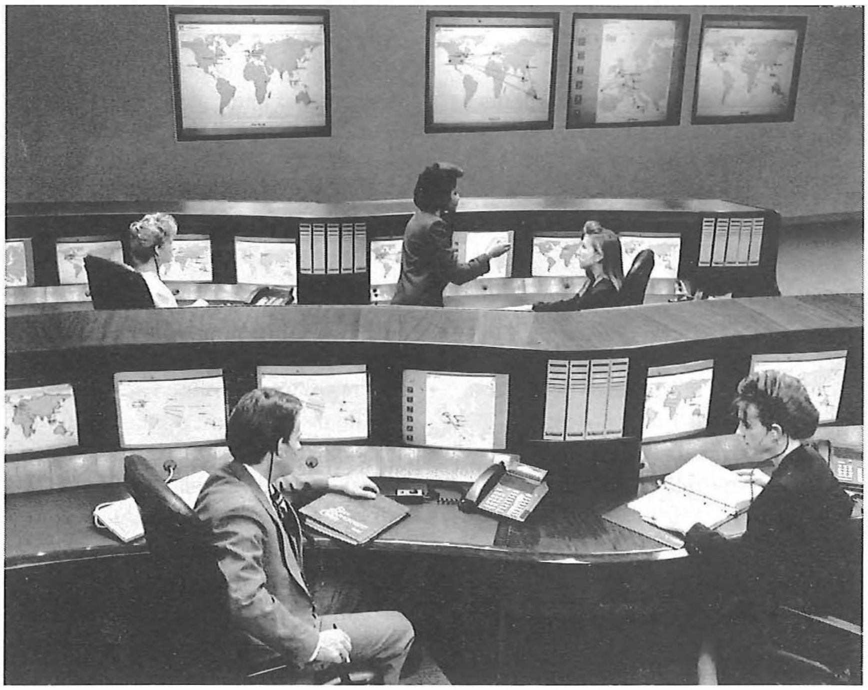
particularly when it is necessary to coordinate activity with more than 200 correspondents worldwide. It will also describe how the correspondent platforms are engineered to support services such as IDD and IPC and the planning of the extension network infrastructure underpinning them.

Two subsequent articles in the January 1994 issue of the *Journal* will address the development of subsea-cable and satellite networks respectively. In the digital subsea-cable network, technology advances have been major enablers for global connectivity. BT Marine has played a key role in providing cable-laying and maintenance activities to support the extension of the cable network. Complementary to the subsea-cable activity have been satellite developments which have been vital to provide routes for diversity and hard-to-reach destinations. BT has been a major participant in bodies such as INTELSAT and EUTELSAT.

Articles in a later issue will be devoted to describing the development of the BT network supporting the outsourcing services offered by Syncordia, and the extensive data network supporting BT's Global Network Services (GNS) offering, and making BT a world leader in the global data services market.

Concluding the series will be articles which describe the BT non-correspondent networks supporting data, fax and visual services; BT's acquisitions and activities to provide bespoke network solutions to global customers, including BT's involvement in the MCI/BT joint venture; and how the provision of supporting infrasture can enable economies of scale for these services to be delivered.

Syncordia's Atlanta network control centre



Conclusion

BT has an extensive global network which can be understood by means of a simple architectural model. This article has briefly described the scope of those activities with reference to that model, each of which will be the subject of more detailed articles in this series. BT is determined to be a major player in the global telecommunications market and the development of an advanced, well coordinated global network platform will be a key element in achieving that goal.

Biography

Mike Read
Senior Vice-President
Worldwide Planning and Operations
BT-MCI Joint Venture

Mike Read was recently appointed Senior Vice-President of the BT-MCI joint venture company and will be responsible for the planning, provisioning and operations of the new company's worldwide network and services. Prior to this appointment, he was the Director for BT Global Networks, responsible for planning and providing BT's global networks and services. This included subsea cables, satellite earth stations, plus leased lines and networks for new services such as the integrated services digital network and virtual private networks. In addition, he was responsible for Aeronautical and Maritime (A&M), BT (Marine) Ltd. and three offshore operations: Manx, Belize and Gibtel.

Dino D'Sa and Alan Lowe

Planning the International Network

The BT international network is not developed in isolation, but in conjunction with more than 200 overseas carriers, and requires a multi-million pound investment programme. Planning is essential to ensure that the network develops in a cost-effective and an efficient manner and delivers the features and quality of service that the customers expect. This article describes the network and how its planning is structured to achieve this.

Introduction

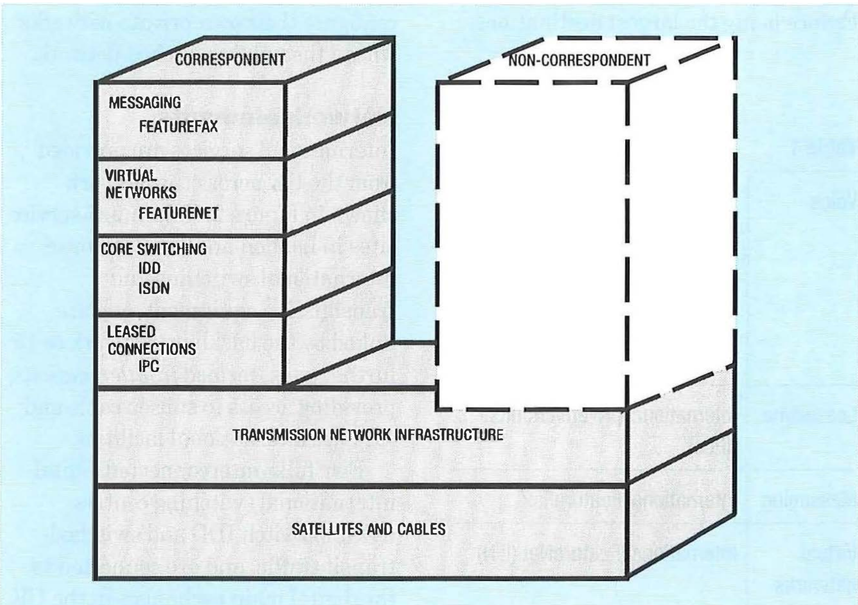
BT has one of the most extensive international networks in the world, providing access to over 200 countries worldwide; a considerable advance in the 100 years since the first international telephone call between London and Paris was made in 1891. Technological advances have dramatically reduced costs, increased the capacity and range of features available, and fuelled demand for international telecommunications services.

The network is planned and developed in conjunction with other operators throughout the world (known as *correspondents)* because an international connection is provided from a number of elements, only some of which are BT-owned: others are under shared ownership, and some are not owned by BT at all. As liberalisation and deregulation of telecommunications services progress, network operators are being permitted to own or control more elements to provide access to customers worldwide. However, until totally open international telecommunications service provision is permitted, BT will need to continue to plan a large proportion of its global network in conjunction with correspondents.

The introductory article* in this series has shown how correspondent (termed *international*), and non-correspondent aspects of BT's global network can be described with reference to a simple model. This article, the scope of which is shown shaded in Figure 1, describes in more detail both how the correspondent elements of the network are planned

* M. Read The BT Global Network. *Br. Telecommun. Eng.*, Oct. 1993, **12** (this issue).

Figure 1—The international network



and how overall global network evolution is monitored. It outlines the BT international network and the services it provides, and discusses planning objectives and individual planning aspects to provide a network delivering cost-effective international services to BT's customers, both now and in the future. Throughout this article, the network described is referred to as the *international network*. This article will not cover detailed non-correspondent aspects, nor project management and the implementation of specific international network elements, which will be subjects for future articles in this series.

BT International Network

International services

International services are delivered upon a network provided by BT and a correspondent network operator, with revenue from these services being apportioned between them. Table 1 shows the main voice, leased-line data, messaging and virtual network services which are offered on this basis in conjunction with correspondents.

International direct dialling (IDD), which accounts for most international revenue, is available to over 200 countries: the USA, Germany and France being the largest destinations.

Table 1 International Services

Voice	International direct dialling (IDD) International switched transits Integrated services digital network (ISDN) International Freephone
Leasedline	International private circuits (IPCs)
Messaging	International FeatureFax
Virtual networks	International FeatureNet (IFN)

International switched transits, in which other operators use the extensive BT network to access countries to which they do not have a direct route, also generate significant revenue. Such services need to be provided on a network that ensures a satisfactory grade of service under varying traffic and possible failure conditions.

The integrated services digital network (ISDN) service, currently offered to 18 countries worldwide, allows customers to send and receive high-speed and quality voice, text and image transmissions across a public network via a single digital connection.

International private circuits (IPCs), offered at rates from 2·4 kbit/s up to 2 Mbit/s, account for over 35% of international transmission requirements, and are available to almost 50 countries. Customers may request completely separate physical paths for different circuits, often requiring both cable and satellite routings.

International FeatureFax is a managed store-and-forward facsimile service allowing customers to send a single facsimile transmission to between 1 and 250 destinations worldwide on an international Freephone number.

International FeatureNet, currently available to 15 other carriers, is an international correspondent virtual network service providing customers with the ability to configure their own private networks within the public switched network.

Network elements

International services are provided from the UK across the network shown in Figure 2. Four multi-service sites in London and Madley house international switching and transmission equipment, and are linked by the backhaul network to 15 further sites, termed *frontier stations*, providing access to subsea cable and satellite international facilities.

Five fully-interconnected digital international switching centres (DISCs) switch IDD and switched-transit traffic, and are connected to the digital main exchanges in the UK. Each DISC is specially engineered to switch several thousand erlangs of international traffic and can interwork with the range of signalling systems used worldwide. IPCs are primarily supported upon 64 kbit/s cross-connects in London, where the majority of IPCs originate, and are interconnected with the national private circuit cross-connect network. Also on these sites are more specialised international switching units supporting other network services; there are units which solely support ISDN traffic and the International FeatureNet service.

Relative to national capacity, international transmission capacity is costly. Digital circuit multiplication equipment (DCME) typically increases circuit utilisation by a factor of four, by using advanced algorithms to compress voice and facsimile traffic onto 2 Mbit/s bearers. Multiplexers amalgamate both compressed and uncompressed bearers into high-capacity plesiochronous digital hierarchy (PDH) line systems forming the backhaul network. Synchronous digital hierarchy (SDH) line systems and cross-connects, when available, will provide faster provisioning, restoration and better performance information.

Connection through the international network

The path of an international telephony circuit, shown in Figure 3, is outlined below.

A customer in the UK is routed through the local exchange, to a main exchange, and then into a DISC located in London or Madley.

Once switched through the DISC, DCME may compress the voice capacity before it is multiplexed together with bearers for other services (such as IPCs) onto the transmission network. Circuits are then carried in the backhaul network upon dedicated high-capacity digital line systems to frontier stations. Up to and including the frontier station, BT exercises ownership and control of those elements within its own network.

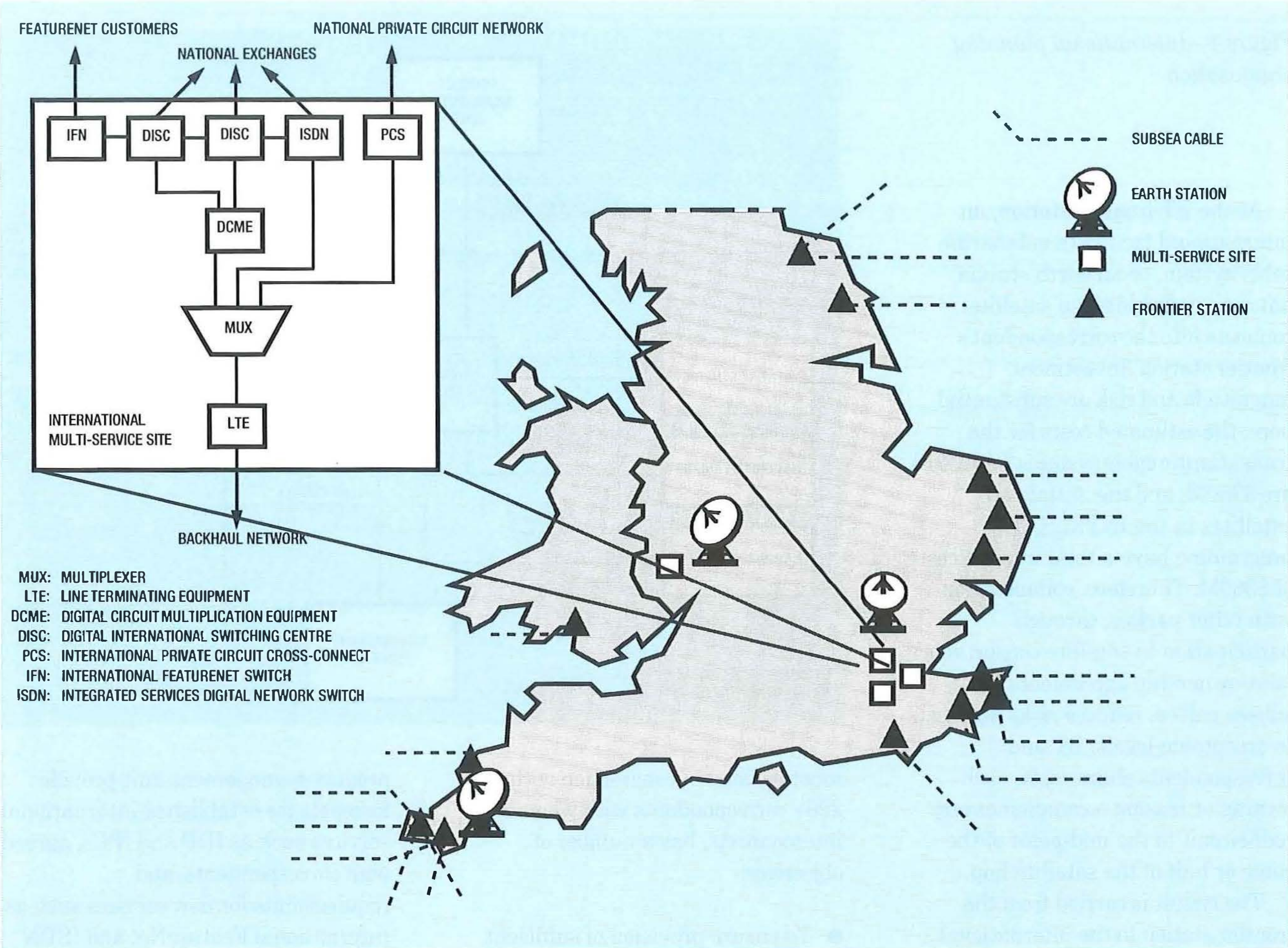
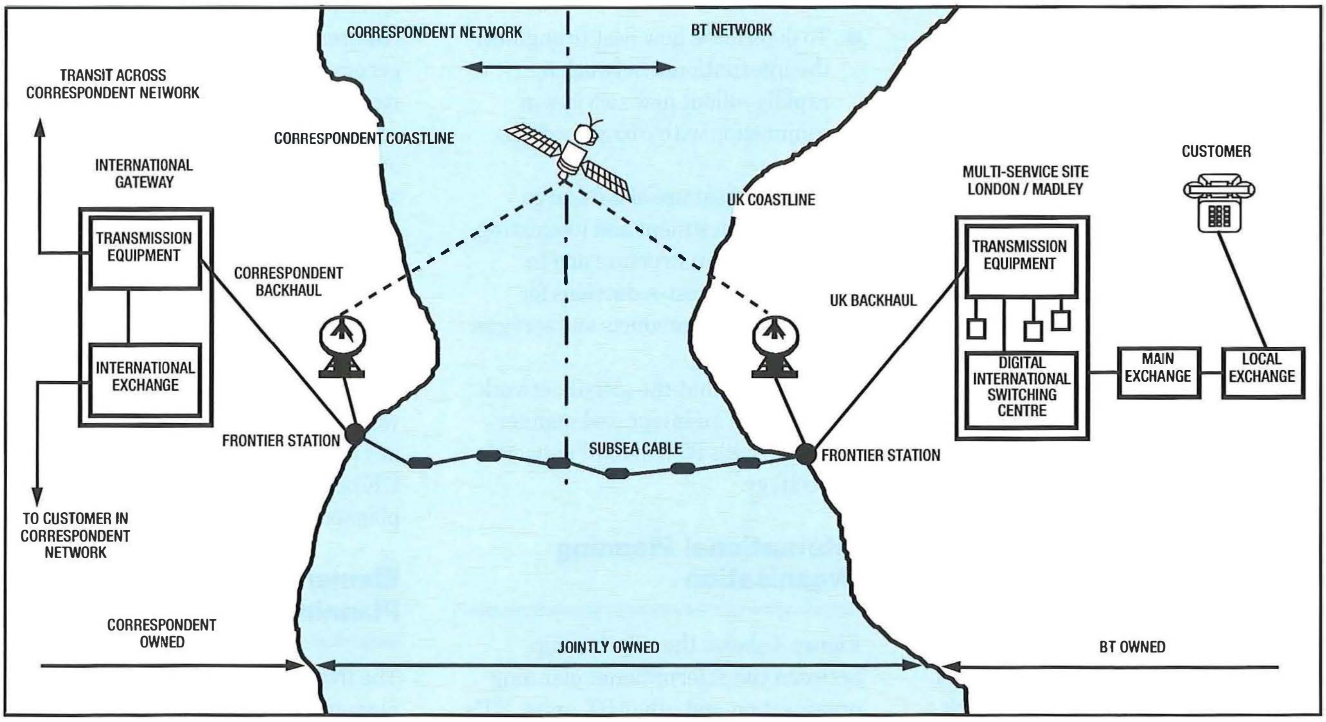


Figure 2—BT international network in the UK

Figure 3—An international network connection



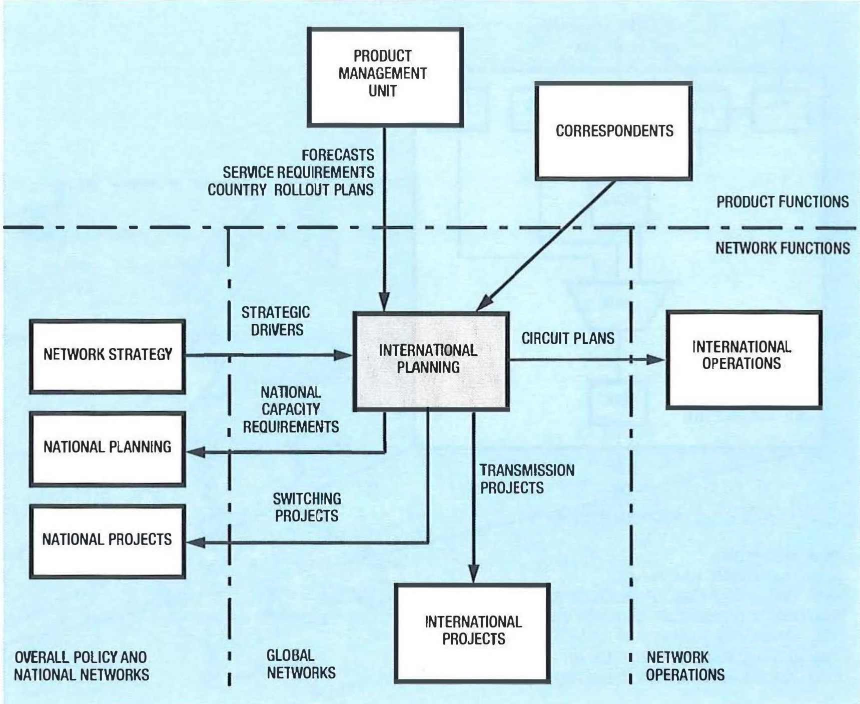


Figure 4—International planning organisation

At the BT frontier station, an international facility (a submarine cable system, or an earth station antenna uplinking to a satellite) connects into the correspondent's frontier station. Investment magnitude and risk are substantial here; the estimated costs for the transatlantic cable systems TAT12/13 are $750M, and the initial two satellites in the INTELSAT 8 programme have a total in-orbit cost of $360M. Therefore, collaboration with other parties, through participation in satellite consortia or joint-ownership agreements for subsea cables, reduces risks and costs to acceptable levels. BT and correspondents share costs, each owning or leasing a complementary half-circuit to the mid-point of the cable or half of the satellite hop.

The circuit is carried from the frontier station to the international gateway in the correspondent network where it can either transit to an onward destination, or be demultiplexed and switched to an end-customer in that country. BT has no control or ownership of this section. Correspondents deliver services to their end customers for BT by mutual agreement, BT doing the same within the UK. Bilateral planning ensures sufficient capacity to support international circuits is provided when required and that a complete end-to-end connection is formed.

International Planning Objectives

BT invests hundreds of millions of pounds in its international network every year to meet the needs of its customers. Privatisation and competition have created an environment where this network investment must be directed within a commercial framework and used to provide features to win and keep customers.

Planning is essential, as provision of network elements is capital intensive and subject to long lead-times, while customers require products and services on demand. Planning, which must be done in conjunction with the 200+ correspondents with whom BT interconnects, has a number of objectives:

- To ensure provision of sufficient network capacity to meet forecast demand for all international services and to schedule bringing that capacity into service.
- To monitor the quality of services delivered over the network, and establish plans to continuously improve it.
- To determine how best to engineer the international network to rapidly rollout new services in conjunction with correspondents.
- To make best use of BT's large annual investment and its existing network infrastructure and to deliver unit cost-reductions for international products and services.
- To ensure that the global network evolves in an integrated manner, in line with BT's overall network strategy.

International Planning Organisation

Figure 4 shows the relationship between the international planning organisation and other BT units. BT's product management unit provides forecasts for established international services such as IDD and IPCs, agreed with correspondents, and requirements for new services such as International FeatureNet and ISDN which are also agreed with correspondents.

International planners determine how to augment the network to meet the forecasts and engineer the network to support any new services. Any proposals take into account the impact of new technology, seek to achieve quality and cost improvements and are agreed with correspondents. Client requirement definitions (CRDs) are generated, which contain planning requirements and engineering plans for equipment to be procured, installed and commissioned by both national and international BT project groups according to BT's standardised project management discipline. Circuit plans are produced to schedule the necessary operations by field units to bring capacity into service. The international network is evolved within the framework set by the network strategy, with any capacity requirements within the UK being supported by national planners.

Elements of International Planning

The five main aspects of international planning are shown in Figure 5. These

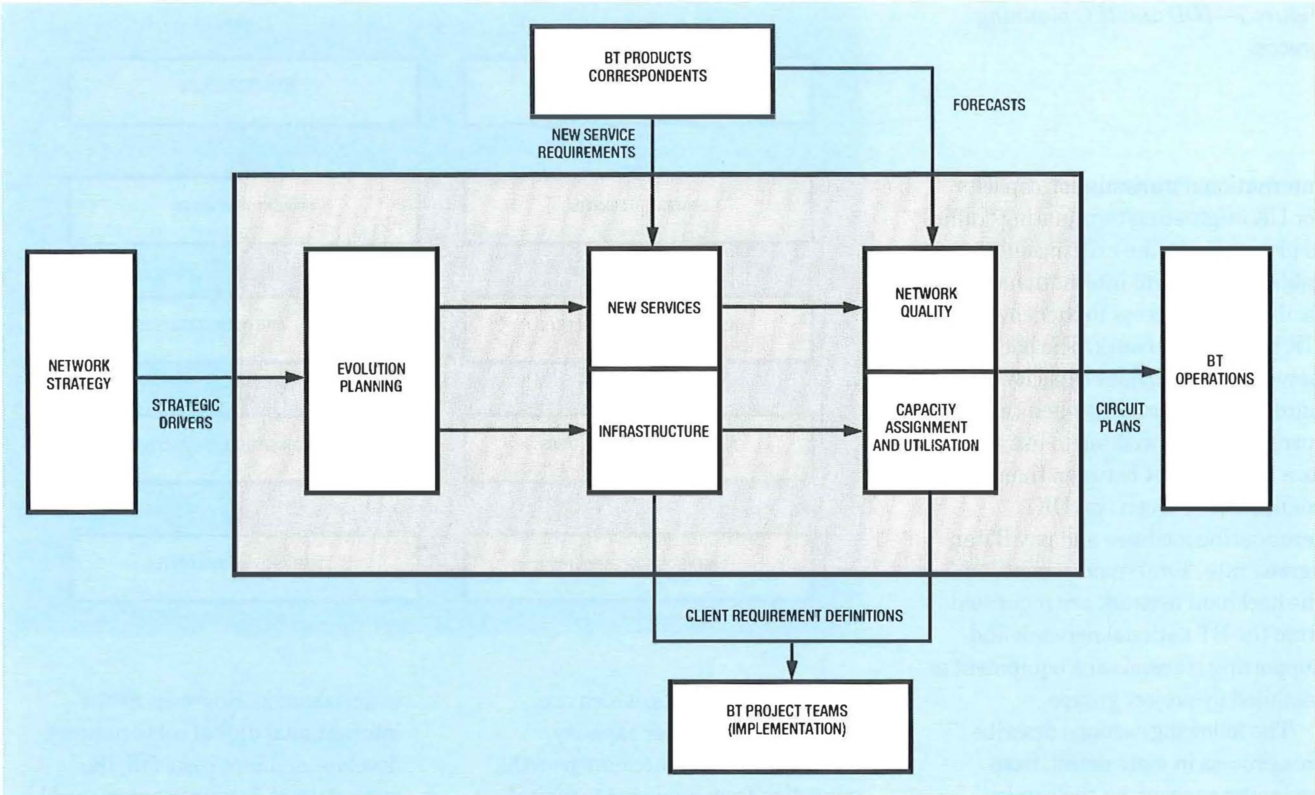


Figure 5—Main aspects of international planning

are listed below and are described in each of the following sections.

- Assigning capacity from the existing network in response to forecast demand and scheduling the bringing of that capacity into service.
- Planning new infrastructure when there is insufficient network capacity available.
- Monitoring the quality of a range of services delivered across the network and progressing plans to improve it.
- Planning enhancements to the network to support new services.
- Ensuring that the network maintains a consistent evolutionary path, aligned with BT's overall strategy.

Capacity assignment and utilisation

This process uses planning rules to assign capacity in the existing network to meet demand forecasts from BT product groups, issues circuit plans for operational units to bring the capacity into service, and CRDs for project groups to procure any additional supporting equipment required. If growth in demand is not supported across the network, customers experience degradation or unavailability of service and may switch to an alternative carrier, losing BT revenue. At the same time, international network assets must be utilised efficiently otherwise higher costs will result.

Figure 6 shows how this process applies to the network. Individual platforms supporting services such as IDD and IPCs are augmented in-line with agreed BT/correspondent forecasts. Their requirement for

Figure 6—Capacity assignment planning

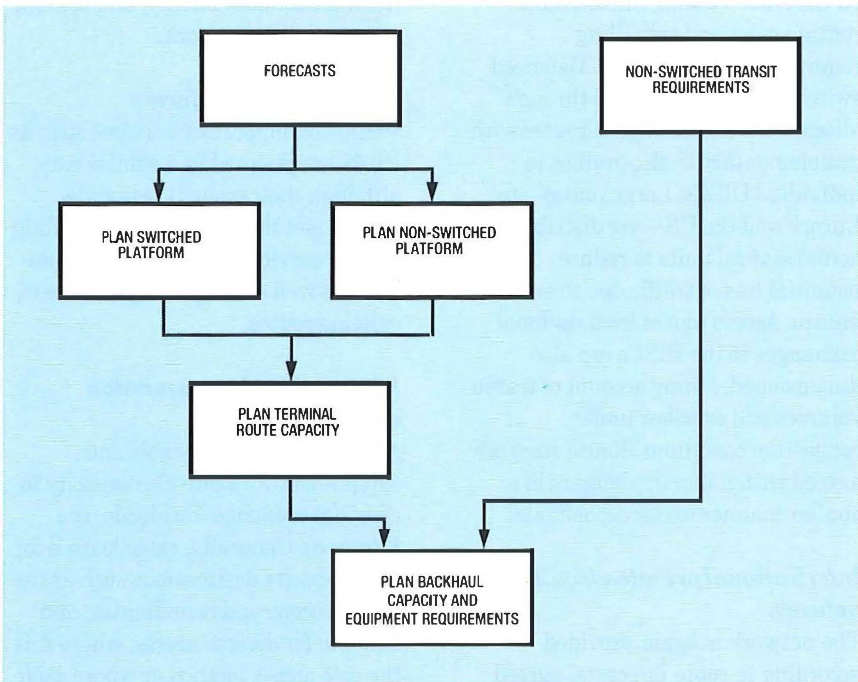
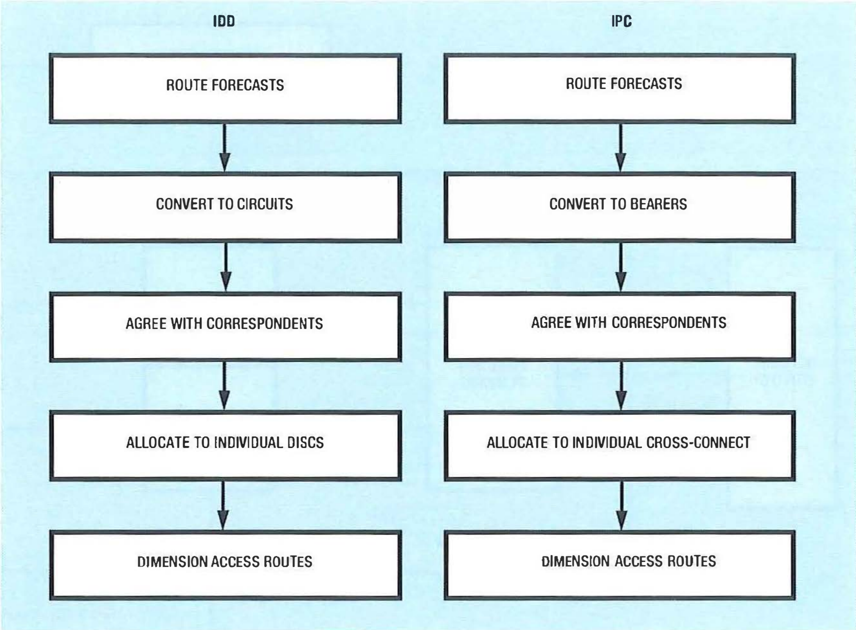


Figure 7—IDD and IPC planning process



international transmission capacity for UK originating/terminating traffic is planned over the existing subsea cable and satellite international facilities, and access to them over the UK backhaul network. The backhaul network also provides capacity for hard-patched transits, when two correspondents wishing to use the UK as a transit point between them use a connection between two UK-terminating facilities and pay BT an agreed rate. Total requirements on the backhaul network are requested from the BT national network and supporting transmission equipment is installed by project groups.

The following sections describe this process in more detail, from assigning capacity on the service platforms and transmission network to bringing that capacity into service.

Planning IDD and switched-transit networks

Figure 7 shows the process, commencing with forecasts from BT product groups on a carrier-by-carrier basis, which are converted into circuit equivalents by using dimensioning criteria for international routes and agreed bilaterally with correspondents. These requirements are then allocated to individual routes on the DISCs taking into account routing rules and signalling requirements of the route. Balanced switch-loading is achieved through allocation of international routes with complementary traffic profiles to individual DISCs. Large routes—to Europe and the US—are distributed across several units to reduce potential loss of traffic due to switch failure. Access routes from national exchanges to the DISCs are also dimensioned, taking account of traffic volumes and overflow under congestion conditions. Route sizes are agreed with national planners in a similar manner to correspondents.

International private-circuit network

The network is again provided according to route forecasts, agreed with correspondents, which are converted into bearer capacity. Planners take into account growth, migration from analogue to digital and to other services such as ISDN, and increases in capacity required on cable rather than satellite. Planning rules ensure customers can separate their circuits across all network sections, to minimise the impact of failures. Sufficient capacity is provided between the UK-serving exchanges and multi-service sites to meet potential demand. Shorter-term plans with a 12–18 month time-frame are then used to specify exactly how a customer's private circuits will be routed from centres in the UK, across the international facility, and into the correspondent network.

Other service platforms

Platforms supporting services such as ISDN are planned in a similar way, although their scope is less widespread and the emphasis is on rolling out the service to additional destinations as well as increasing the size of existing routes.

International transmission network

An extensive subsea-cable and satellite network provides capacity to over 200 countries worldwide (see Figure 8). Generally, cable is used for high-capacity destinations such as the USA, Europe and Scandinavia, and satellite for diverse access, where it is the sole access method or where cable is uneconomic. However, as the international digital cable network develops and unit costs fall, the proportion of destinations reached by cable will increase. Destinations are reached both directly over cable, and indirectly by using transit capacity across other countries and cross-border links or further subsea cable systems.

Voice circuits are converted into bearer requirements to allow for the effects of DCME, then combined with other service bearers to provide total circuit quantities to each destination. These circuits are then allocated across the cable and satellite routes to that destination. Planning rules and commercial considerations aim to minimise the impact of failures by setting maximum permissible proportions of total capacity on an individual facility. Plans also aim to develop the network to provide both cable and satellite access to a destination and to offload capacity on analogue cables onto newer digital systems. The resulting terminal cable and satellite requirements and facilities used to each destination country are agreed bilaterally with correspondents.

Within the UK, the backhaul transmission network provides access to international facilities from multi-service sites in London and Madley, and capacity between international facilities to support requirements from correspondents for hard-patched transits across the UK. BT ratifies forecasts for hard-patched transit

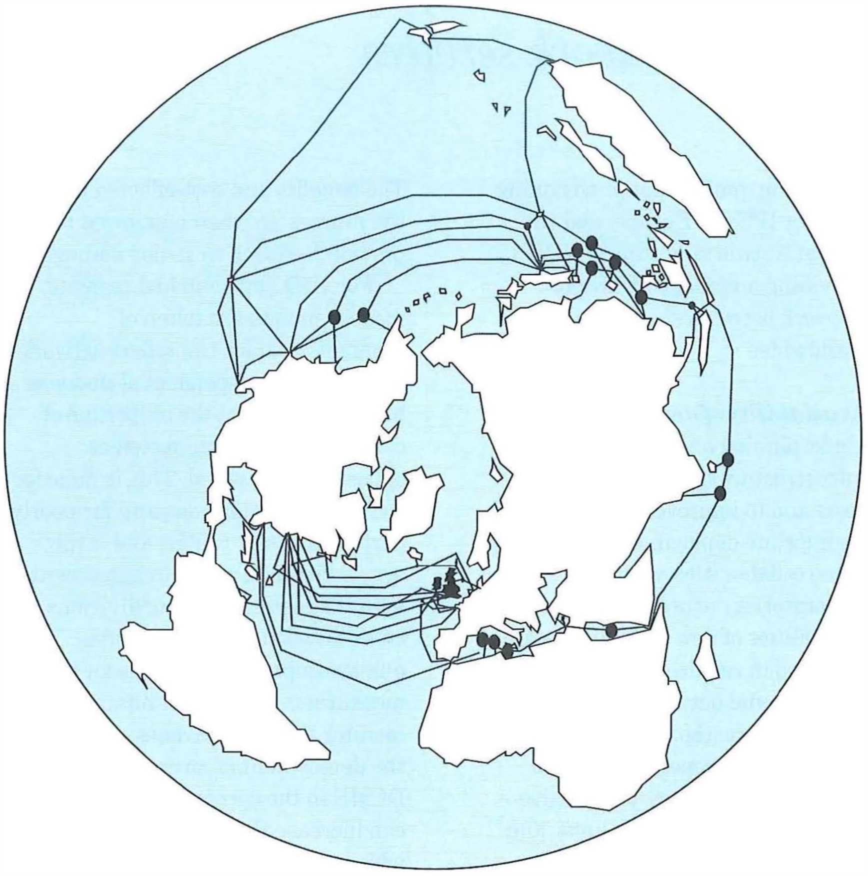


Figure 8—The international cable network

requirements provided by correspondents before terminal and transit capacity is converted into backhaul network requirements.

Damage caused by ships to subsea cables is being reduced, but potentially such damage can be catastrophic, and therefore between 25 and 33% of subsea-cable capacity is earmarked for restoration purposes. An internationally agreed plan (in which BT participates) specifies how traffic on a failed facility should be restored by using restoration capacity within other facilities. The backhaul network performs this rerouting by using its own protection capacity in conjunction with manual patching or automated cross-connects, and similar action is taken in the correspondent network. This protection capacity is also used to restore backhaul network failures. Simulation tools and planning rules are used to determine the optimum network structure and ratio of protection to traffic capacity.

Backhaul network capacity requirements are determined for the supporting terminal and transit, traffic and protection capacity, requested from the national network in digital 140 Mbit/s blocks, and assigned to international facilities. Other supporting transmission equipment, such as multiplexers and DCMEs, is also requested from project groups for supply and installation at multi-service sites.

Bringing capacity into service

Capacity, once assigned on the switching and transmission networks, is converted into a schedule of circuit operations, so that it can be brought into service. This is done through coordination with correspondents as it requires the testing and lining up of the international switch, backhaul network and the international facilities in both the BT and correspondent networks.

Infrastructure planning

Normally, spare capacity in the international network is assigned and brought into service to meet increases in demand. However, a number of events each generate a requirement to plan extensions to the current network infrastructure:

- insufficient network capacity is foreseen;
- new multi-lateral network initiatives are proposed;
- new technologies are available.

In each instance, planning activity is required to determine the most appropriate course of action, as outlined below.

Insufficient network capacity is foreseen

In both switching and transmission networks, capacity will be exhausted at some future time. Forecasts of requirements are compared with actual network capacity to identify when a capacity shortfall will occur.

To provide additional switching capacity, existing DISCs may be expanded or new units provided. Factors such as performance of existing units, current routing policy, support for ISDN capability, and availability of new switching architectures and technology are considered. Optimum locations for proposed new units are determined using costing models. The existing long-term plan is modified and agreed, financial authority sought, and a CRD issued to project groups to procure and install equipment by the target date. Similar processes apply when extending the platform supporting IPCs.

In the international transmission network, planners can acquire or release capacity in satellite and existing cable systems, or invest in new cable systems. The decision will consider a cost analysis, desired international facility network topology, planned withdrawal of analogue cable systems, and development of cable access and route diversity to international locations. Once an option has been selected, financial authority is sought for the level of proposed capital expenditure.

For new cable systems, meetings are held to agree co-owners and their shares, culminating in the signing of a Construction and Maintenance Agreement, specifying ownership and timescales for the system. In parallel, *Quality planning aims to measure and improve the quality of international network services*

a CRD is issued specifying system technology, capacity and landing point, to BT project groups who oversee implementation of the system to the required timescales. Acquisition or sale of capacity in cables, is generally done in half-2 Mbit/s blocks called *Indefeasible Rights of Use* (IRU), and can only follow once agreement has been obtained from holders of the other half-block.

BT's satellite requirements are negotiated through participation in satellite consortia such as INTELSAT and EUTELSAT, ownership share in the consortia being proportional to utilised capacity. The board of governors of those bodies take a decision to invest in new satellite facilities if total satellite capacity is exceeded by forecasts. Users of satellite capacity are then charged tariffs to provide a satisfactory return on the capital invested. If a new antenna or earth station is required to access increased satellite capacity, planners issue a CRD for project teams to implement it.

New multi-lateral network initiatives are proposed

Availability of transmission cross-connects has provided opportunities to establish managed transport networks spanning international boundaries, with associated benefits of reduced costs, provisioning time and improved transmission quality for participants. BT involvement is project managed, representatives attending working groups to ensure such networks align with BT's requirements, to formulate an operating agreement which BT can sign. Cost and quality benefits, and interaction of the proposed network with the existing international platform are examined to determine the best engineering solution. Financial authority is then obtained to purchase equipment providing BT's partition of the network, resulting in the issue of a CRD to project groups. Recent initiatives include the Global European Network (GEN), a managed network for improving quality and provisioning time for IPCs in Europe, and the Global Networking Project (GNP), providing a managed transport network between six operators worldwide.

Availability of new technology

Underpinning any extension of infrastructure is a drive to reduce costs and to improve quality through appropriate deployment of technology. Close collaboration with BT Laboratories ensures that the capabilities of new technologies are captured in requirements for international network projects. Examples are: the use of high-bit-rate SDH optically-repeatered digital subsea cable systems, progressive digitalisation of satellite links, and the use of the latest-generation DCME to compress facsimile as well as speech traffic. BT also participates in pilot networks with correspondents for technologies such as asynchronous transfer mode (ATM) in order to gain experience of new technology in an operational environment prior to introducing it into the network.

Quality plans

Poor quality in the network leads to dissatisfied customers and loses revenue as business is transferred to alternative carriers. BT can control quality of its network in the UK, but in the international network, heavy reliance is placed upon influencing other operators to achieve satisfactory results. Quality planning aims to measure and improve the quality of international network services through the progression of quality improvement initiatives.

Customers' subjective quality requirements are translated into measurable network parameters. Targets are set against those parameters, agreed with customer-facing divisions and improvement plans put in place to achieve the targets. This is done for a number of products, the main ones being IDD and switched transits, IPCs, International FeatureNet and facsimile services. The benefits and cost-effectiveness of the process are then monitored to provide feedback to senior managers.

For IDD and switched transits, measurements are taken of parameters which can reflect network performance independent of customer behaviour, such as the proportion of calls successfully connected as opposed to answered. This is done for the top 20 destinations and for poorly performing 'tail' routes, and targets are set for each route, in agreement with BT customer-facing divisions. A cross-divisional team identifies quality-improvement plans for these measures, and international planners monitor their effectiveness. Funding the deployment of an earth station or DCME in the correspondent network can increase the number of calls which complete by enlarging route sizes. Call-clarity can be improved through the introduction of echo-cancellation equipment into the network. BT can also deploy its overseas task force to analyse the correspondent network and produce recommendations for the correspondent on how to reduce call failures.

With IPCs, targets are mainly aimed at reducing circuit down-time and fault-correction time. Again, teams have determined a number of improvement plans which, when implemented, will improve these measures. Planners oversee the implementation of improvements, including providing separacy into the network, introducing in-service monitoring facilities and determining optimal restoration plans.

New-services planning

In a competitive environment, BT must provide the new network services and features that customers require or risk losing them to an alternative carrier. Much of the planning described so far augments the network to support existing well-established services such as IDD and IPCs. In the past five years, enabled by advancing technology, a number of new services have been introduced and rolled-out internationally:

An evolution planning process establishes a longer-term framework for network development to ensure overall consistency is maintained

International FeatureNet, ISDN, and International FeatureFax.

New-services planning entails foreseeing new international service requirements, which may be delivered over the existing or new service platforms. After the conception of a new service, a feasibility study is carried out to assess the commercial/technical viability of the new product prior to a decision being made on whether to implement it.

Requirements for new services or additional rollout of existing services are identified by BT customer-facing divisions and captured in a commercial CRD. Planners examine the requirement against existing network platforms and determine how best to support the service. This may be through enhancement of existing development of a new platform and results in the generation of a project CRD and network engineering plan (NEP).

The CRD details options for project groups who then perform a feasibility study. Based on the results of the feasibility study, planners recommend a solution to product groups who provide concurrence on an agreed business case requiring financial authority. Planners also agree with the project manager, a project requirement definition (PRD) providing a common understanding of the aims, objectives and deliverables for the recommended solution.

The PRD leads to a business case and project implementation to provide the service required. Prior to commercial service a two-stage pilot may be put in place. The alpha phase uses BT divisions as trial customers with or without correspondent involvement. This is succeeded by the beta phase consisting of external customers trialling the new network or service in conjunction with correspondents. The project is then deemed *ready for customer service* and the service is rolled-out to correspondents as commercial agreements are reached.

The NEP provides a comprehensive plan describing elements needed for project completion, particularly the interrelationship of network elements and how they are to be integrated to provide a complete network infrastructure or service platform enhancement.

Additions to the correspondent international service portfolio requiring supporting platforms in the international network are currently being considered. Among these are international credit-call validation (ICCV), and new higher-speed data services.

Evolution planning

The planning of the international network is primarily focussed on meeting customer's needs, which are typically short-term on-demand requirements. An evolution planning process establishes a longer-term framework for network development to ensure overall consistency is maintained, otherwise higher operational costs and longer lead-times could result as the network became over-complex and unmanageable. Longer-term planning also enables capital expenditure to be assigned to future network development and input to budgetary and business planning cycles.

Evolution planning is done within the framework for development of the global network set by the network strategy department, as defined in an annual network strategy statement. BT's correspondent and non-correspondent activities cannot be developed separately, so scope of the evolution planning process covers both, not just correspondent, activities. A diagram of the process, which runs on an annual cycle, is shown in Figure 9. Planners compile segment evolution plans (SEPs) summarising developments in each of five sectors covering the global network. These focus primarily on the 3–5 year development, outlining the major initiatives, how they fit together and strategic issues for resolution.

The SEPs are compared and aligned, any potential overlaps and gaps being identified. In addition the overall network strategy statement is compared against the evolution plans and shortfalls to their alignment recorded. Both these activities result in immediate amendments to the SEP, and issues requiring further study. The issues list is prioritised and studies assigned owners who will solve them and produce recommendations, to be reflected in the re-issued SEP.

During the year, SEPs track initiation of projects. Projects falling outside the scope of the SEP are logged and the reasons recorded, highlighting areas of divergence between the defined and actual network evolution. Reviewing these occurrences enables SEPs to monitor the network evolution and steer it towards BT's strategic aims.

Issues which SEPs focus on are how new technologies such as SDH and ATM are introduced in a consistent and well-planned manner, and how an integrated network management and control layer is put in place for the global network. SEPs specify supporting research and development activity, enabling prioritisation of projects supporting network evolution within the annual research and development build. SEPs also focus on maximising long-term cost-reductions and quality improvements, and the migration of individual service platforms onto the core network as it evolves. SEPs also provide complementary development paths for the correspondent and non-correspondent platforms.

Future Development of International Planning Functions

The past few years have seen unprecedented changes facing the company. On the international side, competition has become more intense with the price-cap being extended to international calls and with BT under pressure to maintain quality while reducing costs. This has been against the backdrop of a prolonged recession in the UK, reducing network call growth, and a large reduction in BT people. BT has also made major moves to globalise its network.

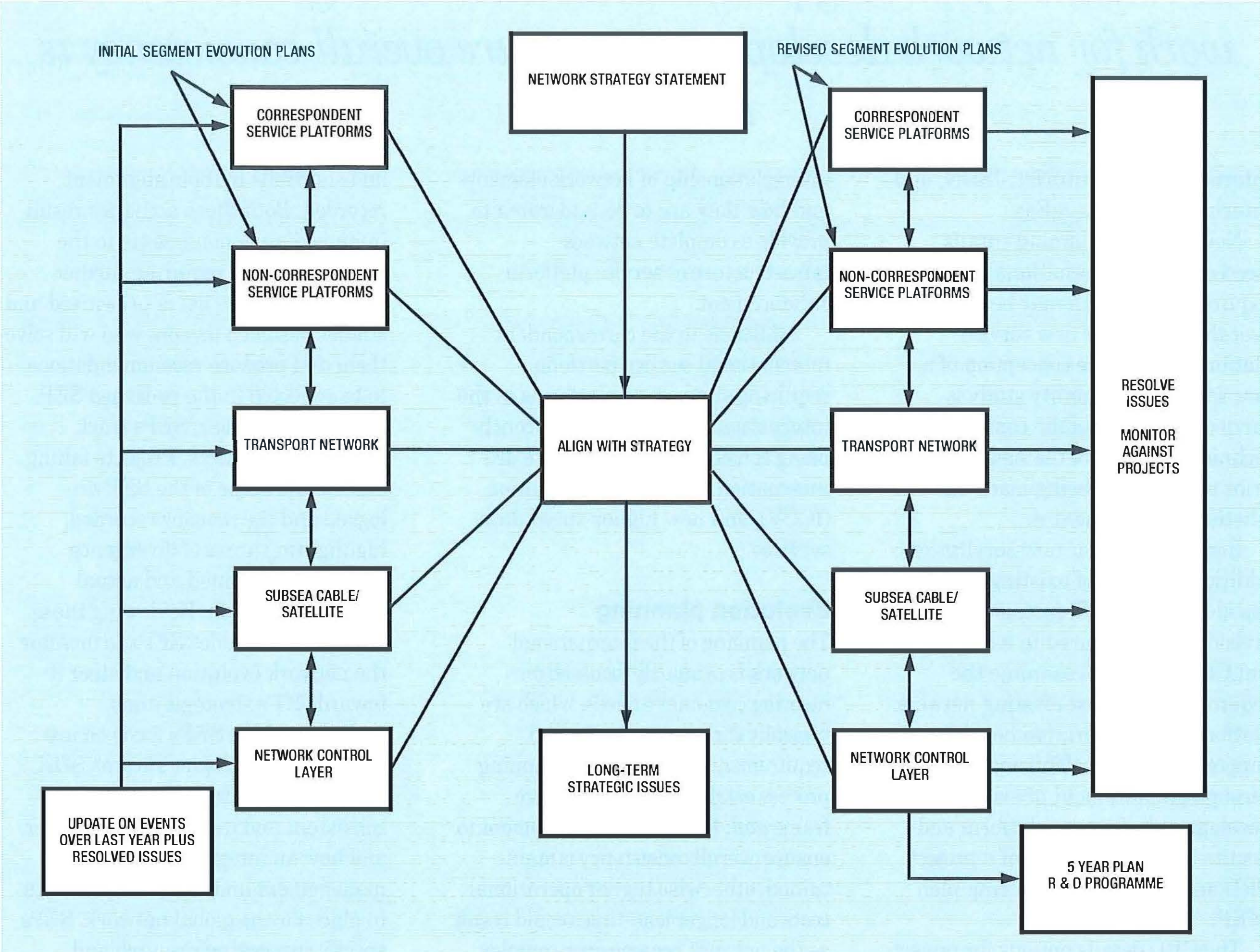


Figure 9—Network evolution process overview

Against this backdrop, international network planning and development, in conjunction with correspondents, must continue with reducing resources while quality is improved. This has been aided by the establishment of a quality management system. Each activity associated with planning, implementing and operating the international network has been captured and documented as a series of Key Processes. The use of Key Processes has enabled the planning organisation to focus on producing deliverables which are key to meeting customer's requirements and improving the quality of those deliverables. Processes are measured, controlled, and reviewed in a philosophy of continuous improvement, to streamline and improve efficiency. The organisational structure is also evolving to support this and ensure efficient deployment of people and information resources. After this process capture and control, appropriate elements can then be automated to reduce further planning resources on routine operations and release additional resources to respond to new multi-lateral initiatives and global activities as they arise.

Summary

The planning of the BT international network is a complex operation involving coordination with over 200 correspondents worldwide and comprises a number of key aspects. Capacity is assigned from the international network to meet forecast demand and major changes to the network size and functionality are implemented. At the same time, the quality delivered across the network and future evolution of the network are monitored and improvements or changes initiated if required. In its drive to obtain ISO9001 accreditation, BT is ensuring that the international planning discipline is measurable and improvable, making it well-positioned for future changes demanded from planning activities as the worldwide telecommunications market is opened up to further competition.

Glossary

ATM Asynchronous transfer mode
CRD Client requirement definition
DCME Digital circuit multiplication equipment
DISC Digital international switching centre
EUTELSAT European Telecommunications Satellite Organisation
GEN Global European Network
GNP Global Networking Project
ICCV International credit-call validation
IDD International direct dialling
IPC International private circuit
IRU Indefeasible Rights of Use
ISO International Standards Organisation
ISDN Integrated services digital network
INTELSAT International Telecommunications Satellite Organisation

NEP Network engineering plan
PDH Plesiochronous digital hierarchy
PRD Project requirement definition
SDH Synchronous digital hierarchy
SEP Segment evolution plan

Biographies

Dino D'Sa
BT Worldwide Networks

Dino D'Sa joined BT's sponsored studentship scheme in 1982. He obtained an honours degree in engineering from Cambridge University in 1986 before joining BT's National Network Strategy Unit. There he used computer-based network design tools in the formulation of network strategy. Since then, he has worked on network design and strategy in a number of national and international departments, specialising in the development of resilient cost-optimal switched and transmission networks, and the introduction of new network technologies. He currently works in BT's global networks department, maintaining the overall network evolution and architecture for BT's global network, and developing the international planning processes. He is an Associate Member of the Institution of Electrical Engineers.

Alan Lowe
BT Worldwide Networks

Alan Lowe is currently the General Manager for Global Networks and is responsible for planning and providing all aspects of BT's global networks and services. This includes: subsea cables, satellite earth stations and technology, planning and provisioning all voice services, leased lines, and the development of networks for new services such as ISDN and virtual private networks. He has additional responsibilities as Chairman of the Metran Management Board and is management board member for a number of European collaborative network activities. Alan has previously been head of units dealing with transmission planning, international packet switching, network strategy and international service provision. He has also worked in South East Asia, for the United Nations, on a range of consultancy projects. He is a Chartered Engineer and a Member of the Institution of Electrical Engineers.

William Dangerfield, Simon Garrett and Melv Bond

Caller Display and Call Return

Caller Display and Call Return are two new network services from BT that will help customers to make better use of their telephone and to reduce significantly the problem of nuisance calls. For the first time, a customer can find out what number is calling without having to answer the call. This article describes the introduction and launch of these services, and explains the technical aspects, and the privacy measures necessary to make calling line identity information available on the majority of calls.

Introduction

Two new network services are being introduced by BT into the UK that take advantage of the facilities available with the modernisation of the telephone network. These new services, known as *Caller Display* and *Call Return*, will be the first in a range of new network services that make use of information carried within the signalling messages used in the digital network.

Caller Display

Caller Display allows customers to see the telephone number of their caller. The number is shown on the screen of a special telephone or display unit when the telephone is rung. Customers will be able to know who is calling them before they answer the telephone.

The Caller Display service redresses the balance between the called customer and the caller. It will enable customers to screen incoming calls and will actively discourage malicious calls. It will also allow customers to keep track of calls that they might have missed because the number information will be stored automatically in a log within the Caller Display unit.

This new service is made possible by BT's massive investment in the modernisation of the telephone network. Caller Display is the first in a range of new network services that are dependent upon the transfer of the calling party's telephone number—known as the *calling line identity* (CLI)—within the BT network. This information is carried within the signalling messages that are used in the digital network, and provides the foundation for further CLI-based services. One that will be introduced at the same time as Caller Display is Call Return.

Call Return

The Call Return service allows customers to find out the number of their last caller and then, if they choose, to make a return call to them. The number information is stored within the BT network and can be accessed very simply by the called customer from their normal telephone: all they need to do is to dial a short access code and an automatic announcement will speak the number. The customer can then decide to return that call by dialling a further short code. This facility is useful to customers who may have just missed a call, or simply if they want to find out if they were called while they were out.

Call Return provides customers with some of the benefits of Caller Display without the need for a special Caller Display telephone or display unit.

Service Availability

Very successful customer trials of the concept of Caller Display were held between December 1992 and March 1993. A technical pilot trial of the Caller Display and Call Return services will be conducted in Scotland during the Autumn of 1993. The services will then be introduced into the UK in 1994, starting in Scotland, and then rolled out to the rest of the country. A comprehensive public information campaign will support the launch.

New Telephones and Display Units

A new range of customer premises equipment (CPE), including Caller Display telephones and units that add a display capability to existing ordinary telephones will be available for sale and on rental terms from BT. Both types can be used in conjunction

Figure 1—Caller Display telephone

with existing plug-and-socket type telephones. The first BT Caller Display telephone is shown in Figure 1.

Why is BT Introducing the Services?

BT believes Caller Display and Call Return will be the most important services that can be offered to help prevent malicious or nuisance calls. Caller Display has been introduced in North America where it is fast becoming one of the most popular services for personal customers. However, in some parts of the USA it has raised some concerns over the privacy issues surrounding the display of the calling number. Under certain circumstances, customers may have legitimate reasons for not wanting their number released to the called party; for instance, a customer phoning a special helpline may want to remain anonymous.

It is possible to address these concerns fully by providing customers with the option to withhold their number going forward on certain calls where they do not want to expose their number to the called party. Again, experience from the USA indicates that if all the appropriate safeguards are put in place, the benefits of Caller Display greatly outweigh any disadvantages. The essential point is to give customers the choice and control over the way they make and receive calls.

Caller Display—the benefits:

- The Caller Display service is a major deterrent to malicious calls. In parts of the USA where the service has been introduced, it has reduced the volume of malicious calls by as much as 40%.
- It restores the balance between the caller and the person receiving a call. Now the person can tell who is calling them and can decide when and how to answer the telephone.
- Where a telephone is shared by several people for incoming calls, Caller Display will help identify the most appropriate person to answer a call.
- Peoples' privacy is reinforced because Caller Display allows them to screen their calls and decide who they wish to speak to and help them form a friendly or appropriate greeting.
- Business customers will be able to improve their service by identifying callers immediately. Recognised numbers could be used to call up customer records information quickly and automatically to avoid the caller having to wait. The service will also reduce time and costs wasted by hoax and fraudulent calls.
- The Caller Display service offers convenience by logging calls that were missed.
- The introduction of CLI is an enabler for other valuable new services.
- Caller Display will greatly increase the proportion of calls received by integrated services digital network (ISDN) customers for which CLI is delivered.

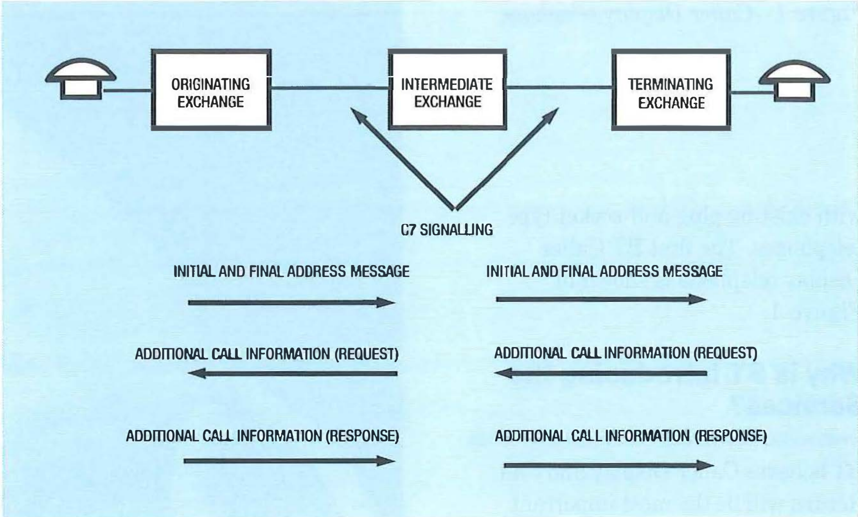
Caller Display—some concerns:

- Under certain circumstances, customers may be concerned about their number being revealed on a call; for example, callers to helplines may wish to preserve their anonymity.
- Certain police or security operations may be hampered if a caller expects their telephone number to be disclosed.
- Number information is personal data, and callers must be reassured that it is being used in accordance with the Data Protection Act.

BT has consulted widely with many organisations, including OFTEL, the Data Protection Registrar, police etc. concerning the privacy issues that Caller Display raises. Before the service is introduced, BT wants to minimise any risk that the Caller Display service could be abused.

Caller Display and Call Return are intended to benefit all customers, and BT will have the necessary measures in place to protect those who genuinely need to keep their number private. This will be achieved by allowing customers to decide whether or not to reveal their number each time they make a call. When the digits

Figure 2—Caller Display inter-exchange signalling



141 are dialled before the normal number, their CLI number is not revealed. In addition:

- Customers with a Caller Display who receive a call from a customer who has withheld their number will be able to see that the number has been withheld and can choose whether or not to answer the call.

- If for any reason the caller's identity is not available on an incoming call (for example, an incoming international call), then the customer will receive an indication to that effect to distinguish it from a caller who has deliberately withheld their number.

ISDN customers will welcome the introduction of Caller Display since it will greatly increase the number of calls for which CLI information can be delivered. Customers familiar with ISDN services know that, at present, CLI information is delivered only to and from other ISDN lines. The launch of the Caller Display service will also enable BT to deliver CLI to and from ordinary telephone lines, thus giving ISDN customers all the benefits of Caller Display. This will be of special interest to ISDN customers using the BT Linkline 0800 and 0345 services for incoming calls.

How Caller Display Works

The Caller Display service requires changes to BT main networks, local exchanges and local access signalling techniques.

Main network signalling

Most of BT's customers are connected to GPT System X or Ericsson AXE10 digital exchanges, or to TXE4 electronic reed-relay exchanges. All these exchanges are interconnected by digital links using CCITT Signalling System No. 7[1], known generally as *C7* signalling. C7 signalling provides a mechanism for passing the number of the calling customer to the distant exchange, where the destination of the call resides. Previously this has been used mainly for engineering and call-trace purposes. However, it is also possible to pass the information to the called customer, and this already happens with ISDN.

When a call is made to a customer with Caller Display, the customer's exchange requests the number of the caller from the exchange originating the call.

At the terminating exchange, the information contained in the C7 *initial and final address message* (IFAM), which is used to set up the call, is examined to determine whether the caller's identity should be requested. The check includes a test of whether the call has been routed entirely by C7 signalling (otherwise the caller's number will not be complete), and a test of whether the call originated on the BT network, or another C7-connected network with whom there is an agreement to exchange and deliver caller identities. If none of the tests fail, then an *additional call information* (ACI) message is sent back to request the caller's identity from the originating exchange. Where the identity cannot be obtained, a *number unavailable* message is delivered to the Caller Display customer. Even if the information is available, the caller can choose to withhold delivery of the calling number, and this fact is passed to the terminating exchange, which then delivers a *number withheld* message to the Caller Display customer. Figure 2 shows the sequence of C7 messages between exchanges during call set-up.

Other network operators

It is possible to transfer CLI information between BT and other network operators such as MCL, international networks and mobile telephone companies. Customers are unlikely to distinguish between calls within the same network and those between different operators' networks. It is therefore proposed that the minimum level of privacy protection must be available on individual networks before CLI presentation is allowed on calls between different networks. All network operators exchanging CLI information for display purposes will need to comply with a common code of practise.

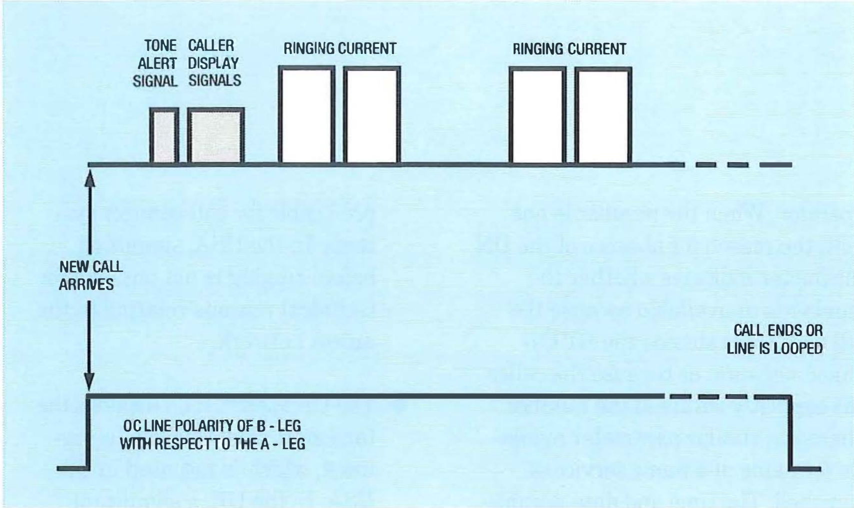
Access lines

BT exchange lines that are used to access other licensed operators will support the use of 141 as prefix digits to withhold the caller's number. Receipt of 141 at the BT exchange (as a prefix in front of the access code for the other carrier) will not affect the onwards routing of the call other than to ensure the CLI is not sent forward for display purposes. BT has taken steps to ensure that, when the CLI has been withheld on calls originated on BT lines, the withhold request is upheld by other carriers that may be involved in conveying the call.

Network-to-customer premises equipment signalling

Although ISDN signalling provides messages for sending Caller Display information to the called customer, until now there has been no means of doing this on analogue PSTN exchange lines in the UK. However,

Figure 3—Caller Display signalling sequence



Bellcore, the research laboratories of the principal local telephone companies in the USA, have developed a simple signalling protocol for carrying additional information on analogue lines[2]. BT has developed this system for use on local lines in the UK, and this specification has been published as SIN 227[3].

The system works by sending information encoded as V.23 frequency-shift-keying modem tones from the exchange to the CPE just before ringing current is applied to ring the bell or tone caller. V.23 allows a data rate of 1200 bit/s, and is the standard used by Prestel. This standard was chosen because it is rugged and reliable, even without error correction, on long lines. It is also the fastest standard for short messages of less than 100 bytes in length: higher speed modems using V.22 or V.32 require a significant time for training, and offer no speed advantage for short messages. The Caller Display messages take about three quarters of a second to send.

In order to implement the new signalling, V.23 senders will be required at every exchange concentrator.

Figure 3 shows the timing of a Caller Display message, just before the familiar ringing pattern. Note that signalling is carried out before any ringing is applied, and that there is a reversal of DC polarity on the line before signalling. This is a unique feature of the UK telephone network, and can be used to alert the CPE of the imminent arrival of a Caller Display message. The *tone alert* signal that follows the polarity reversal is a short audio tone used to increase the reliability of message detection.

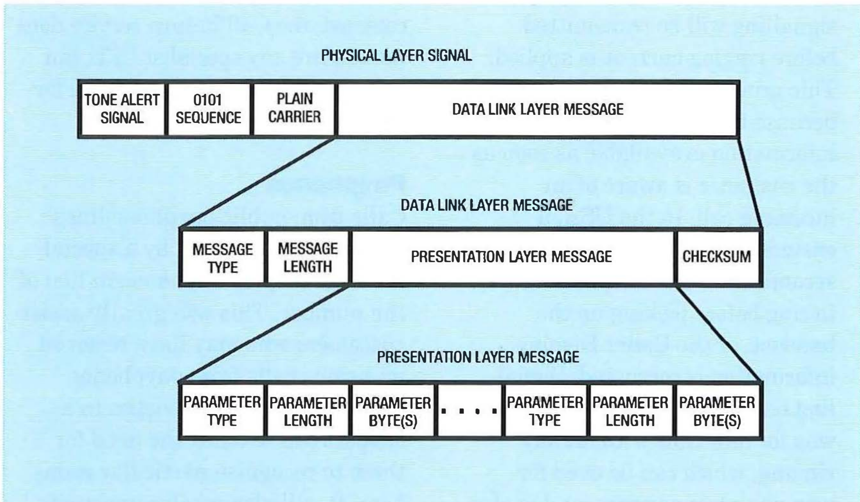
Viewing the Caller Display protocol according to the OSI Reference Model, four of the seven layers are used: physical, data link, presentation and application:

- Physical layer: defines data symbol encoding and modulation, and analogue line conditions.
- Data link layer: defines framing of messages for transmission and a simple error-check procedure.
- Presentation layer: defines how application-related information is assembled into a message.
- Application layer: defines the application (Caller Display) that uses the signalling.

The physical layer defines the V.23 modulation and timing, and includes at the start of the message a 250 ms pattern of 0101 bits, modulated onto a V.23 modem carrier, followed by a short period of plain (unmodulated) V.23 carrier. Together with the tone alert signal, this aids reliable message detection.

The physical layer signalling carries data link messages, which contain within them presentation layer messages as shown in Figure 4.

Figure 4—Caller Display signal format



The presentation layer message comprises a sequence of application parameters. Six parameters will be used initially:

- calling-line directory number (DN);
- reason for absence of DN;
- time and date;
- caller name/text;
- reason for absence of caller name; and
- call type.

This allows the caller's number and a text string to be sent, together with a time stamp indicating when the message was sent. In future, the text string may be used for the caller's name, but initially it will be used only for messages such as *Payphone* or

Operator. When the number is not sent, the reason for absence of the DN parameter indicates whether the number is unavailable because the call originates outside the BT C7-linked network, or because the caller has explicitly withheld the number. There is a similar parameter available for name, if a name service is launched. The time and date parameter has an incidental benefit: it can be used to set clocks in telephones, avoiding the need ever to set the time manually. The call type parameter initially will indicate only voice call, but could be used in future to distinguish these from non-voice calls, such as facsimile calls.

Further parameters may be used in the future. These might be used for message-waiting indications, or to indicate additional information such as the called number (the latter would be useful when, for example, a call has been diverted: in this case the called number may not be the number dialled).

The signalling system described here to be used by BT for the Caller Display service is very similar to the Bellcore CLASS specification on which it is based. This is important, as it allows CPE makers to base Caller Display equipment for the UK market on CPE designed for North American use, thus providing manufacturing economies. However, there are some differences:

- In the UK, the Caller Display signalling will be transmitted before ringing current is applied. This provides a better service because the Caller Display information is available as soon as the customer is aware of an incoming call. In the USA, a customer must wait for about four seconds after the telephone starts to ring before picking up the handset, or the Caller Display information is corrupted. Signalling before ringing also opens the way for new calls without any ringing, which can be used for new non-voice services, and is also preferable for call-connect systems. In the USA, signalling before ringing is not possible for technical reasons relating to the access network.
- The UK specification includes the tone alert signal, shown in Figure 4, which is not used in the USA. In the UK, a significant proportion of local lines are routed on aluminium rather than copper cables. Aluminium joints are more prone to becoming electrically noisy than their copper counterparts. Aluminium cable has not been used in the USA, and is now no longer used in the UK for new lines.

These enhancements are expected to avoid some of the problems that have occurred in North America, and provide a better and more reliable service for UK conditions.

Customer Premises Equipment

To use the Caller Display service, suitable CPE is needed. As well as displaying Caller Display information when a call arrives, it is likely that Caller Display equipment will probably log the last (say) 30 incoming calls, together with the date and time of the calls.

Integrated Caller Display telephones might use the log to return calls at the touch of a button. In contrast, the Call Return service does not require any specialist CPE, but will provide number information for the last call only.

Payphones

Calls from public payphone lines may be distinguished by a special message display *Payphone* in lieu of the number. This will greatly assist customers who may have received malicious calls from payphones since it will alert the victim to a suspect call without the need for them to recognise particular numbers. It will also resolve questions about confidential calls made from payphones; for example, to counselling helplines.

Switchboards

Customers with switchboard systems may wish to prevent calls being made with the 141 prefix; for example, to maintain the integrity of their call-barring facilities or call loggers.

To cater for customers not wishing or able to bar 141 within their switchboard equipment, BT will make available a Bar 141 service which can be applied to the customers' exchange lines on request. Under these circumstances, numbers will usually be sent forwards for display on all calls made using such lines.

Privacy measures

When the Caller Display and Call Return services are introduced by BT, customers will be able to withhold their number on any individual call. This will be done by simply prefixing the number they wish to dial by a special short code—141. This service will be available from all customers' lines free of charge. No additional call charges are associated with that call for the use of the 141 facility. Customers will not require a special telephone to use the 141 number-withhold facility.

It is important to appreciate that dialling 141 before a call would not prevent it being traced by BT's malicious-call interception service.

Under exceptional circumstances, some customers may need to withhold their number on all calls that they make. If this is the case, BT will provide a facility which automatically prevents a customer's number going forward on all calls. Research has shown that the usefulness of the Caller Display service is diminished if callers' numbers are not available on as many calls as possible. For this reason, BT advocates that customers only need to adopt call withholding when they consider it to be absolutely necessary.

Some customers may decide that they do not want to receive calls from

BT is ensuring that all privacy concerns—both for the caller and the called party—are fully addressed

customers who have purposely withheld their number. In the future, BT will be able to provide theses customers with a facility that screens out these anonymous callers. Callers will hear a message telling them that the customer is not receiving calls from people who have not released their number. The calling customer then has the choice of whether or not to redial, releasing their number. This facility is known as *anonymous call rejection*. Customers who have permanent number withholding on their line will also be provided with a facility to release their number on an individual call basis. This will be done by prefixing calls from their line with a special code. This will ensure that they will be able to choose whether to contact customers with anonymous call rejection in place.

By putting in place all these facilities, BT is ensuring that all privacy concerns—both for the caller and the called party—are fully addressed.

Customer Trials

Caller Display on trial in Scotland

BT has conducted a trial of the Caller Display facility to assess customer reaction to the concept of the new service. This took place in the Elgin area of Scotland, and ran for three months from January to March 1993. Five hundred residential customers volunteered to take part and were given special display units which were connected to their existing line. These units displayed the number of an incoming call from any of the other 23 000 customers in the Elgin area. When making calls in the Elgin area, all customers were told that they could prevent their number being shown by dialling the prefix code 141 immediately before making a call.

During the trial, extensive market research was conducted to gauge the reaction of both callers and users to the Caller Display facility. These were some of the results:

- On the privacy issues:

— 83% of people said customers had a right to see the calling line identity;

— but 87% agreed that callers had a right to privacy;

— 75% would not object to their number being displayed; and

— 74% could not see why customers would want to withhold their number.

- On the use of Number Withholding:

— over 70% of residential customers knew there was some method of withholding numbers on calls;

— however, there was hardly any use made of the 141 facility with usage estimated at 0·01% of calls;

— there were no requests for permanent per line withholding of number;

— around 90% of customers believed BT should introduce the service; for ex-directory customers this figure was 82%;

— triallists of the service saw the benefits of the service as offering convenience and comfort rather than just call screening; and

— to make a commercial service acceptable, over half of triallists believe that 90% or more of incoming calls would have their number displayed.

The Future

Future evolution of Caller Display

Several enhancements to Caller Display are possible, and are under study. As has already been mentioned, the signalling protocol has been designed to allow the caller's name as well as number to be sent. This could be the directory name associated with a line, or it may be possible to personalise names so that, for example, different family members sharing a telephone line might be able to trigger the appropriate name being sent.

The protocol also allows Caller Display messages to be sent during a call; this causes a brief silence in the call while the signals are interchanged. This could be used with the call-waiting service, so that when a new call arrives during an existing call, the customer can see the identity of the new caller, as well as hearing the call-waiting beeps.

The ability to signal practically any information to the telephone before or during a call, with the ability to use touch-tone signalling in the reverse direction, provides a signalling capability similar in some respects to the ISDN D-channel. This not only enhances the PSTN, but will provide a smoother evolution path to ISDN or other advanced network access systems.

Screen telephones

One of the possibilities opened up by Caller Display signalling is to support screen telephones. With the increasing complexity of services that can be offered over the network, there are limits to how usable services can be made using voice-only input and output, and in some cases touch-tone input.

For very many applications, the telephone is the ideal interface: a computer screen interface is not only bulky, but in most cases does not have the user-friendliness of two-way voice communication. Screen telephone proposals such as the North American analogue display services interface (ADSI) enable a simple interactive screen similar to a bank cash machine to be added to a telephone, to enhance (not replace) a voice dialogue.

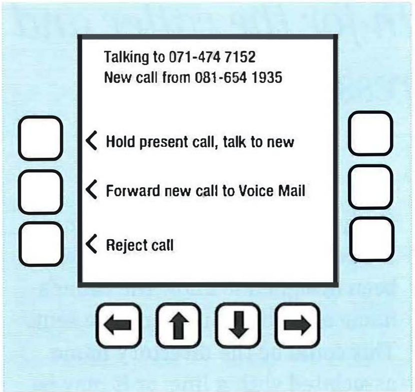


Figure 5—Screen telephone menu example

Figure 5 illustrates how such a screen might be used to make the call-waiting service easier to use by providing a menu that appears automatically when a second incoming call arrives.

The ADSI specification builds on Caller Display signalling, and a number of telephone administrations are studying this. Although the signalling protocol is based on the analogue Caller Display interface, the screen model is equally appropriate to ISDN.

Acknowledgements

The authors gratefully acknowledge the help and contributions received from Steve Grimes, BT Worldwide Networks, and Amanda Brown, BT Products and Services Management.

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Glossary

ACI Additional call information
ADSI Analogue display services interface
CLI Calling line identity
CPE Customer premises equipment
DN Directory number
IFAM Initial and final address message
ISDN Integrated services digital network

Biographies

William Dangerfield
BT Products and Services Management

William Dangerfield joined BT in 1980 as a graduate of Warwick University. Since then he has worked in the fields of regulatory approval, customer service, technical and sales support of a wide variety of customer premises equipment, and as product manager of Meridian 1, ISDX, and BTeX switchboard systems. This included leading teams involved in the first customer trials of ISDN 30, 2b+d digital featurephones, and DPNSS as used on private networks. He is currently leading the project team responsible for the trials and launch of Caller Display and Call Return and other network services that use CLI.

Simon Garrett
BT Development and Procurement

Simon Garrett has worked with BT since joining the then Post Office in 1975. After running a semiconductor life-test laboratory in BT Laboratories, and developing test equipment for it, he designed and developed a number of embedded computer systems including real-time operating systems, distributed processing systems and a photo videotext system. He led the PC 2000 strategic studies into new residential services and technology, and managed BT's involvement in a number of pioneering European collaborative projects for Home Systems. He represents BT and the UK on standardisation activity in this area. For the CLASS project, he designed the signalling system to be used in the UK, and led the development team at BT Laboratories.

Melv Bond
BT Products and Services Management

Melv Bond joined BT, then the Post Office, in 1979 where he worked on the development of the local exchange modernisation programme, planning the introduction of the new digital environment. After spells in Strategic Planning and Business Planning, he moved to Products and Services Management. Formally national project manager for Network (Star) Services, he is now working on the evaluation, commercial development and launch of new network-based services, principally those associated with CLI.

Colin Banks and Mike Mikkelsen

Systems Engineering in BT's Account Management—The Bid Manager

The bid manager plays a key role in the systems-engineering function in account management. This article outlines the bid processes and shows how the bid manager takes responsibility for a proposal by becoming the hub of a virtual team created to manage the BT response to an invitation to tender.

Introduction

This article is the third of a series of articles on account management in BT, with special emphasis on engineering aspects of the full and virtual account team.

In this article, the specialist role of the bid manager, which is undertaken by specialist systems engineers, is outlined together with the relationship of the bid manager to the account teams in major sales.

In the previous two articles[1,2] on account management, and systems engineering, which appeared in the July 1993 issue of the *Journal*, reference was made to the heavy demand placed on the systems-engineering functions of account management by the dramatic increase in competition in the market-place. The impact of that change was underlined by John Wheeler, General Manager of the Retail and Finance Sales Sector, in his introduction to that issue of the *Journal*, emphasising the competitive pressures on both BT and BT's clients, and the resulting increased need for BT and its clients to be cost competitive.

This article explores how a sales prospect becomes a bid, what a bid is, and how the bid manager coordinates a multi-hierarchy team to produce a proposal to a client which leads on to a successful contract placement between BT and the client.

In addition, both the formal bid process (BT's sales sector processes, including bid process, are accredited to ISO 9001), and the less formalised, but arguably more important area of business management, are reviewed.

Definition of a Bid

The use of the term *bid* in BT historically conjures up the view of a large and highly-technical invitation to tender (ITT) that has been presented by a client to the BT sales team for BT to provide an equally large and technical response with the aim of securing the available business. To that end, the constant request from colleagues in other areas has been 'Can we have a copy of the ITT please'.

However, the competitive pressures on both BT and its clients has changed the philosophy of how clients buy and the methods they and, indeed, we within the sales environment employ to approach the competitive sale.

This competitive pressure has created the need for a redefinition of a bid which meets the greater demands.

This definition must now take into account the following points:

- BT's technical depths,
- BT's commitment to the total-quality concept,
- BT's commitment to account management of its key clients,
- BT's need to protect its revenue streams,
- BT's need to protect its position in the UK marketplace,

a bid centre has been created to provide high-quality bid management for sales prospects

- BT's commitment to being a major global communication provider,
- BT's commitment to providing service to its clients, and
- BT's regulatory position in any marketplace.

All or some of the above criteria will be included in the proposal.

The definition of a bid can now read: 'Any document that will be presented to a client that contains:

- a price,
- the terms and conditions of the BT offer,
- a requirement for concurrence to the BT offer from its operating divisions, and
- a commitment by BT to fixed timescales.'

The fundamental change is that BT can now provide an uninvited proposal to a client with the complete confidence that on winning the business BT can deliver and support the offer while importantly ensuring profitability.

In an aim to minimise the costly overhead of the above, BT's Group Commercial Contracts (GCC) has developed quality procedures which controls the BT bidding process.

These procedures allow a large percentage of proposals and bids to be managed by BT's sales teams, leaving the high-value complex proposals to be managed by dedicated bid managers, thus adding real value to the sale.

The Role of the Bid Manager

The bid manager becomes the hub of the virtual team that is created to manage the BT response, taking responsibility for the proposal until submission of the bid, and providing further input until acceptance of the proposal by the client.

The bid manager will, in many circumstances, act as a facilitator by maximising the skills of the team members to ensure that BT provides the most competitive proposal.

The key aim of the bid manager is to win profitable business for BT by complementing all business areas represented on the bid team while ensuring that the team complies with the GCC procedures.

In many of the high-value complex proposals, the bid manager takes a further role of a conduit between the requirements of the client and the requirements of BT. This requires the bid manager to develop sensitivity to both needs and to reflect these to the bid team.

In many respects, the bid manager becomes the ombudsman for the bid, and this is key in the creation of a competitive proposal.

Within a sales sector, each account team has its account strategies and plans for sales and service, formed from planning and review sessions, and operates in a coordinated way to implement its plans. The sector-based bid manager maintains an overall view of the line of business (LOB) and account team strategies and plans, and ensures that the bid strategy fits both the account strategy and the client's needs.

The Bid Manager's Skill Set

The bid manager's skill set is based on the system engineer's skill set (as befits a specialism of the systems engineer), but requires a substantial addition of general management skills and process control knowledge and ability.

The BT values exemplify the additional skill set needed in that the bid manager must lead the bid team by example to:

- put the customer first
- be professional
- respect others
- work as one team
- be committed to continuous improvement.

The bid manager also needs to have a good supporting knowledge of the structure of BT, the decision-making processes within BT, and above all a strong ability to motivate people that are assembled together into a team for a short period.

The bid manager represents BT when meeting with a client (as do all BT staff), but is seen by the client as part of an account team that has a special relationship and responsibility for the client's business with BT.

The bid manager needs to be presentable, articulate, able to engage in conversation on any subject (whether it is the client company's fortunes in the stock market or the latest software level of a product), and to be aware constantly of the confidential information that is being handled and to exercise discretion accordingly.

The BT Retail and Finance Sales Sector Bid Centre

Within the retail and finance (R&F) sector, a bid centre has been created to provide high-quality bid management for sales prospects.

The bid centre aims to provide:

- first-class bid management directly to qualifying bids;
- first-class business management where this can add value to the client and the BT account team;
- a managed route to other sources of bid management within BT, such as product specialisms;
- a mentoring service to account teams who are managing their own bids;
- first-class bid publication including providing bid publication for

This has created a team with a remarkable level and range of knowledge and expertise

account teams who are managing a bid themselves; and

- training seminars on the bid process for the account teams.

To enable the R&F bid centre to provide these services, a team of six bid managers, each focused on an LOB, and two bid production staff were created. Lead by a senior systems engineering manager, they operate a virtual bid centre, based at Leeds, with units operating at Birmingham, Bristol, Brighton and London. Electronic data systems using the BT wide-area network (BT WAN) enable the unit to operate as one 'office' with the ability to send raw data hundreds of miles to the bid publication unit for assembly into the required format and then returned electronically for local printing and physical assembly.

The bid centre has been formed from both long-term BT staff with wide-ranging experience of sales and bid management, and comparatively recent recruits from communications management and commercial contracts background outside of BT. All of the R&F bid managers are systems engineers. This has created a team with a remarkable level and range of knowledge and expertise, from simple basics to the most advanced complex bid situations.

The bid-centre team operates an internal control process designed to focus the bid-centre resource into sales prospects that will produce the maximum contribution to the R&F sales sector and its client community.

This process was developed from workshop-style seminars at which unrestricted open debate was used to ensure all issues were aired and addressed. This has resulted in a system that is proving to be robust and is welcomed by the account teams as adding value to their account management activities. In particular, the R&F bid-centre qualification pack has been accepted by many account-management teams as a powerful aid to the standard sales qualification process.

The Bid Centre Process

The R&F bid centre operates a set of processes which are summarised in the Table 1.

Table 1 Bid Centre Processes

1	Initial contact between the account team and the bid manager representing the sales LOB
2	Completion of a simple single-page *Bid Alert* form by the bid manager, sent to the bid centre control (Leeds)
3	Registration of the bid at bid centre control
4	Reservation of bid publication resource
5	Bid qualification pack passed to account team by the bid manager
6	Completed bid qualification pack returned to bid centre control with the bid manager's recommendation
7	Bid centre control circulates qualification pack to senior sales managers to advise of acceptance as a bid, and for support information in clearing resource contention if appropriate
8	Decision point: does the account team proceed supported by advice from the bid centre, does the LOB bid manager manage the bid, or does the LOB bid manager pass the bid to a further specialised bid management group such as the customer skills centre?
9	Assuming all clear, the bid begins

Considering that this precedes the bid process, it may seem to be demanding on time and resource, but in practice a smooth and rapid transition to the bid process can be achieved.

Bid Qualification

The cornerstone of successful bidding lies in bid qualification. The relationship created with the client through the account team should offer BT the real opportunity to qualify fully the clients requirements and to influence the ITT in BT's favour.

This activity is an iterative process throughout the sales cycle and it is the constant communication of the client's drifts and changes of requirements back into BT through the bid manager and the bid team that allows the BT internal processes to be positioned in advance of the client issuing the ITT. The reason that qualification is iterative is that BT's competitors are also attempting to influence the client and it is the counters from BT at this stage that can give an advantage at the time of response.

In an aim to assist the account teams in this important stage, the R&F bid centre has developed a bid qualification pro-forma. This pro-forma, in conjunction with the initial standard bid information forms, allows the account team to provide an initial information package which assists the bid manager in identifying the most appropriate members of the bid team and provides valuable background information for the initial bid meeting.

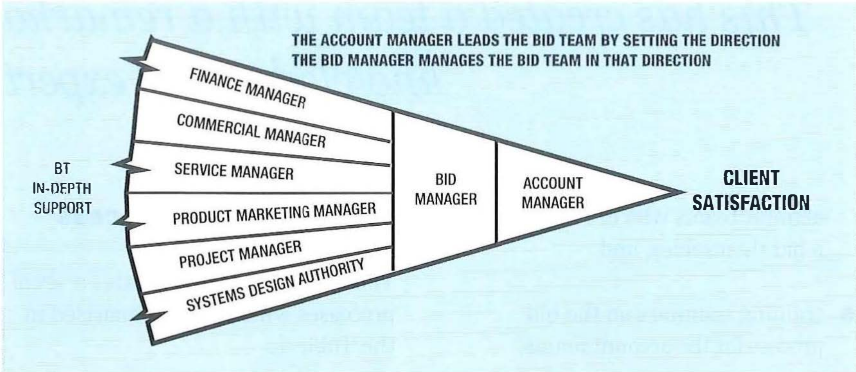
Examples of details required in the bid qualification pro-forma are:

- budget available,
- BT's solution,
- account details,
- client's adjudication process,
- fit of this proposal into the sales strategy for the account,
- timescale for the sale, and
- competitors.

The above information is provided by the account team. In addition, the bid manager will provide details on:

- identifiable areas of risk to BT, and
- the cost of bidding.

Figure 1—Major elements of a bid team



With the assembly of the above information, it is then possible to recommend progression of the bid response.

In providing bid-qualification assistance to the account teams, it is the aim of the R&F bid centre to provide winning proposals that enhance the team's professional standing with their client and increase the revenue flows from the client to BT.

To draw an analogy, in chess the following points will assist in winning:

- understand the 'rules of engagement',
- fully research the competition,
- plan your strategy against your strengths and weaknesses, and
- stick to your strategy.

Bid Management

Bid management is the management of all processes leading to a successful contract. Effective control of the bid team is essential to deliver this result.

Figure 1 shows the major elements of a bid team focused on satisfying the client's needs.

The account manager is the bid owner and is ultimately responsible for all aspects of the BT interface to the client account. It is the account manager (and account systems engineer) who ultimately reaps the reward for success, or failure.

The bid manager forms and manages the bid team from BT's various internal business divisions to produce a successful contract with the client. The bid manager is responsible for the bid until bid submission, and retains an input to the bid until acceptance of the bid by the client.

In short;

- The account manager leads or points the direction.
- The bid manager manages the bid team in the direction given by the account manager.

Supporting the bid manager in the bid team are six major elements:

1 Commercial contracts, represented by the commercial manager, who may be asked, dependent on the bid, to confirm a simple contract text for errors and acceptability, or write a full contract running to several volumes (aided by support groups) and including supplier contracts between contractors and BT.

2 The finance manager, responsible for determining bespoke pricing and the profitability of a project within overall business strategy.

3 The service manager, one of the most vital elements of any contract, responsible for the client interface after contract implementation, including two areas of major concern to the client—billing and maintenance.

4 Product marketing, dealing with technical issues specific to the product(s), supply, product enhancements and, of great interest to the client, price and discount.

5 Project management, responsible for the critical period between contract acceptance and contract completion, but invaluable to the bid team from the inception of the bid.

6 Systems design authority, often the account team systems engineer, leading the biggest section of the bid team and frequently the most onerous task on the team. The systems design authority must ensure that the technical designers of each element of the technical solution produce a system that meets or exceeds the client's business needs.

Supporting these bid team elements is a vast resource in depth of expertise which can be co-opted onto the bid team to reinforce the team.

This leads to a bid team typically ranging from eight to twelve in number, focused on producing the winning contract.

The bid timeframe can vary considerably, but an 'average' bid, if indeed such a thing exists, will become apparent to the account team ten to twelve weeks before a clear client requirement can be documented. This will lead to bid activity starting perhaps 12 weeks into the timeframe followed by four weeks activity on producing the contract and then four to six weeks after contract submission to achieve contract award.

The total timeframe for this 'average' sales opportunity to contract award is 22 weeks, although there are considerably longer bids than this, running into several years.

Bid sales values can vary from a few hundreds of thousands of pounds to over 20 million pounds (and occasionally much higher).

Business Management

The ultimate development of bid management is known as *business management*, and in this scenario the bid manager becomes the 'business manager' and enters the sales cycle at a much earlier stage. The account manager will have detected a business need in the client account and involved the business manager almost immediately to help in developing the opportunity to a

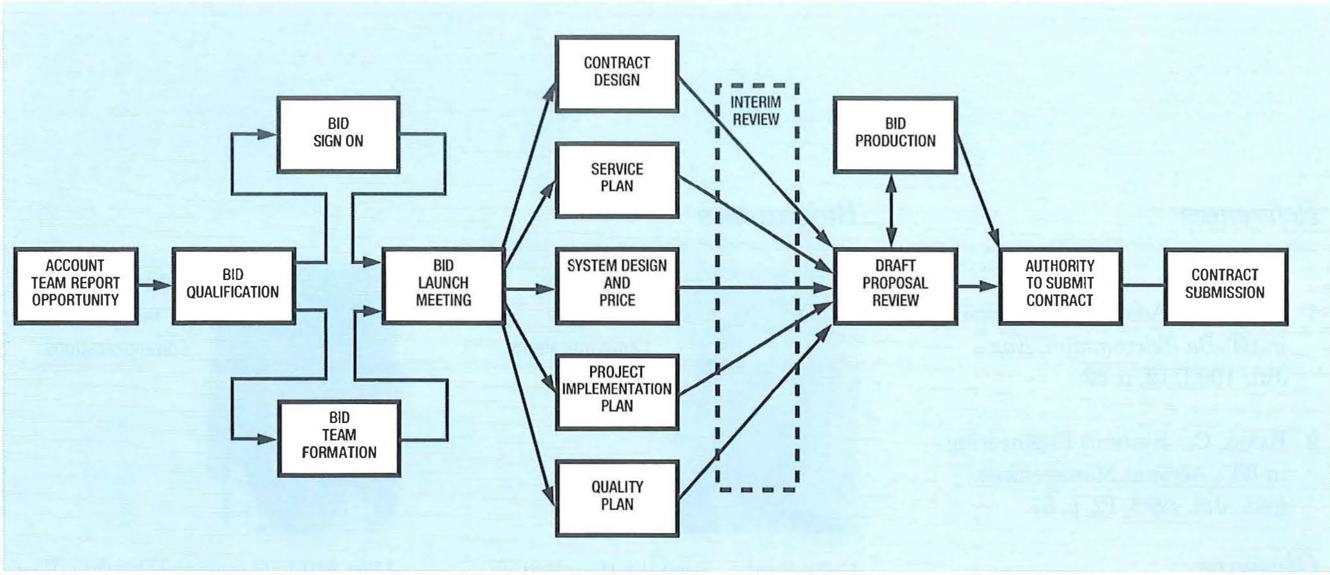


Figure 2—Basic stages of a bid

contract stage. The typical business need will be complex and large value, and will require effort of a scale beyond the account manager's normal resource availability.

The business manager will take a lead role in developing the opportunity with the client and will control the whole cycle through to completion.

Some specialist divisions of BT normally operate in this manner.

The basic steps of a sale can be viewed as shown in Table 2.

The bid manager normally becomes involved at stage 4, but as a business manager, will become involved at stage 2.

Viewing the bid process as a project

The bid process is essentially a project and can be (and often is) run to project-management principles.

Figure 2 shows the basic stages of a bid expressed as a project PERT chart.

The basic stages from notification are shown in Table 3.

This is a very simple model of a bid, a full model will have 30 to 40 stages or more with many interdependencies.

All of the checks, authorities and reviews are designed to ensure a high-quality contract implemented to delight the client while ensuring acceptable profitability to BT.

Table 2 Basic Steps of a Sale

1	Detection of sales opportunity
2	Development of opportunity
3	Building of sales plan
4	Gaining commitment to resource bid
5	Commercial design
6	Technical solution design
7	Financial build
8	Text draft construction
9	Review of draft
10	Bid sign off
11	Bid submission to client Formal presentations Question and answer
12	Contract negotiations
13	Contract agreement and signatures
14	Contract handover to Implementation (project manager)
15	Implementation handover to service organisation and client
16	In service

Table 3 Basic Stages of the Bid Process

1	Bid qualification
2	Bid sign on (commitment of resource to bid)
3	Bid team formation (normally concurrent with stage 2)
4	Initial bid (launch) meeting
5	System design build and price
6	Contract design
7	Service plan design
8	Quality plan design
9	Project implementation plan design
10	Interim progress review
11	Draft proposal review
12	Bid production
13	Final authority to submit contract Finance Commercial contracts Sales Implementation
14	Contract submission to client

Conclusion

In the ever-growing highly-competitive worldwide telecommunications area, BT's position as a major communications player requires that it capitalise on its vast experience and expertise.

To achieve its objectives, BT must ever strive to lead its competitors. A major strength will be its ability to respond to bids in the most competitive manner by utilising the account teams, the sales strategies and the growing skills of the bid teams.

The role of the bid manager and the bid team members is dynamic, and that flexibility will be a valued unique selling point for the future.

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Glossary

GCC BT's Group Commercial Contracts
ITT Invitation to tender
LOB Line of business
R&F Retail and finance

Biographies

Colin Banks
BT Business Communications

Colin Banks joined the then British Post Office in 1963 as a Trainee Technician (Apprentice) in London North Telephone Area. In 1969, he joined the Strowger local exchange maintenance division and progressed to managing local strowger and TXE4 exchanges. In 1981, he became responsible for the area Management Services Unit, including manpower planning for the local exchange modernisation programme, and area computing services. In 1984, he became part of the team that created National Networks, (later to evolve into Worldwide Networks), and ran transmission and trunk switching operations for Northern London District until 1988, when he moved into BT National Account Management as a level 3 senior project manager for the Lloyds Bank account team. In 1991, he moved on to systems engineering manager initially for the NatWest Bank account team and then for the London-based banking LOB. He is now a Senior Bid Manager in the R&F bid centre. He is a Member of the British Institute of Management.

Mike Mikkelsen
BT Business Communications

Mike Mikkelsen joined the then Post Office Engineering Department in 1966 as a Technician 2B on internal construction duties in the West Midlands Area from Dowty Mining Equipment Ltd., where he served a 3 year Management Apprenticeship. In 1970, he moved to the Regional Engineering College at Shirley, Birmingham taking apprentice, customer apparatus, and management training courses. With the introduction of the field sales force, Mike joined the Birmingham team as an MSR finally becoming the first of the District account managers with responsibility for the Health Authorities and British Leyland. Mike then moved to National Accounts, initially managing the BASS account then moving to manage the Cellnet account. From National Accounts, Mike joined the customer skills centres as a member of the newly-formed project management team with responsibility for the other licensed operators (Racal Vodafone, Racal Data Networks, Cellnet, Mercury Personal Communications and others). On the creation of the R&F bid management centre within the customer skills centres, Mike joined as a senior bid manager and then moved, in April 1993, to the bid centre of the R&F Sales Sector.

Mike Peace and Barry Stagg

Telconsult: BT's World Consultancy Service

All over the world telecommunications entities are responding to pressure for technological evolution and organisational changes of the kind already so familiar to BT. Often the desire to make such progress is a prelude to significant growth in telecommunications market activity and there are decisive advantages on both sides if BT can be involved. This article describes the range, purpose and organisation of BT's worldwide technical and management consultancy services provided through BT Telconsult.

Telecommunications Consultancy

Technological and organisational changes on the scale contemplated by many overseas telecommunications operating entities (including major companies with large networks of their own) depend for their success on preliminary studies, careful planning and expert guidance. BT's own store of experience places it in a position to help by offering highly professional assistance in the form of consultancy.

There is a four-fold strategic benefit to BT in offering international consultancy services:

- BT can use its skills and experience to positively assist governments, overseas network operators and private companies to achieve significant technological and operational improvements;
- in doing so, BT can enhance its image abroad and build up relationships with key overseas customers and correspondent administrations;
- BT can, through consultancy, actively support other countries in deregulating world telecommunications markets; and
- consultancy provides what is very often the earliest (and sometimes the only) market presence in many overseas locations.

Without intensive planning and preparation it would be unrealistic to contemplate national network modernisation and growth on any great scale, or the complex legislative changes and organisational restructuring needed to place a state-run telecommunications department onto a commercial footing. Yet in the international arena, growth and change of this sort are often needed to support a developing economy and it is at this point that those sponsoring such changes turn to consultants to provide the necessary planning, preparation and implementation skills. Consultancy is therefore often the earliest activity in a market about to show substantial development and it follows that many overseas clients' first contact with BT is through consultancy work.

Meeting clients in this way leads BT into exciting parts of the world (see Figure 1). Consultants offer expertise

Figure 1—Consultancy takes BT to exciting parts of the world

In a major network modernisation and expansion project, Telconsult can be asked to manage the project and provide the technical expertise needed. BT experts undertake the survey and planning work, produce network designs and detailed technical specifications, produce international tendering documentation, conduct evaluations of contractors' offers, negotiate contracts for implementation, carry out quality assurance checks, oversee the construction works, verify contractors' performance, supervise acceptance-testing and commissioning and deal with the relevant certificates and invoicing. BT uses its skills to plan, procure and oversee installation of vastly upgraded switching, transmission and access networks, and will often subsequently provide operation and maintenance consultancy.

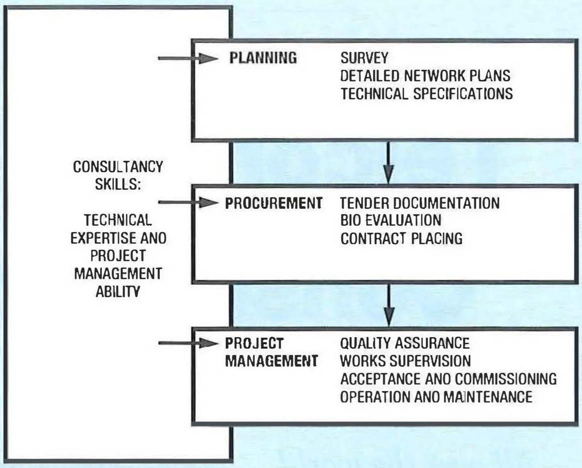


Figure 2—Typical overseas network expansion project

and resources to which their clients do not otherwise have access and indeed few telecommunications entities possess all the skills they need for important innovations within the sector. Therefore the related consultancy market is a very active one, with a number of major consultancy firms engaged in serious competition. It is in fast-developing areas of the world where the opportunities for growth and change in the telecommunications sector are greatest and occur on the geographic and economic scales to which BT is accustomed. Hence BT has had, over the years, excellent opportunities to demonstrate how it can act as an agent for change. It has, through its worldwide consultancy arm BT Telconsult, become a very well established competitor in both the technical and management consultancy arenas.

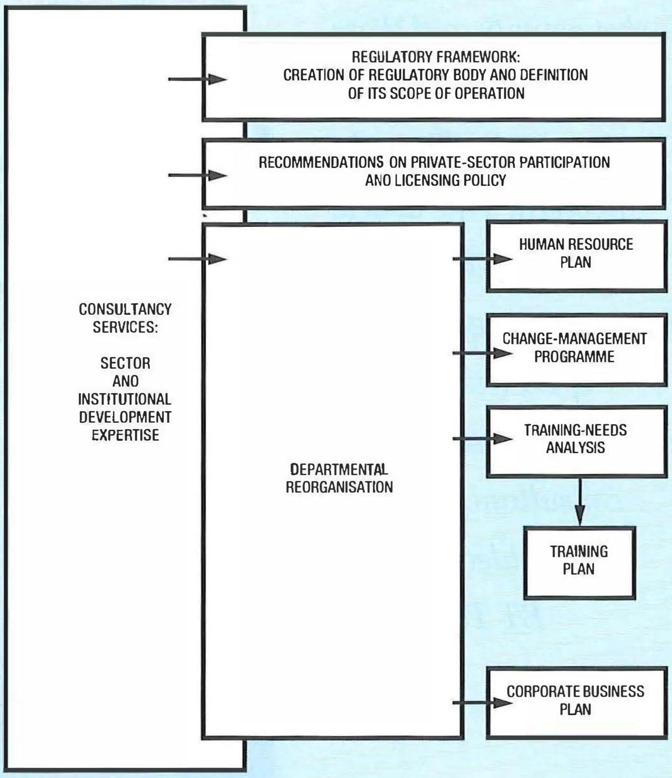
Figures 2 and 3 illustrate what might be involved in typical technical and management consultancy assignments overseas. A completely different type of assignment occurs in more advanced areas of the world where there is a need for leading-edge technological and policy studies. Telconsult is geared up to respond to requests for consultancy assistance across the entire field of telecommunications operations and management.

History

For many years, BT's predecessors (the GPO and the British Post Office or BPO) met developing countries' requests for assistance by seconding mainly technician-level help to carry out tasks such as underground-plant

Figure 3—Typical overseas sectoral development project

In a sectoral development project, a client will typically ask Telconsult to provide a framework for commercialisation through constructing a regulatory regime and reorganising the state telecommunications entity to meet the prospect of private participation in the sector. This usually entails the associated human resourcing and change-management issues together with an analysis of the training needed to provide the commercialised entity with the skills to operate successfully in a competitive market. A corporate business plan often accompanies the reorganisation. The client might also expect proposals for creating a regulatory body and defining its scope of operation, together with a draft policy for licensing network operators.



Now a mature consultancy 'firm', Telconsult is giving thoroughly professional assistance on a worldwide basis and is respected as a major player on the field.

construction. In the 1970s, the BPO moved towards exporting expertise in the shape of professional network-planners and first-line supervisors who relied on local labour to carry out works. The transition to a fully professional consultancy service came in 1978 when British Telconsult (as it was then called) was established from what had become known as the BPO Consultancy Organisation. Then, in the early 1980s, Telconsult was able to explore the world consultancy markets, and in doing so gained invaluable expertise in competitively winning business and operating overseas some years before sectoral and market changes in the UK allowed BT as a company to do likewise.

BT's corporate entry into overseas markets was launched in 1986 with the creation of its Overseas Division whose nucleus was formed by teaming up Telconsult with BT's newly acquired subsidiary IAL (International Aeradio Ltd, which had its own network of overseas offices). At this time, Telconsult concentrated on consultancy work with ancillary activity which it had previously carried out (such as managing network operations and tendering for turnkey contracts) being handled by other parts of the Overseas Division.

BT's reorganisation in 1991 fully established a geographical focus for each of the world's principal markets, with Telconsult attached to the Asia Pacific region but working equally in Europe to support initiatives in both regions. Now a mature consultancy 'firm', Telconsult is giving thoroughly professional assistance on a worldwide basis and is respected as a major player on the field. Through its long record of achievement and through delivering services which are completely attuned to clients' requirements, it seeks to encourage clients to regard BT as a natural partner whose advice and services can be thoroughly relied upon.

Consultancy portfolio

Although its origins were in technical consultancy, Telconsult rapidly expanded throughout the 1980s into the management consultancy field, which is now a very important part of the market. Indeed many prime consultancy projects combine the technological and management disciplines (for instance by requiring a network master plan to be prepared in conjunction with a corporate reorganisation) and the consultancy firm that cannot cover both components is seriously disadvantaged.

The sources of BT's expertise in the technical disciplines are self-evident, with in-house skills ranging from compiling bills of quantity for external plant to implementing centralised real-time traffic management systems. The commercial management of the UK's major telecommunications enterprise is also BT's business, embracing as it does (uniquely amongst European network operators) experience of liberalisation and privatisation, and of restructuring to address a regulated competitive market. Hence Telconsult is properly qualified to offer management consultancy services within the telecommunications sector. Table 1 illustrates the full range of its consultancy portfolio.

Table 1 BT's International Consultancy Portfolio

Management Consultancy
Sectoral and organisational development
Financial analysis and management information systems
Strategic corporate planning
Demand analysis and market strategy
Human resource development
Commercialisation and regulation
Training design and delivery
Tariff strategies and billing systems
Technological Consultancy
Switch and power plant
Transmission (line, optical fibre and radio)
External plant
Distribution (cable and radio)
Local, trunk and international networks
Detailed network design and engineering
Specifications
Works supervision, quality assurance and commissioning
Developmental Services
Strategic network optimisation and costing
Fundamental and master planning
Project identification and planning
Project management
International tendering and procurement
Feasibility studies
Residential and business services
Traffic analysis
Advanced Services
Mobile networks
Network management and operations and maintenance
Broadband services
ISDN
Data networks
Value-added services
Satellite communications
Computer-aided support

Markets

The work that forms the principal focus of Telconsult's activities (see Figures 2 and 3) primarily involves major national infrastructural development projects and institutional innovations such as separating posts and telecommunications or introducing commercial factors into the sector. Such projects tend to centre on the European and Asia Pacific markets (the latter notionally enclosing Africa) with a small amount of work around Central and South America. A summary of activity in the world's markets is given below, to illustrate the breadth of BT's consultancy presence.

Western Europe

Western Europe has been an active market for many years, featuring advanced studies such as the visual communications aspects of the integrated services digital network (ISDN). Telconsult is a member of ETCO (the European Telecommunications Consultancy Organisation), a five-member EC special economic interest group through which much of this type of work flows.

Consultancy is by its nature a high-profile activity with far-reaching consequences. ...an opportunity to demonstrate BT's competence to very influential people.

Central and Eastern Europe
Telconsult entered the previously unknown Central and Eastern European market as early as 1988 with an important traffic management study in Hungary. Since political liberation in the region, the consultancy market has blossomed, with clients seeking equally dramatic and virtually concurrent strides in both technology and commercialisation. A major part of consultancy effort is now focused on this region and is clearly a prelude to greater market freedom from which may flow opportunities for global network service connections and increasing international traffic.

Asia Pacific
Consultancy in the Asia Pacific region has historically centred on the Middle East with, for example, major network growth in the Sultanate of Oman, but the Far East has now become a very dynamic market. BT's consultants have for example designed a 2-million line network for Bangkok which is now being installed at a phenomenal rate. Consultancy is by its nature a high-profile activity with far-reaching consequences. BT's reputation is therefore very significantly defined by its consultancy successes, and many more consultancy opportunities are in the pipeline in the Asia Pacific region.

Africa
Africa is one of Telconsult's traditional territories and BT consultants have designed and project-managed the implementation of a number of very large networks across the continent, not just for national network operators but for major oil companies too. The emerging economies of places like Kenya, Zimbabwe, Tanzania and Nigeria (based on oil, minerals and tourism) indicate that Africa is an important centre of correspondent traffic.

Funding agencies, competitors and partners

Consultancy projects may be paid for either directly by the client or by a development (aid-funding) agency such as the World Bank. Projects are normally offered to consultancy firms through the mechanism of international competitive tendering and, as a rule, six or eight firms bid for each project, making the market very competitive indeed (see Figure 4).

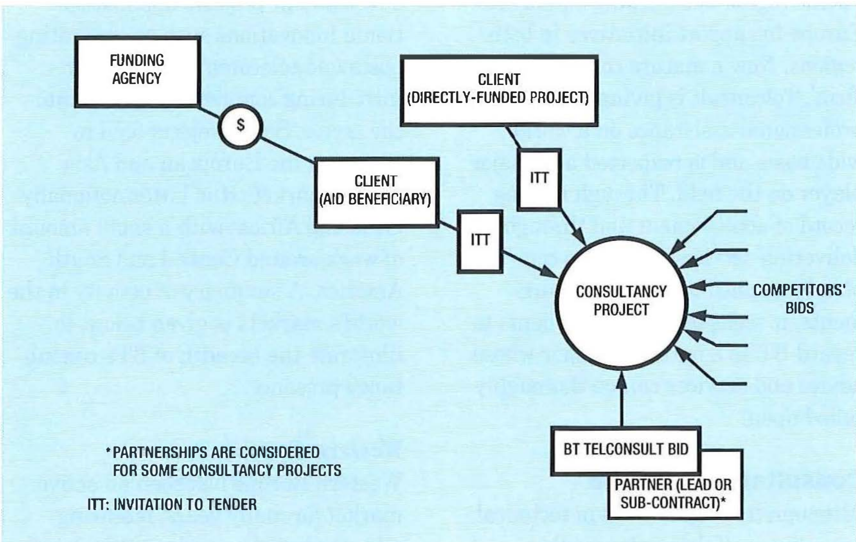
Some of the aid-funding agencies most often encountered are the International Bank for Reconstruction and Development (World Bank), the European Bank for Reconstruction and Development, the Commission of the European Community, the African Development Bank, the Asian Development Bank, the UK Overseas Development Agency, and the Commonwealth Fund for Development and Training. The richer nations and private companies generally fund their own projects, leaving aid-funding free to flow to state-run telecommunications undertakings in need of assistance with infrastructural and institutional development. Through consultancy contracts BT is able to establish a track record in aid-funded work which can be helpful in winning further work in most regions of the world.

Competitors in the field usually include the consultancy arms of the principal European network operators (for example, Swedtel from Sweden, Detecon from Germany, Sofrecom from France and Consultel from Italy) and, in the Pacific area, the Australian and Japanese consultancies, as well as firms such as Cable & Wireless, Arthur D Little, Ewbank Preece and other specialist consultancies. For management consultancy projects the well-known names of Touche Ross, KPMG Peat Marwick, Coopers & Lybrand, Price Waterhouse and so on will be among those on the bidders' lists.

On occasion, Telconsult will join forces with one or more of its competitors in a joint bid to win and run a project. The advantages of such associations lie in combining the strengths of the members of the partnership, and in the opportunity to observe how other players address the markets. The choice of which firm acts as lead contractor and which as sub-contractor depends on assessing the client's view of the partners' relative strengths in relation to the demands of the project. Thus, in recent work in Hungary, Telconsult acted as a specialist sub-contractor to Ernst & Young on an asset-valuation assignment, while in Mongolia Telconsult engaged Touche Ross as a sub-contractor for elements of an institutional and fundamental planning study.

One of the strongest benefits of performing consultancy assignments

Figure 4—Bidding for consultancy projects



is the chance to establish relationships at very senior level within client organisations and government departments (usually up to Boardroom or Ministerial level). The relationships are necessary for Telconsult fully to understand client requirements and aspirations and so deliver quality services but are valuable also as an opportunity to demonstrate BT's competence to very influential people.

Places and Projects

All of the locations in which Telconsult operates are interesting; many are exotic and some are very unusual. They have taught BT people how to make telecommunications systems work successfully in difficult terrain, how to deal with long supply lines, difficult logistics and differing legal systems, how to address commercialisation in varying political climates, how social and cultural factors affect the sector, and how to cope with civil war and natural disasters. In all, Telconsult has carried out over 500 consultancy assignments in around 80 different countries; some recent and current work locations are shown in Table 2.

A summary of recent projects, below, gives a flavour of BT's recent overseas consultancy activities. Figures 5–9 illustrate the locations and the work carried out there.

Table 2 Recent and Current Consultancy Locations

Angola	Ivory Coast	Qatar
Bangladesh	Kenya	Romania
Belgium	Lesotho	Russia
Bulgaria	Liberia	Sierra Leone
Cyprus	Libya	Slovakia
Czech Republic	Malawi	Swaziland
France	Malaysia	Tanzania
Gambia	Malta	Thailand
Ghana	Mauritius	Trinidad and Tobago
Gibraltar	Mongolia	Uganda
Greece	Nigeria	Ukraine
Guyana	Sultanate of Oman	West African Community
Hungary	Papua New Guinea	Yemen
Italy	Portugal	Zambia

Czech Republic and Slovakia: technical planning and institutional reform

By evaluating conflicting master plans we were able to point the way forward for a digital overlay network—an important step towards rapidly modernising a system that had been starved of investment. We are about to undertake extensive technical planning and project implementation work on behalf of both the Czech and Slovak authorities.

Our senior advisers are helping both authorities prepare the way for sectoral reform through separating posts and telecommunications and making preparations for commercialisation. We have also validated recommendations for a regulatory framework.

Hungary: preparation for competition

With the Hungarian Telecommunications Company's (HTC's) plans for modernisation already well under way, our experts have been assisting in tender preparation and bid evaluation for optical-fibre routes together with an access network to upgrade services. We have also helped the HTC make plans to introduce CCITT Signalling System No. 7 and ISDN.

On the commercial side we are advising the HTC on marketing policies and techniques designed to help the company address the market in the light of government proposals to license competing operators. Hand in hand with the advisory services is a training programme giving HTC people a good grounding in the principles of marketing.

Romania and Bulgaria: economic development

In Romania we are helping efforts to support economic growth by providing

Figure 5—Chief management consultant Brian Goulden, centre, on assignment in Taiwan

Figure 6—Human resources expert Bill Gibson with local reorganisation manager, Qatar

specially-tailored demand analyses and fundamental planning which will lead to high-quality networks for high-usage residential and business customers.

In Bulgaria we are taking part in a programme to separate posts and telecommunications and help the emerging telecommunications corporation to organise itself effectively within the changing market sector. Detailed technical, accounting and management support is being supplied to a local project implementation unit which is running the programme.

Greece and Cyprus: consultancy missions
As part of a European consultancy mission we devised a strategy to improve network provision and service quality in Greece. Now we are helping to implement the strategy.

Close by in the Mediterranean Sea, the Cyprus Telecommunications Authority identified a need for better manpower planning procedures which led to another detailed mission by our experts. Our proposals for using new human resourcing techniques have been accompanied by training courses for staff on the island.

Poland: network optimisation
We have recently been awarded an important contract to carry out a network development study designed to optimise the technical configuration of the evolving Polish network. The resulting technological gain will leapfrog what might formerly have been regarded as years of traditional network evolution.

Thailand: new network for Bangkok
Telconsult is providing the technical services that Thai company Telecom Asia needs in order to plan and procure a 2-million line network for the capital city Bangkok. For this immensely ambitious and important project we produced a network plan using innovative concepts to reduce cost and complexity and permit rapid implementation.

Subsequently we assisted in preparing specifications and letting contracts, and now have a number of experts seconded into Telecom Asia's line structure to assist with project management as the new network begins to offer service.

Bangladesh: long-term plan
In association with German consultants Lahmeyer International we have been providing the expertise needed to evaluate how the Bangladeshi network may be developed confidently in the longer term. Through setting out in a network master plan our detailed advice on architecture and implementation, we are providing guidelines for developing the switching, transmission and local-line elements of the network. We are also providing plans for routing, numbering, operations and maintenance, training, tariffs and billing.

Mongolia: sectoral development and master planning
Mongolia is a country reasserting its national identity and seeking to establish a basis for future economic development, a crucial component of which will be a sound telecommunications infrastructure. We have been assisting the Mongolian Telecommunications Authority on two fronts: master planning for the next 15–20 years, and a review of the vital sectoral and institutional issues.

A Telconsult team of ten consultants (including three experts from Touche Ross) carried out three months of field work in Mongolia, working with local staff before returning to the UK to develop recommendations. The result is a detailed technical development plan accompanied by proposals for reforming the telecommunications sector and reorganising the main operating entities.

For BT there is a bonus in working in Mongolia, in that funding flows from the Asian Development Bank, which is the major aid agency in the Asia Pacific region. Through the Mongolian project BT has been able to establish its credentials not only with the Mongolian authorities but with the Bank too.

Sultanate of Oman: major infrastructural expansion
Following a number of large-scale network projects over the years, work in the Sultanate of Oman has continued recently with massive expansion in the Muscat and Batinah regions together with the surrounding rural areas. Our experts have designed and project-managed the installation of switching and transmission equipment and external plant.

Similar work is set to continue in the Buraimi region, in which there will be a requirement to install optical-fibre routes over difficult terrain, using both buried and overhead cables.

Taiwan: security training
One of our senior consultants has recently delivered a series of seminars

Figure 7—Technical operations in Africa

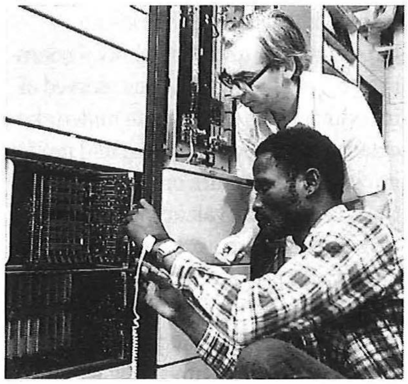
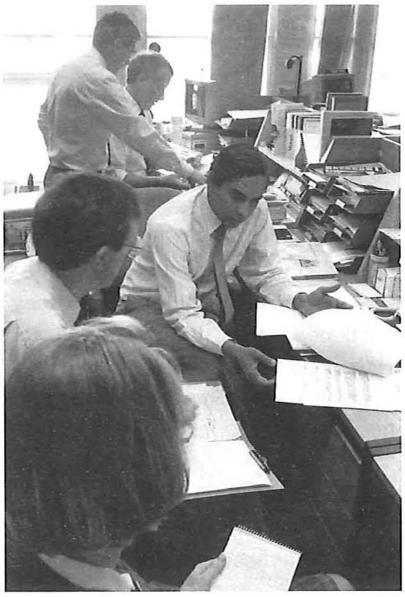


Figure 9—Project control office, Telconsult headquarters

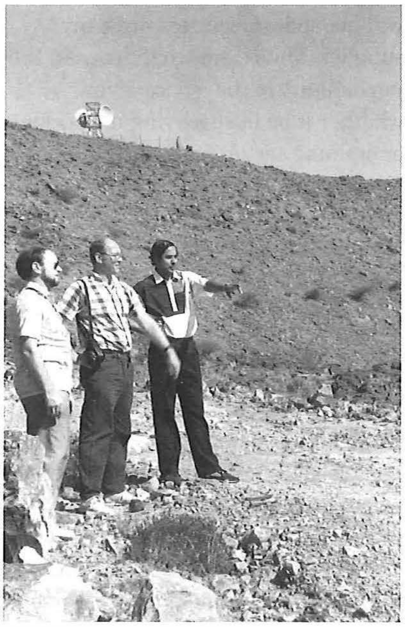


in Taiwan addressing aspects of security which affect a telecommunications company's operations. This consultancy illustrates the diverse nature of topics on which BT is approached for advice.

Malawi: wide-ranging rural communications upgrade

As long ago as 1984 the Republic of Malawi undertook a 2-year project to install a small number of UXD5 rural digital exchanges connected to main switching centres via 2 GHz digital radio links. Oversight of the installation, commissioning and maintenance was provided by Telconsult, and we continued to provide maintenance expertise and on-site training for a further two years. The success of the project persuaded the Malawi Post Office (MPO) to proceed with a much larger number of similar exchanges and radio links in 1988, to bring about significant improvements in rural communications and bring service to previously isolated villages. Again we provided project management as well as setting up an operations-and-maintenance organisation for the network. The project is now complete, and we concluded our extensive assignment by revising Malawi's comprehensive network plan and devising a new training strategy for MPO staff. This series of projects illustrates the value of consultancy in establishing and maintaining durable relationships with clients.

Figure 8—Pre-contract survey, Middle East



Kenya: restructuring appraisal

The Republic of Kenya is planning to reform its public enterprise sector and the Ministry of Finance asked Telconsult to consider restructuring postal and telecommunications services in the light of its plans. We reported on the potential performance of the Kenya Posts and Telecommunications Corporation (KPTC) within a commercial environment, the related issues of ownership and management, and the options for delivering services both by public enterprise and through private participation, and we produced a plan of action for meeting restructuring targets.

A team of three very experienced sectoral management consultants completed the study within six weeks, building on a knowledge of the KPTC gained through a year-long institutional development study of the corporation carried out by Telconsult and Price Waterhouse during 1988–89.

Nigeria: oil company communications and national network evolution

Following a feasibility study for the Nigerian National Petroleum Corporation (NNPC) we were able to advise on the technical and cost aspects of a statewide network in support of oil pipeline operations. Subsequently we helped to evaluate contractors' offers and then undertook the management of a 2½-year installation programme for optical-fibre routes, microwave hops, digital switches and mobile radio systems.

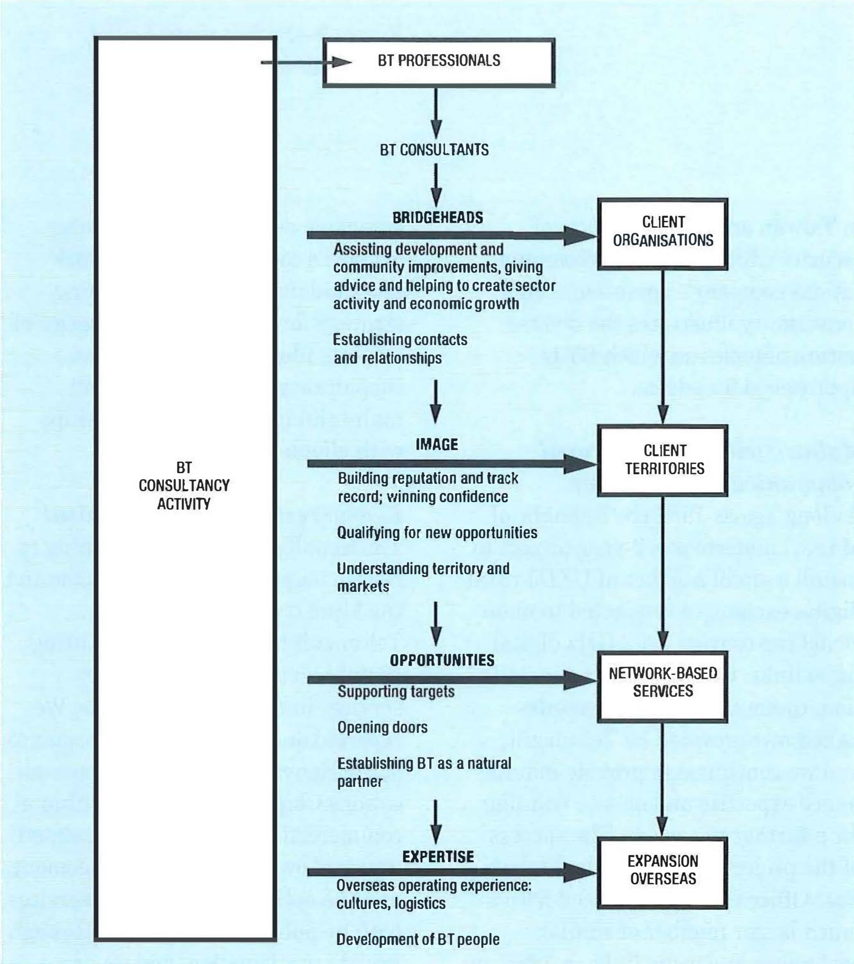
Design and supervision of a comprehensive operations-and-maintenance service followed, and its success led NNPC to decide recently to expand its network to embrace oil production in the eastern zones of Nigeria. We used computer-based evaluation tools to help NNPC select the best-value tender for the work, which entails difficult crossings of the Niger Delta and the use of advanced fibre technology to achieve unregenerated operation over sections of up to 200 km. The benefit, which is crucial to continuous oil pumping operations, will be a very high degree of reliability.

Also in Nigeria we have mobilised a consultancy team for a 3-year project on behalf of NITEL, the Nigerian Telecommunications Company. Six consultants will be working with NITEL's staff to implement a number of important network projects in Lagos and the main provincial centres, and improve NITEL's ability to plan and control its network. These objectives will be achieved principally through providing local staff with the guidance and technical advice they need for every stage of the work from network planning to warranty supervision, and will be helped by recommending appropriate departmental reorganisations. NITEL's engineers will be able to strengthen their own technological and project-management skills by taking responsibility for complex network expansion projects under the mentorship of a relatively small number of BT experts.

The Value of Consultancy

Given that consultancy tends to herald increases in network and sector activity, its importance becomes clear. Consultancy allows BT not only to offer expert assistance but to establish relationships, gain

Figure 10—Consultancy gains for BT and client



understanding and demonstrate its professionalism in a way that can be decisive in winning confidence in its other services: indeed later work may well depend on the quality of the bridgehead thus established (see Figure 10). The opportunities arising out of consultancy are:

- to get to know clients and offer much-needed assistance from a well-established base of expertise;
- to meet key people, understand the problems they face and win their confidence;
- to experience the cultural, logistical and technological factors affecting telecommunications in unfamiliar and developing territories, and apply BT's specialist knowledge to resolving problems within these demanding frameworks;
- to understand overseas market directions, establish a good reputation and a sound track record, and so pre-qualify for further work, perhaps opening doors for global network services and consolidating correspondent relationships;
- to understand competitor and partner behaviour;
- to give BT managers and professionals the chance to use their skills in important positions abroad, helping kindred organisations and preparing themselves for greater responsibilities in the context of BT's technical and commercial operations; and
- to help overseas administrations dismantle regulatory barriers.

Telconsult's influential position

Consultancy necessarily entails a close collaborative working relationship with key people in client organisations, be they multinational companies, overseas network operators or international funding institutions. Within these partnerships, BT is able to behave in a way which reinforces those characteristics that differentiate it from its competitors: its values, its resources, its services and its ability to work with customers to derive solutions. The resulting bond of trust may lead to enquiries for other services based on a mutual understanding of needs, and in that sense consultancy complements BT's commitment to growth outside the UK. Certainly a track record in successful consultancy encourages brand confidence and brand loyalty.

Conflicts of interest

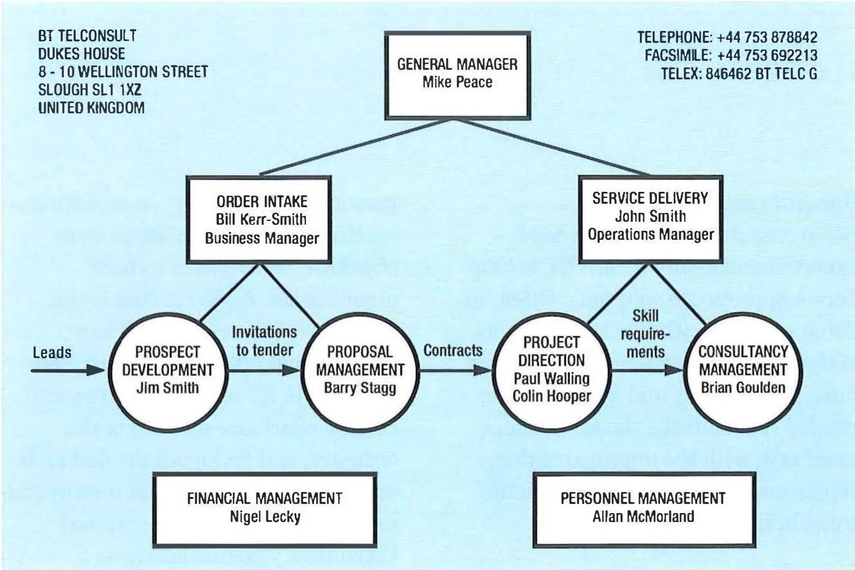
There are, however, potential conflicts of interest between consultancy work (which must be directed impartially at furthering clients' best interests) and the sale of network services where BT may have an interest in the client's choice of supplier: it cannot allow a privileged position in one area to be seen as prejudicial to giving service in the other either now or in the future. BT analyses these conflicts before bidding and decides which services to offer, and resolution of BT's position usually removes any reservations clients may also have about possible conflicts. Nonetheless BT does seek clear indications of client attitudes before proceeding with consultancy bids.

Once engaged as a consultant, BT takes a very clear view of its responsibilities and behaves scrupulously in its client's interests. Any services which may subsequently be bought in at the consultant's recommendation will not show favour towards any supplier. Thus client confidence in the impartiality of the advice given, whether it be in specifying networks or defining sector development, is absolutely respected.

Organisation of Consultancy

Telconsult is based at Dukes House in Slough, conveniently close to Heathrow airport and London itself. It maintains a small pool of permanent consultants each one of which is a specialist but, of the 90 or 100 consultants placed in overseas assignments each year, most come on temporary secondment from BT itself.

Figure 11—Telconsult organisation



There are project offices at all overseas locations where major projects are under way.

Telconsult's skill lies in planning, organising and managing overseas consultancy. To that end it is structured around winning and operating consultancy projects, as Figure 11 illustrates, addressing the four areas of prospect development, bid management, project direction and consultancy management.

Order intake

The prospect development team works closely with BT's regional sales organisations and maintains relationships with clients and the funding institutions to generate a steady flow of potential work. Prospects are carefully managed so that Telconsult submits bids in response to invitations most closely in tune with BT's business directions, and the best possible support is made available to clients. The international consultancy market is characterised by the virtually universal use of formal and comprehensive invitations to tender issued to short-listed companies, and firms are expected to respond with detailed written proposals which are then subjected to rigorous evaluation of both the technical solution and the commercial terms offered before a successful firm is selected to negotiate a contract.

For this reason, Telconsult operates a professional bidding group which brings together the unusual skills needed to prepare winning consultancy bids and which, with quality-based bid management techniques, has since its creation in 1987 improved Telconsult's win-rate from the ordinary to the outstanding, now consistently achieving well above 70%.

Service delivery

Live contracts are administered by project-control teams which deal with mobilisation and logistics, project plans and staffing, and project progress and financial performance.

Consultancy managers and consultants from Telconsult's own pool of specialists assist the project controllers in making the right skills available, and themselves carry out consultancy duties in the field.

Accounting and personnel management

The particular demands of costing, billing and producing management information in the context of international consultancy work are handled by an in-house accountancy team, although it has reporting links with Telconsult's parent regional finance structure. Similarly, a small on-site personnel unit deals with the issues surrounding consultants' foreign service contracts, covering selection, engagement, medical services and so on.

Telconsult is a Lloyd's Register Quality Company

Quality management

Telconsult is a Lloyd's Register Quality Company, committed to achieving quality in all consultancy activities. Its quality management system won approval against international quality standard ISO 9001 during 1992.

The system is firmly based on corporate BT quality management procedures which have been expanded and focused onto activity in the international consultancy market. This gives it some unique features which have led to the system being identified by the name *Quaesitor*, which is a service mark of British Telecommunications plc.

BT's consultants

Project staffing is one of Telconsult's most important activities. With consultancy assignments covering the whole range of telecommunications knowledge, and potentially over 150 000 experts to call upon in BT, the task of matching people to clients is one which requires considerable precision. The primary source of experts is Telconsult's own in-house pool of consultants but this is relatively small and heavily committed. In any case the purpose of Telconsult is to make BT's expertise as a whole available to the world and there are four main methods of doing so, set out below.

Consultants' register

People who have previously worked on Telconsult assignments, or who have expressed an interest in doing so, are registered and, as such, can be considered automatically for consultancy opportunities. Clients often require consultants to have had previous experience of consultancy work, and the advantage of the register is that appropriate experience can be incrementally added to consultants' CVs. Generally, people on the register offer a specialist skill together with significant relevant experience which reassures clients about the professional nature and depth of assistance they can expect to receive.

Special recommendation
Some consultancy problems need expert departments within BT to help derive appropriate solutions. Often, in doing so, one or other of the members of these departments reveal that they have the qualities and qualifications needed to undertake the assignment itself and, with the approval of their senior managers, are able to join the consultancy team overseas.

Internal advertisement
Long-term contracts abroad are generally advertised internally and consequently entail appropriate selection procedures.

Skillbase and associate consultants
Some consultants are placed through Skillbase, an organisation holding a register of skills available through BT's professional release schemes, or from a small number of associate consultants, usually senior BT people who have left the company and now work as freelance consultants.

Appointment of consultants

Consultancy assignments can range from a few weeks in duration to several years, although they generally tend not to exceed around three or four months. BT consultants are given contracts which reflect the impact of their tour of duty upon their day-to-day lives and, depending on the duration of their assignments, consultants may either be on loan from their home units, or on secondment to Telconsult, or transferred to Telconsult. Advantages usually include tax benefits accruing from working abroad, premiums for foreign service and right of return to the home unit.

Personal benefit

The major advantage for BT people joining a consultancy team abroad is the personal development which accrues, which benefits both BT and the person undertaking the assignment. Generally, such assignments demand a considerable level of personal responsibility in achieving specific technical or management objectives on behalf of a client organisation. Added to that is the experience of working with key decision-makers in an organisation different to BT and in a country and culture which are also out of the ordinary, and facing all the demands on personal resilience and resourcefulness that are inevitably involved. Consultancy means acting as a conduit for BT's professional services and upholding BT's reputation, and success in a consultancy position is therefore confirmation of unusual personal qualities. In addition, considerable satisfaction comes from using professional skills to help a kindred organisation resolve problems which could have national and lasting implications. Overseas assignments are reckoned to enhance careers in the view of 72% of the people who undertake them, and BT has in place a corporate international assignment policy which recognises the needs of those working abroad.

Consultancy gives overseas clients direct access to BT's core skills

Consultancy Achievements

Over the 15 years it has been operating, Telconsult has achieved:

- network expansion and modernisation on a large scale on several continents for telecommunications administrations and major private companies, leading to community improvements, revenue generation and economic growth for client countries;
- extensive training to equip clients with skills to operate their business and their evolving networks successfully;
- improvements in operations and services all over the world in line with current best practices;
- organisational development and sectoral innovation leading to more effective commercial operation and greater sectoral freedom in a number of telecommunications environments;
- advanced technology solutions on a regional basis in the developed world, especially in Europe; and
- groundwork for BT's investments in Gibraltar and Belize.

These achievements have gained for BT a significant reputation for professional competence and high standards. Consultancy activities have thus been helping BT to gain footholds and get to know new customers, as well as making life easier for communities all over the world.

There is a great deal of consultancy business in the telecommunications market, often as a precursor to demands for greater network-based services, new operational opportunities and enhanced traffic streams. Telconsult's turnover doubled in the last financial year, reflecting growing activity especially in Central and Eastern Europe and the Asia Pacific region.

Consultancy gives overseas clients direct access to BT's core skills—in network technology and sector management—at the time when clients themselves are making important decisions about telecommunications and need the best possible advice and assistance. Consultancy brings decision-makers into direct contact with BT. It influences events and courses of action on both corporate and national scales and gives BT people unparalleled chances for self-development. Consultancy depends for its success on close collaboration between consultants and key members of client organisations and therefore represents the opportunity to make an immensely important good first impression at very senior level. It helps to build up a mutual understanding of clients' real needs. Trust engendered at such times, when clients are in most need of solid support in their very own best interests, is invaluable in providing reassurances about working with BT in all spheres of telecommunications activity.

Through its consultancy work over the past 15 years, BT has been able to demonstrate to the world the full value and professionalism of its services, laying down foundations which have materially supported its emergence as a worldwide company offering integrated network services on a global scale. Consultancy continues to open doors, allowing BT and its customers to get to know each other, and enhancing BT's references around the world. For many years now, overseas administrations and companies have turned to BT for assistance and they have been helped in no small measure. They will continue to look for sound advice and, the more they learn about BT, the more they will be encouraged to return for all their telecommunications needs.

Biographies

Mike Peace
BT Telconsult

Mike Peace, Telconsult's General Manager, is responsible for BT's consultancy work worldwide. He has been involved with Telconsult since its inception in 1978, after a career in transmission research and planning. Mike graduated with honours from the University of Southampton in 1967 and carried out research into optical-fibre transmission at BT's research laboratories before becoming responsible for expenditure and investment for the UK's main transmission network. He planned 60 MHz coaxial cable systems and the experimental trunk waveguide system. When BT won a major transmission consultancy project abroad in 1978, he organised the consultancy work—a move which led to the creation of Telconsult. He later took charge of all consultancy projects in Africa and Europe before becoming BT's regional director for Far East ventures. In 1986, he was appointed General Manager of Telconsult. He is also a director of the European Telecommunications Consultancy Organisation.

Barry Stagg
BT Telconsult

Barry Stagg leads Telconsult's team of Proposal Managers whose task is to win consultancy business through competitive bidding for contracts which may individually be valued up to several million pounds sterling. Barry, a Chartered Engineer, joined BT's headquarters staff from Reading Telephone Area in 1970, as part of the team looking after serviceability in the trunk network. In 1973, he become one of the first full-time editors of the then *Post Office Electrical Engineers' Journal* (now *British Telecommunications Engineering*) before moving on to System X definition work. From 1980–85 he represented BT at the British Standards forum dealing with connection of apparatus to the network under the liberalisation regime, taking special responsibility for core PSTN compatibility requirements and the performance of the simple telephone, loudspeaking telephone and automatic calling and answering apparatus. After publication of the standards he went on to study signalling interworking in the evolving digital network, and network performance in relation to the quality of service perceived by customers. He was appointed as Telconsult's Senior Proposal Manager in 1987, to create a professional bidding team capable of addressing the consultancy market. He has brought together a number of different disciplines and techniques directed at achieving high win-rates and was one of the chief architects of Telconsult's quality management system. He also looks after Telconsult's marketing and sales publications.

Tony Rybacki and Graham Warren

BT Broadcast and Satellite Services

Communications is at the core of the broadcasting business, and BT Broadcast and Satellite Services plays an essential role in meeting the transmission needs of British and international radio and television broadcasters. This article, part of a series in the Journal on visual and broadcast services, reviews this highly competitive market, describing some of the services offered, and discusses the impact being made by new technology.

Introduction

Billions of people around the world rely on television and radio broadcasts for information, entertainment, education and to provide a pleasant background to their everyday activities. For others in government and commerce the broadcast media are essential to enable them to inform and sell. In the late twentieth century it is impossible to contemplate the idea of the world without radio and television.

Yet the sounds and pictures that come from loudspeaker or screen follow a long journey from the studios where they were created; for many the path they follow is provided by BT. All follow routes that have been especially created for them.

Whatever the route these signals follow, one thing is certain, without the telecommunications expertise of BT Broadcast and Satellite Services there would probably be very little broadcasting—for communications is at the core of the broadcasters' business.

The Business

BT Broadcast and Satellite Services (BSS) is part of BT Visual and Broadcast Services. As a business unit it is specifically concerned with the needs of a specialist market and is focused on the requirements of both British and international radio and television broadcasters. Those needs are exacting, since without the ability to link studio to transmitter or newsgatherer to studio, the broadcaster has no business.

The group provides services which are product managed by four business units:

The first is Inland Television, which is concerned with terrestrial circuits and networking solutions for established broadcasters based in the UK such as the BBC, Channel 4, and the ITV companies and facilities companies.

The second unit specialises in Radio. This unit provides stations with terrestrial circuits and network solutions, mostly dealing with independent local radio stations and national stations, providing many services to the BBC.

These two units mainly provide permanent links for their customers.

A third business unit has a name which is to a large degree self explanatory: the Temporary Broadcast Services Unit. This unit is subdivided into two product areas: one to provide facilities for outside and location TV and radio broadcasts within the UK and the other for International Occasional Use services via satellite.

Lastly, the largest of the four business units is devoted to International TV. It mainly provides facilities for the new wave of broadcasters—some of them global; some of them, like BSkyB, broadcasting directly from satellites to viewers' homes; some delivering programmes for onward distribution by cable television network companies. Customers include companies such as BSkyB, MTV, ScanSat and the BBC World Service Television. All use satellite communications, although there is a distinction between the direct-to-home broadcasters and those working to supply cable. The latter can use larger receive dishes and so can work with lower power satellite signals.

Although all these business units serve different needs, essentially the 'product' is the same. In all cases, BT

The whole group is a 'transmission systems integrator', reselling bandwidth and adding value with the application of specialised equipment required to establish and manage a link.

Broadcast and Satellite Services is selling transmission capability—a combination of bandwidth and time, based on 30 years' experience and expertise in building links between points on the globe to special order and to the special requirements of a particular broadcaster. The whole group is a 'transmission systems integrator', reselling bandwidth and at the same time adding value with the application of specialised equipment required to establish and manage a link.

The way in which the capacity is sold can range from a minimum 10 minute time-slot on a satellite transponder for a point-to-point occasional-use satellite link to a 10 year deal to provide terrestrial circuits with 99·98% reliability.

A significant portion of the unit's turnover derives from international communications. The unit buys transponder capacity from satellite consortia and combines this with earth station solutions supplied via BT Worldwide Networks. A solution is engineered in line with the customer's overall transmission needs.

Competitive Environment

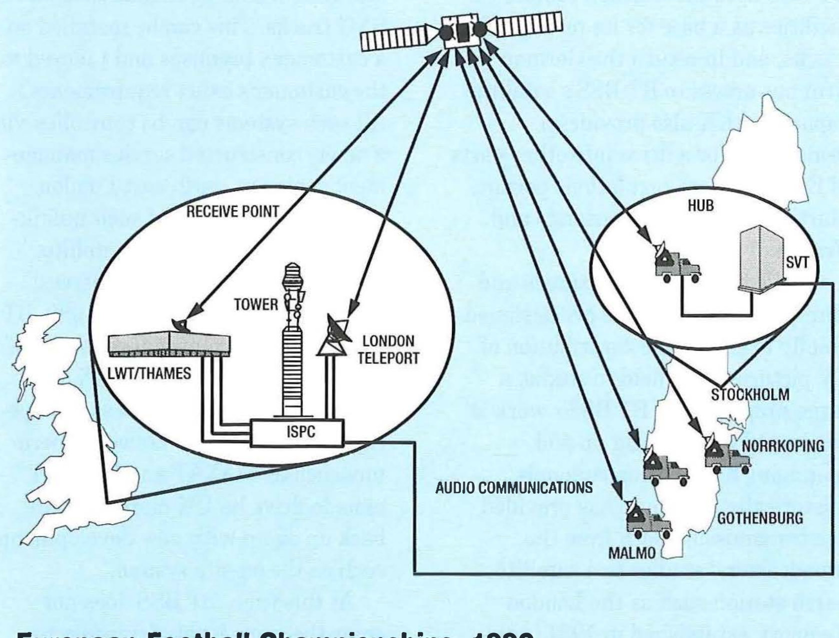
Increasingly the provision of these services is becoming a highly competitive business and attention is increasingly focusing on price and quality. To a large extent it is deregulation that has altered the landscape for Broadcast and Satellite Services.

In the UK, for example, the Government's decision in 1991 to introduce a Class Licence to replace the Specialised Satellite Service Operators' Licence (introduced only two years before) has established the freedom for any organisation to operate its own earth station. At the same time, the implementation of the Signatory Affairs Office within BT has allowed third parties that would historically have been captive customers of BT to make their own arrangements for the purchase of satellite capacity. As with many other areas of telecommunications, the provision of broadcast communications links is no longer, at least for the UK, a market jealously guarded by a PTT or national monopoly operator.

But the new competitive environment brings with it many opportunities. Whereas in the past BT BSS would have been constrained to operate within the territorial limits of the UK, it now has some freedom to operate overseas. Alternatively, it is possible to form alliances with independent operators.

A good example of the latter is Atlantic Express—an 'occasional use' product for temporary broadcast links that US-based broadcasters can use for *contribution* services; that is, for news gathering.

Atlantic Express is the result of a service partnership formed with US-based IDB Communications. It provides dedicated satellite capacity for setting up complete end-to-end two-way transatlantic services using dedicated satellite capacity on INTELSAT VI flight 4 at 332·5° East. It can arrange uplinks from London Telecom Tower or other European locations direct to the USA, using transportable earth stations or via the local PTT where necessary. In the USA, the main receiving Teleport is IDB New York, with access to Washington or any major US destination. The service can operate in either direction, from the UK or



European Football Championships, 1992

Continuing its innovative approach to sports coverage, British commercial broadcasters ITV Sport aimed to bring the British viewing public closer to its national teams competing at The 1992 European Football Championships in Sweden.

Rather than providing the normal remote coverage from a studio in London with feeds from stadiums for live coverage of the games, ITV Sport teamed up with BT to move all its football programmes to Sweden for the two weeks of the tournament.

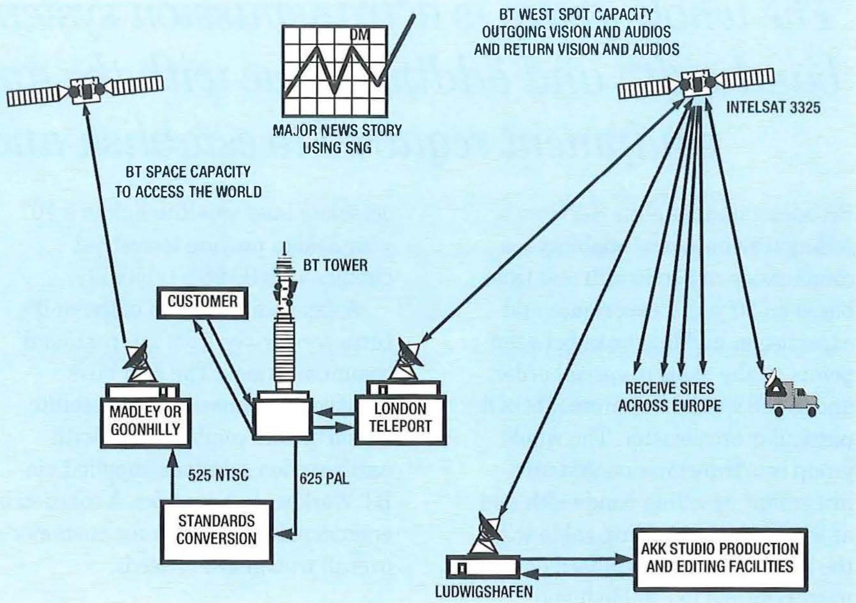
BT deployed four satellite news-gathering terminals in Sweden to establish a bespoke satellite network hubbed at the host broadcaster's headquarters in Stockholm.

Prime-time audiences of over 12 million were offered 184 hours of football programming, including live and recorded coverage, transmitted via BT's satellite network.

BT in Europe

BT's cooperation agreement with German broadcast production company AKK enables UK and European broadcasters to expand their coverage of international news and sports from a base in mainland Europe. The combination of AKK's resources with BT offers studio production, editing and satellite link facilities and provides access throughout Europe.

In Germany, broadcasters can access the German Video Broadcast Network to reach Ludwigshafen and then use the BT permanent fixed satellite earth station for onward transmission. In addition, BT has also deployed a full-time satellite news-gathering terminal.



Europe to the USA, or from the USA to the UK or Europe.

Atlantic Express is one example in the satellite sector where the group has had an impact creating a completely new service based on a new alliance. In another, but complementary, sector, satellite news gathering (SNG), BT BSS is taking advantage of regulatory changes in Europe.

Although mainland Europe still has a way to go before deregulation has been carried through to the same extent that it has in the UK, the environment is becoming more free. In particular, Germany, France and the Netherlands provide opportunities for an exciting operation in the provision of ad hoc occasional use services. Already, BT BSS has a small fleet of trucks based in Ludwigshafen in Germany, and these allow it to provide an SNG service for German and other broadcasters. For example, for sports or 'hot' news events, the TV companies can book the trucks to provide mobile uplinks. The truck will arrive on site, deploy its antenna, align it with the appropriate satellite and the TV company can then plug in its cameras and begin sending pictures. The service is proving popular: a single truck carried out no less than 28 SNG assignments during June 1993.

Now the group is negotiating with a number of German and other European broadcasters for more permanent relationships in the form of long-term contracts rather than purely working on an ad hoc basis.

This service in Germany is another example of a collaboration with a national company, in this case a production company, AKK. The arrangement is one of mutual benefit: BT BSS uses the German company's facilities as a base for its roving SNG trucks, and in return the German firm has access to BT BSS's satellite capacity. AKK also provides a bridgehead for a drive into other parts of Europe where regulations permit, starting with the Netherlands and France.

While both Atlantic Express and European SNG services are designed chiefly to enable the contribution of TV pictures from field to studio, a large proportion of BT BSS's work is concerned with setting up and managing distribution channels. Historically the group has provided the transmission path from the broadcasters' studios to a satellite earth station such as the London Teleport, established in 1984 in the Docklands area to the east of London, or to other BT Earth stations at Goonhilly and Madley.

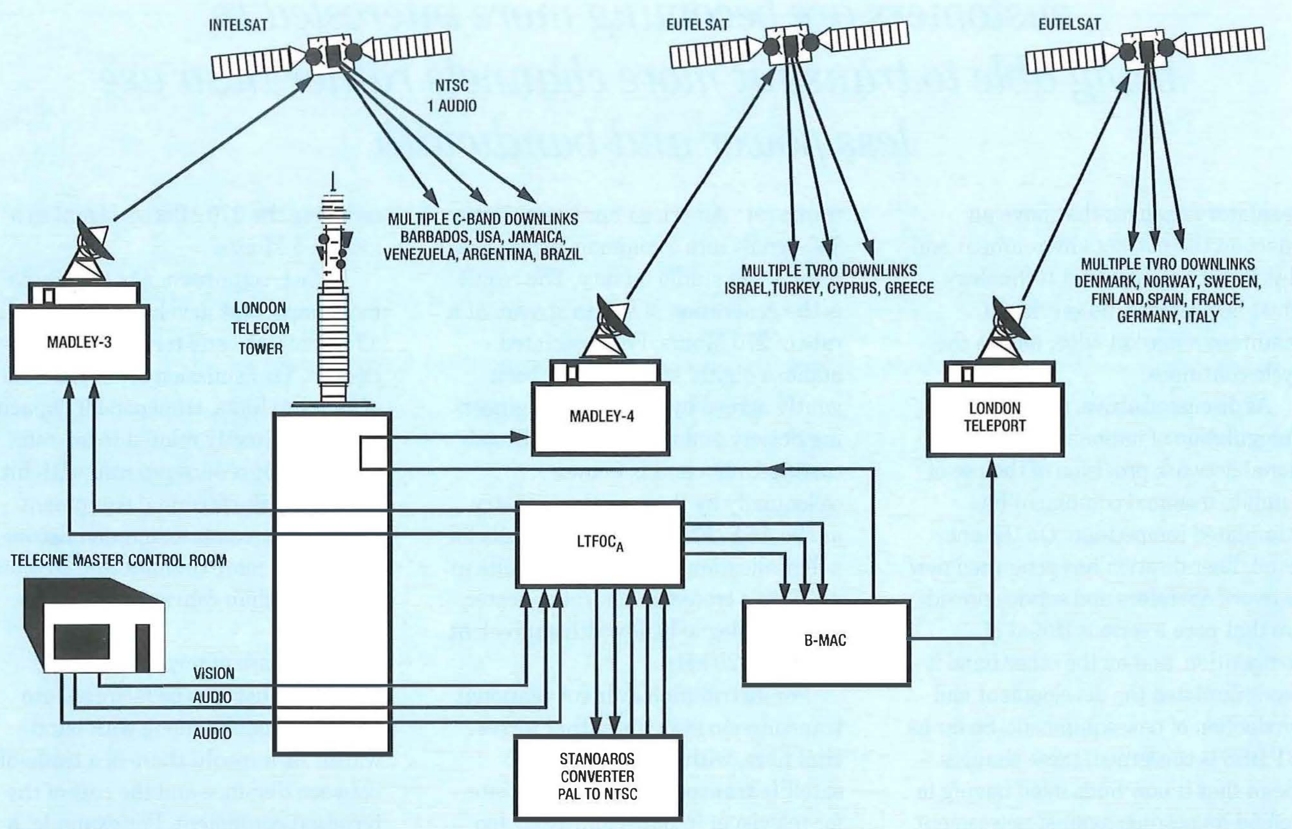
The group still maintains a very high share of the UK market for uplink services. To serve this market, BT BSS operates some 38 uplink channels. Many of these are now used by broadcasters that require transmission directly from the satellite to customers' homes in the UK and Europe.

But here too, regulatory changes are beginning to have their effects.

In particular, broadcasters are now able to erect uplink antennas on their own sites, bypassing fixed terrestrial landline, microwave transmission systems and centralised Teleport facilities. To meet new demand, BT BSS offers a modular on-site system similar to that used on its SNG trucks. This can be installed on a customer's premises and tailored to the customer's exact requirements. All such systems can be controlled via a newly constructed service management centre in south east London.

It is the provision of such uplink-only systems, to access a satellite, where competition is at its fiercest. From a virtual monopoly in 1989, BT can target a current market share of around 60% to 70% in the UK for Astra 1C uplinking business. Competition has come from network operators such as MAXAT and NTL. BT aims to drive its UK market share back up again with new developments such as the on-site system.

At this time, BT BSS does not enjoy the same level of freedom to operate in the home territories of its rivals. Nevertheless, there are signs of change, and the group has an aggressive plan to redress the market balance as liberalisation gathers pace elsewhere in Europe. Its first success has been in Germany, where it has been granted a licence to provide permanent uplink facilities. At present, France is a market denied by regulations prohibiting BT from providing 24 hour uplink satellite distribution services. But there is hope that situation may soon change. In the longer term, the group is



Premier League Football

BT Visual and Broadcast Services was contracted by sports distributing giant CSI to provide a worldwide audience with exclusive coverage of the English Premier League football championships, which took place for the first time in August 1992. The Premier League comprises the top clubs in English football, whose matches attract an avid overseas following.

BT's communications network included transmissions from two earth stations using INTELSAT and EUTELSAT satellites, which provided comprehensive coverage to The Americas, Central Europe and the Mediterranean.

BT is one of the few companies capable of assembling such a complex and extensive network operation.

convinced that its experience, longer than almost any other principal network operator, will pay off and that it will gain a significant share of the total European uplink market.

Like core BT, BSS has a bold strategy which aims to encompass the globe and to exploit new BT relationships—with MCI in the USA for example.

The Asia Pacific market is also being examined in detail. BT has options for potential capacity on the Asia Sat II satellite, which is planned to be operational by March 1995.

Buying satellite capacity is a business where experience and shrewd business judgement are required. In each region, there normally emerges a particular orbital location that is pre-eminent. For example, in Europe the Societé Européenne des Satellites (SES) with its Astra satellites has pole position in the European direct-to-home market. Once a location is embedded, it becomes what is known in the business as a *neighbourhood*; there is then always contention from other operators to establish their satellites to compete with the *hot bird*.

There are two ways of buying satellite capacity. One way is to contract for a long-term lease for maybe 1, 3, 5, 7 or 10 years and establish a service for a user. Such leases are generally used for 24 hour/ day services. The other way (normally for occasional use TV) is to take ad hoc space only, making a booking with a satellite operator for the ten minutes or so when there is a customer request. But, as with Atlantic Express, an end-to-end service is best launched on a full-time lease that is owned jointly with a service partner. BT BSS operates both types of service.

Succeeding in the '10 minutes slot business' requires retailing skills and skills in knowing who to contact to set transmissions up. BSS has a special events unit that knows whom to turn to—which carriers can help and who has what—spotting satellite capacity that is appropriate, available, and has an advantage over what the competition is offering. The time taken for all these stages—designing a link from A to B for a customer, defining the requirement, finding capacity availability, costing, bidding and implementation—can be very short.

Technology

In virtually all areas of telecommunications, the interlocking and interaction of regulation, market forces and technology is so firm that changes in one are reflected inevitably in the others. The delivery of broadcast services is no exception. The emergence of new technologies allows people to do things that stimulate *customers are becoming more interested in being able to transmit more channels rather than use less power and bandwidth*

regulatory changes that have an effect on the market environment and this in turn means that technology must be pressed into service to maintain a market edge, and so the cycle continues.

As discussed above, the deregulation of national and international network provision of the use of satellite terminal equipment has stimulated competition. On the one hand, liberalisation has generated new network operators and service providers that pose a serious threat of competition, and on the other hand it has stimulated the development and production of new equipment. So far as BT BSS is concerned, these changes mean that it now finds itself having to defend its position against newcomers, while at the same time finding that it has the opportunity to move aggressively into new market areas.

Fortunately the group has access to new technologies which it can deploy to its advantage in both the defence of its existing markets and in its attack on new ones. To be successful in both attack and defence, though, it has to employ these new techniques in such a manner as to make it better than the competition—better in the sense of offering more value for money, better in terms of reliability, speed and quality of service, and better in being able to offer new services that rivals are unable to bring to market so quickly.

Currently, the two most-significant areas of work centre on the increasing use of digital transmission techniques. These are on the one hand the compression of signals so that more can be squeezed into existing channel bandwidth. The other is the reverse, the ability to transport, without degradation, signals at extremely high data rates. Both start with the definition of international standards for the conversion of both radio and television signals from their natural analogue form into digital bit streams. In the case of television that standard is CCIR Recommendation 601*.

This defines a standard method of digitising both 625 line 50 Hz frame rate European and 525 line 60 Hz frame rate American analogue colour TV signals into a common format that retains full studio quality. The result is the generation of a data stream at a rate of 270 Mbit/s. For associated audio, a digital standard has been jointly agreed by the Audio Engineering Society and the European Broadcasting Union and is known colloquially by those in the industry as the *AES/EBU* standard. It calls for a digitalisation process that results in a 3 Mbit/s transmission rate to cater for an analogue bandwidth equivalent of around 20 kHz.

For distribution over conventional transmission systems, either terrestrial fibre, with line systems, or satellite transponders, the data rate for television in particular is far too high. However, once the signals are in digital form, then they can be subject to a variety of signal processing techniques, the most valuable of which is *compression*. Not only does compression allow the broadband signals to be carried over standard transmission systems, but it also allows for adaptation to fit with the bit rate hierarchies associated with existing digital trunk transmission systems.

The normal bit rate for standard PAL TV signals tends to be 140 Mbit/s without compression. However, that can be compressed at a ratio of 4:1 so that it can use a 34 Mbit/s trunk distribution system based on standard transmission equipment. That is the approach adopted by BT BSS for a nationwide digital distribution network it has designed and now manages for one of the UK's independent TV broadcasters, Channel 4.

But the real advantages of compression will be fully realisable with the implementation of a soon-to-be ratified international standard device by the Motion Pictures Experts Group (MPEG) of the International Standards Organisation (ISO). The MPEG 2 standard has been agreed as the standard that will be used by broadcasters worldwide for compressing CCIR 601 digital television signals. Applied to its limit it is capable of reducing the 270 Mbits/s signal to a mere 1·5 Mbit/s.

In fact, compression is the single most important development that will affect satellite and terrestrial broadcasters. Transmission or, in the case of satellite links, transponder capacity costs are directly related to bit-rate. Costs do not reduce *pro rata* with bit rate, since the terminal equipment required for compression and decompression is more complex and so more expensive than conventional equipment.

In the case of terrestrial links, distance must also be factored into the cost equation along with bandwidth. As a result, there is a trade-off between distance and the cost of the terminal equipment. For example, a 34 Mbit/s compressed circuit only shows a cost advantage over a full 140 Mbit/s line where the end-to-end distance is above 60 km. However, developments in codec technology are such that distance may be reduced substantially in the near future.

An alternative view of this equation is to look at the economics of retaining a full bandwidth link, but increasing its revenue-earning payload capacity by using it to carry four separate compressed signals. That approach may be more beneficial for satellite systems where distance is not so critical as transponder power and capacity. Again there are two possible ways to use compression. One is to use the same amount of power and bandwidth to carry a greater number of video channels; the other is to use a lot less power for the same number of channels and reduce the cost of the link. However, BT BSS is finding that its customers are becoming more interested in being able to transmit more channels rather than use less power and bandwidth.

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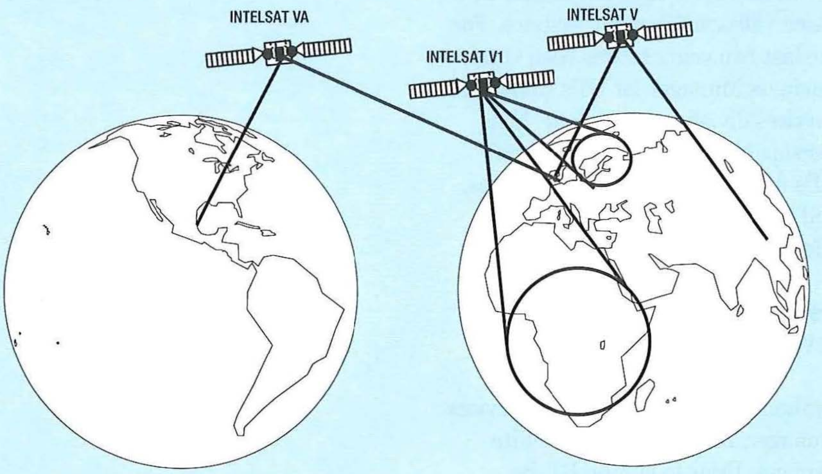
* Since the standard was formulated, the International Telecommunications Union has reorganised its committee structure. Strictly speaking therefore the CCIR is no longer current.

BBC World Service to Africa
BT provides MNET with capacity on INTELSAT V1 f-1 at 332·5°E for the BBC to provide programming for distribution throughout Africa.

BBC World Service to Hong Kong
BT provides Star TV with capacity on INTELSAT V f-7 at 57°E for a point-to-point contribution lease. BBC provides programming for Star TV to re-uplink as part of its bouquet of channels on Asiasat.

BBC World Service to Scandinavia
BT provides BBC World Service with capacity on INTELSAT V1 f-1 at 332·5°E. The BBC programme is distributed to cable head-ends throughout Scandinavia.

BBC World Services to Canada
BT provides the BBC with the link to Canada on INTELSAT VA f-13 at 307°E. CBC Newsworld then incorporates the BBC material into their programming.



BT BSS is at the forefront in the deployment of compression systems. It has just installed what is perhaps the first system to be used on a global scale for the BBC's World Television Service. This uses a system, known as *Digicipher*, that was developed by Jerrold division of General Instrument Corp. Although the system is in advance of the ratification of an international standard, it is finding acceptance in the North American market.

The system became operational in September 1993, and will give the BBC compatibility with local distributors in Canada and the USA. It will subsequently allow the BBC's signals to be relayed from the West Coast of North America and across the Pacific to complete destinations such as Australia and New Zealand. BT BSS already uplinks the WSTV to Hong Kong and anticipates the introduction of compression on this service in the near future.

Although the GI Digicipher system has been chosen for the BBC World TV Service, BT BSS is currently examining several other systems for specific customers. However, in order to benefit from economies of scale, in the longer term it expects to standardise on one system that complies with the M-PEG 2 standard.

One of the advantages of full MPEG 2 compliance, and a facility offered by the Digicipher system, is the ability to adjust compression levels to optimise the number of video channels in use depending on the application. At maximum compression, a standard 39 Mbit/s satellite channel or a 34 Mbit/s terrestrial link can accommodate up to ten simultaneous TV programmes together with forward error correction and other data required for controlling or metering pay-per-view or other service systems.

The penalty is a potential degradation of picture quality at the equivalent of 1·5 Mbit/s per channel. With conventional PAL or NTSC, picture quality depended on the quality of the transmission line; now with compression, picture quality is very much a function of its content. Pictures with a lot of fine details or movement, such as the coverage of sporting events, will suffer most, while those with a more static content will fare best. So the service provider must be able to adjust the bandwidth and vary the level of compression to meet the demands of its customers and their customers.

At the other end of the scale, production companies have a totally different requirement. In order to be able to edit TV pictures and retain the very highest quality they need the full 270 Mbit/s bandwidth available from a picture encoded to CCIR 601 standards. At this end of the chain, there is a whole raft of facilities companies that specialise in making and editing programs which they need to be able to distribute to the broadcasters. At present, telecommunications links do not provide an adequate interface for these very high bandwidth signals to be carried. As a result the facilities companies prefer to have their tapes hand carried by couriers between their studios and those of the broadcasters.

However, BT BSS has a solution at hand for at least the several hundred facilities companies that operate primarily in London. The group plans to offer a service called *Facility Line*.

This will use fibre to link facilities customers' premises with wide-band cross-connect switches controlled remotely from BSS' 24 hour service management centre. Using codecs specially developed by BT, BSS will then be able to provide the studios with an essentially transparent delivery mechanism for Recommendation 601 signals.

The Facility Line project is just one aspect of the work being carried out to provide transmission of broadcaster studio signals over BT's terrestrial network. BSS has now agreed a specification code operating at 140 Mbit/s that can support all types of studio interface and transcode from one standard to another in the codec while maintaining contribution quality.

Future

In the longer term, the introduction of advance networks such as synchronous digital hierarchy (SDH) systems open up the prospect of using BT's regular network as a distribution system for broadcasters of CCIR 601 or high-definition TV programmes. Already coding evaluation and tendering processes are in hand to assess how the new high rate codecs will fit in with SDH equipment. This process is expected to lead to first live trials in 1994. If these prove successful a commercial service may be viable for 1996 or 1997.

Biographies

Tony Rybacki
BT Visual and Broadcast Services

Tony Rybacki is Group Business Manager, Broadcast Services. He began his career in the publishing industry and worked in advertising before joining BT. With BT, he has worked on the development of Europe's first regional satellite and direct-to-home INTELSAT and EUTELSAT services, and then on PC-based videoconferencing systems. For the last two years he has been Group Business Manager for BT's Broadcast Services division. In this role, he is responsible for the profitability of BT's full range of broadcast services, and for terms on which services are offered.

Graham Warren
BT Visual and Broadcast Services

Graham Warren is Technical Services Manager, Broadcast and Satellite Services. Prior to joining BT, he designed specialised radio transmitters. He joined BT as a satellite system engineer, specialising in broadcasting applications. He has carried out extensive work in the fields of video technology, digital compression and network design. In 1991, he assumed overall engineering responsibility for BSS' portfolio of products, which include terrestrial vision and sound services.

Mike Andrews, M. Asif Anwar, Roger Cole, and Guy Reiffer

BT Northern Ireland STAR SDH Network—NISTAR

The July 1991 issue of the Journal contained articles on the new transmission technology known as synchronous digital hierarchy (SDH). This article describes the first use of SDH in the BT network, in Northern Ireland.

Introduction

Synchronous digital hierarchy (SDH) is a new transmission method being defined by the relevant international standards bodies; namely, ITU-Telecommunications Standardisation (formerly CCITT) and the European Telecommunications Standards Institute (ETSI). As the standards have progressed, several operators, including BT, have implemented trials of the technology, and with the maturing of the standards many operators, again including BT, have well-advanced plans for full operational deployment of networks using technology based upon SDH principles. BT, however, in addition to the trials, has already been carrying live operational traffic on its network over SDH equipment for more than six months.

In late 1990, as the final stage of a part EC-funded project known as *STAR* (Special Telecommunications Action for Regional development), BT Northern Ireland chose to implement a network of SDH equipment in the province. At the time the project was planned, it was the first implementation of SDH intended from the start to be operational, rather than a trial, and even now there are few, if any, operational networks of SDH equipment of the size or complexity of the NISTAR SDH network.

SDH provides remotely managed, high-availability transport of digital signals. It offers fast and flexible provisioning, comprehensive protection mechanisms and integral end-to-end performance monitoring together with other management features. SDH is due to take over the role currently provided by plesiochronous digital hierarchy (PDH) transmission systems and is designed to overcome the limitations inherent in such systems.

The Network

The network (Figure 1) consists of three rings of STM-1 *add/drop*

Figure 1—NISTAR network

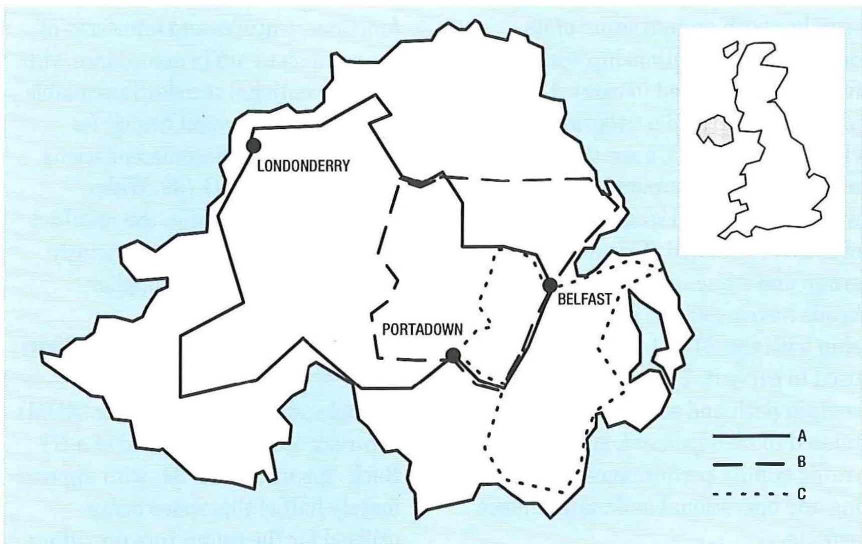
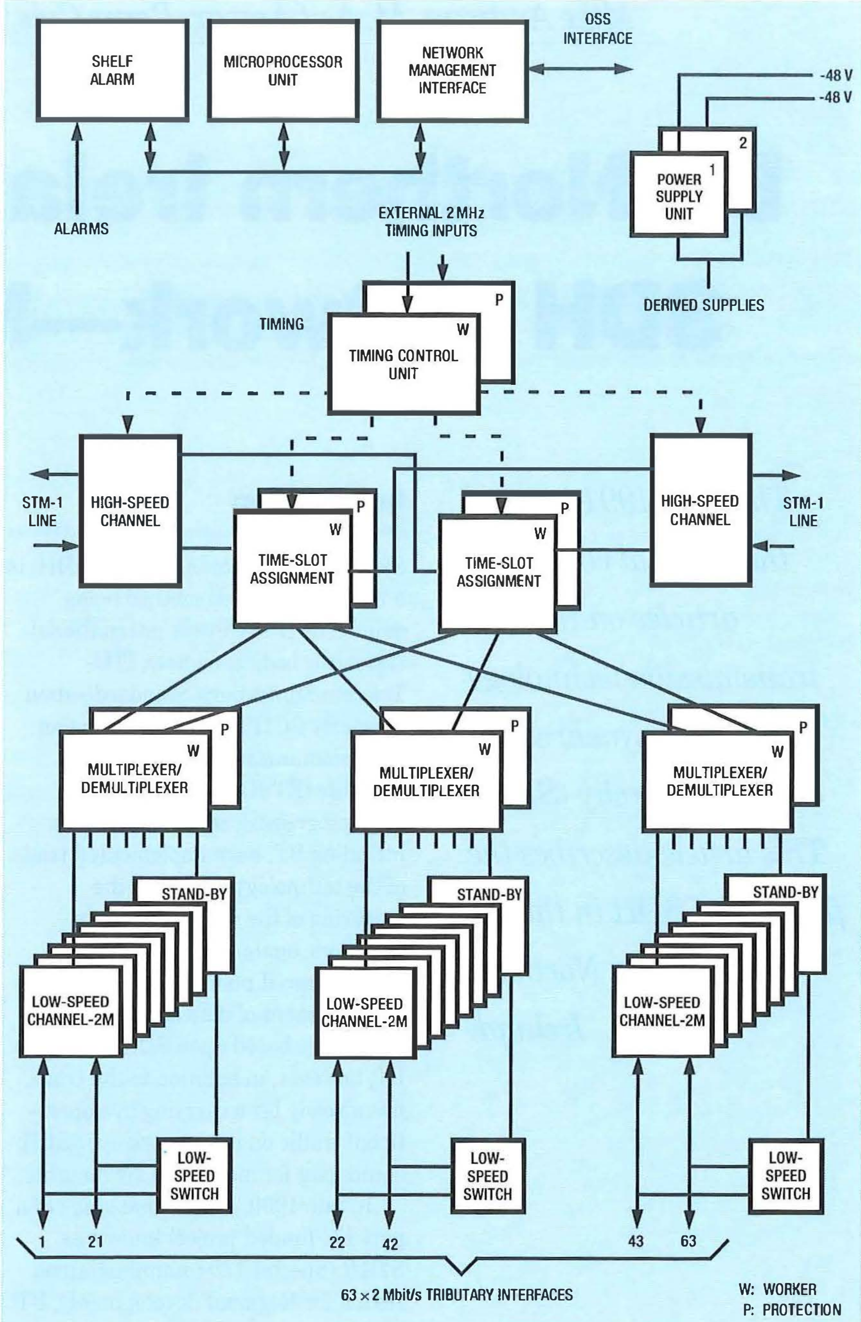


Figure 2—Block diagram of NISTAR add/drop multiplexer



multiplexers (ADM), of 20, 16 and 12 multiplexers per ring, the multiplexers in each ring being interconnected by single-mode optical fibres operating at 1300 nm nominal wavelength. The rings pass through all major and many minor population centres in Northern Ireland, although in the smaller locations the multiplexers are not provided with the full allocation of tributaries. All three rings are managed remotely from the Belfast network operations unit (NOU).

The SDH multiplexers, management system and supporting communications equipment are supplied by Fulcrum Communications Ltd, utilising SDH products developed and manufactured by Fujitsu in Japan and the USA, and Fulcrum in the UK.

General Equipment Description

The appendix to this article provides a review of some key SDH principles.

Each equipment can source and terminate 63 × 2 Mbit/s PDH bidirectional tributary signals and two STM-1 SDH bidirectional line signals. In the equipment, individual tributary signals are first adapted to a sub-rate of the STM-1 frame clock by a process of justification. The adapted signal is then associated with a *dedicated path overhead* (POH) and mapped to specific structures called *virtual containers* (VCs). The VC, together with an indication of its defined phase relationship with the frame which is used to carry it (*pointer*), is termed a *tributary unit* (TU). A group of TUs are then multiplexed into standardised frames with an associated *section overhead* (SOH) being added. This multiplexed group and its accompanying overheads have a defined phase relationship with the STM-1 frame which is used to carry it. The overheads contain path and section information related to management, supervisory, traffic quality performance monitoring and operational and maintenance aspects.

The transmission and management functions, features and interfaces of the equipment are in accordance with the international standards available at the time the project began; for example, CCITT Recommendations G.707, G.708 and G.709. Where standards did not exist, the required functions and features were jointly defined by BT and the supplier.

Equipment Implementation

A single add/drop multiplexer (ADM) sub-rack occupies one third of a BT Rack Apparatus No. 91, with approximately half of this space being utilised for the connectors providing 2 Mbit/s traffic interfaces and connections to other equipment and support services; for example, power, management and alarms. A block diagram of the ADM is shown in Figure 2; the physical equipment is illustrated in Figure 3.

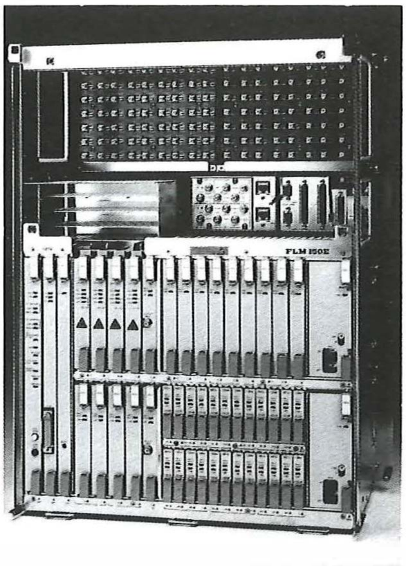
The sub-rack power is provided by two power supply units (PWR). The PWR slide-in unit converts the –48 V station supply into the required derived voltage levels for the equipment. Two units are provided for security, each being supplied by a separate feed from the rack power supply. The PWR units operate in parallel on a load-sharing basis and either can supply the full load if the

This ring topology enables two diverse traffic paths to be provided between any two nodes which ensures that the important objective of very high network availability is achieved

other unit fails. The high-speed channel (HSCH) unit provides all the opto-electrical conversion for the STM-1 signal in both directions of transmission. The SOH, multiplexer section (MSOH) and regenerator section (RSOH) overheads are inserted and extracted via this unit. The electrical signal is transferred to the time-slot assignment (TSA) units for distribution of time-slots to the appropriate multiplexer/demultiplexer (MLDM) or low-speed channel (LSCH) units. The long-haul version of the HSCH used on NISTAR allows a system hop length of 40 km. On two sections of the NISTAR network this distance is exceeded. As optical repeaters were not available, an extra multiplex without tributary capability was used between the terminal stations to obtain the required hop distance.

The LSCH unit provides the interface for three 2 Mbit/s tributary signals. The incoming signals are combined into a tributary unit group (TUG-2) structure and passed to the MLDM unit and vice versa in the opposite direction. There are seven LSCH units in a group which are designated 'workers' and an associated one, designated 'protection'; that is, a one-for-seven protection. This hardware redundancy makes the traffic resilient to any single LSCH unit failure. The traffic being carried by a failed LSCH unit can be diverted to the protection LSCH automatically via the low-speed switch (LSSW) unit to maintain the traffic paths. The transfer of traffic to a protection LSCH results in an error burst of short duration during the switching transition, but ensures high circuit availability.

Figure 3—STM-1 add/drop multiplexer



The multiplexing of a group of tributary signals is provided by the MLDM unit. This unit multiplexes seven TUG-2s into a TUG-3 structure and demultiplexes in the opposite direction. One unit is provisioned for each of the three TUG-3 groups and resilience to MLDM failure is provided by a one-to-one MLDM unit hardware redundancy.

The flexible allocation of the 2 Mbit/s signals to time-slots in the STM-1 signals is provided by the TSA unit. This also provides access to the processed VC-4 POH and performs pointer processing on the administration unit (AU-4) signal. One unit is provisioned for each direction of transmission, and resilience to TSA failure is provided by a one-to-one TSA unit hardware redundancy.

The control functions of the equipment are provided by the microprocessor unit (MPU). It supervises the alarms, events and status of the equipment and is also used for configuring the optional settings during commissioning. Additionally, it communicates with the *network management interface* (NMI) unit, transferring information between the equipment and the management system.

The NMI unit provides the protocol conversion and physical interfaces for linking the ADM to the external management system and supports the *embedded communication channel* (ECC) link carrying messages between the ADMs. In each ring, two ADMs are provided with the external management interface capability, one main, one stand-by, these being known as *gateway network elements* (GNE). The GNEs allow the remote management centre to communicate with the rings. In addition to this remote management capability, each ADM can be controlled via a portable local terminal, essential during initial installation and commissioning when the remote management functionality may not be fully available.

The *shelf alarm* (SAC) unit provides the interface to the BT standard rack alarm bus. A conventional RECEIVING ATTENTION control is mounted on the front panel of the unit. This unit also acts as an overhead access unit. It processes the VC-4 path overheads (POH), MSOH and RSOH bytes used. It receives bytes from the appropriate unit and distributes the resultant signals. In the opposite direction, it receives information from the units and constructs it into the correct byte format for insertion into the frame.

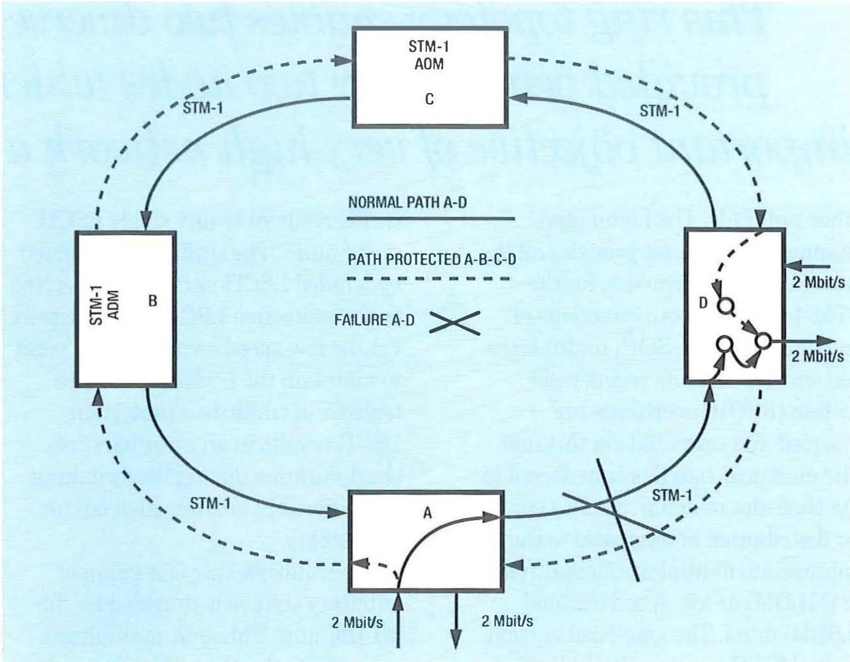
The synchronisation and timing signals for the equipment are provided by the *timing control unit* (TCU). This contains the equipment clock and selects the correct synchronisation source for synchronisation of the equipment clock. It also terminates the incoming external clock synchronisation signals and provides an external clock output signal which can be used as a timing source for other equipment in the station.

Network Operation

The equipment is used in a ring topology. This ring topology enables two diverse traffic paths to be provided between any two nodes, known as *path protection*, which ensures that the important objective of very high network availability is achieved. In addition, this functionality can be selected on a per-tributary basis, enabling its use where operational or commercial considerations dictate.

When path protection is selected, tributary signals are transmitted in both directions around the ring and the receiver selects the best signal based on the information contained in

Figure 4—Unidirectional path-protected ring



the path overhead (Figure 4). For example, the diagram shows a normal path A-D and a protection path A-B-C-D. If there is a failure on the line at any point between A-D, the receiver at D can switch to the other direction around the ring, the traffic now transiting A-B-C-D. The automatic path protection is triggered upon loss of tributary unit pointer, receipt of AIS or the monitored bit interleaved parity (BIP) errors being worse than the set performance threshold criteria. BIPs are an in-built error performance feature inherent in the SDH signal structure. Communication between ADMs is not necessary for single-ended path protection. As an additional feature, on assignment, the mean time between failures (MTBF) of the path can be optimised by programming the worker to be transmitted the short way around the ring, transiting the minimum number of intermediate nodes; for example, A-D on the diagram, instead of A-B-C-D.

NISTAR Ring Synchronisation

To allow synchronisation of an SDH ring an equipment must have two capabilities. It must be capable of accepting synchronisation into the ring and passing synchronisation around the ring. In the NISTAR equipment, this is achieved by allowing a number of configuration options. For external synchronisation input, synchronisation may be taken from a 2 MHz or 2 Mbit/s input. Within the ring, synchronisation is carried between equipment at the STM-1 rate, and may be passed from east to west or west to east. The primary synchronisation path (no failures in ring) is shown in Figure 5.

To protect the ring from synchronisation failure, secondary and tertiary sources can be nominated. Hence if a node is configured to take synchronisation from STM-1 east and this route fails, it will switch to its secondary source of STM-1 west. This scheme at first sight appears highly robust to single and indeed double failure.

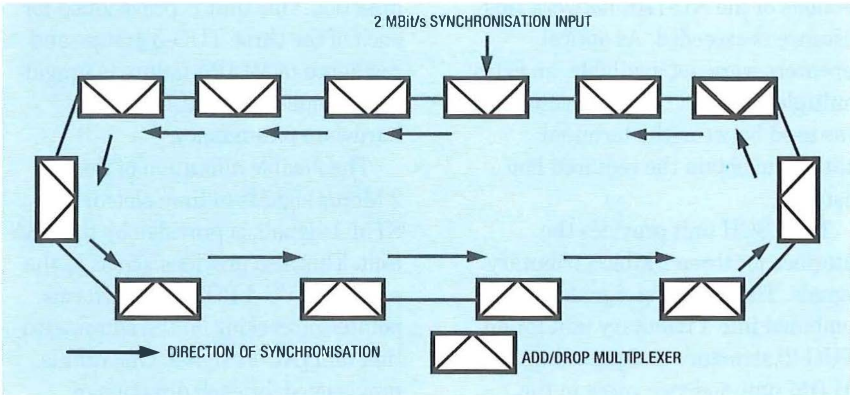
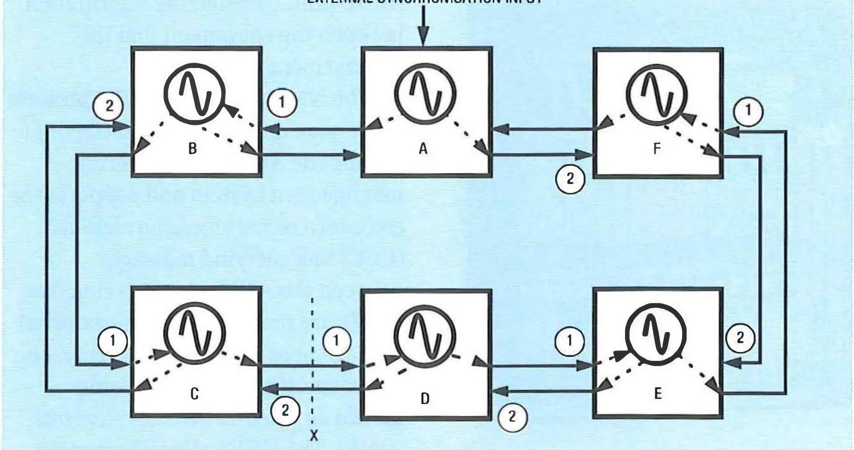


Figure 5—NISTAR ring primary synchronisation plan

However, synchronisation switching purely on priorities without some form of intelligent selection algorithm can create timing loops—a fault condition which cannot be detected by the equipment. This is best explained by an example; see Figure 6.

In Figure 6, an SDH ring is shown. Each equipment synchronises all STM-1 outputs to its primary synchronisation input (designated ① in the diagram). Hence synchronisation is passed around the ring, in this example in

Figure 6—Synchronisation failure



the ring can reconfigure its synchronisation distribution on any single synchronisation failure within a matter of seconds

the anticlockwise direction. If a failure occurs, for example, at point X, node D will switch to synchronise from its secondary input. This results in node D synchronising from node E while node E is still synchronised from node D. This is known as a *timing loop*. In addition, node F remains locked to the now frequency-inaccurate node E.

To overcome the problems described above, a physical layer protocol was required that would enable each node to have sight of the state of synchronisation of the ring. This would enable automatic synchronisation reconfiguration and avoid timing loops when a failure occurred.

The protocol used in NISTAR was simple but effective. Each output synchronised by the equipment contains a marker in the MSOH. The marker indicates GOOD quality if the equipment is synchronised to an STM-1 or 2 MHz/2 Mbit/s input, with the exception that if the equipment is synchronised to an STM-1, the return path marker is set to BAD quality to which equipment will not synchronise, hence preventing timing loops. Synchronism to the equipment's own clock also provokes a BAD marker. If we use this protocol in the example given above, on failure at X, equipment D cannot switch to its secondary synchronisation port because of its BAD setting. It therefore synchronises from its own clock and sets all outgoing markers to BAD. This provokes node E to look for another source which is again unavailable and it synchronises to its internal clock. This process ripples around the ring until the point of synchronisation injection is reached where a GOOD marker is available; hence at node F the equipment is able to switch to its secondary synchronisation port. Node F can now set outgoing markers to GOOD. This marker is received by node E, which can therefore switch to secondary input. This effect ripples around the ring until the affected nodes are resynchronised.

The above mechanism ensures that the ring can reconfigure its synchronisation distribution on any single synchronisation failure within a matter of seconds without invoking timing loops. A more complex algorithm has now been standardised internationally, but the principles involved in the NISTAR ring are unchanged, and indeed experience on the NISTAR project enabled BT to make valuable inputs on this subject.

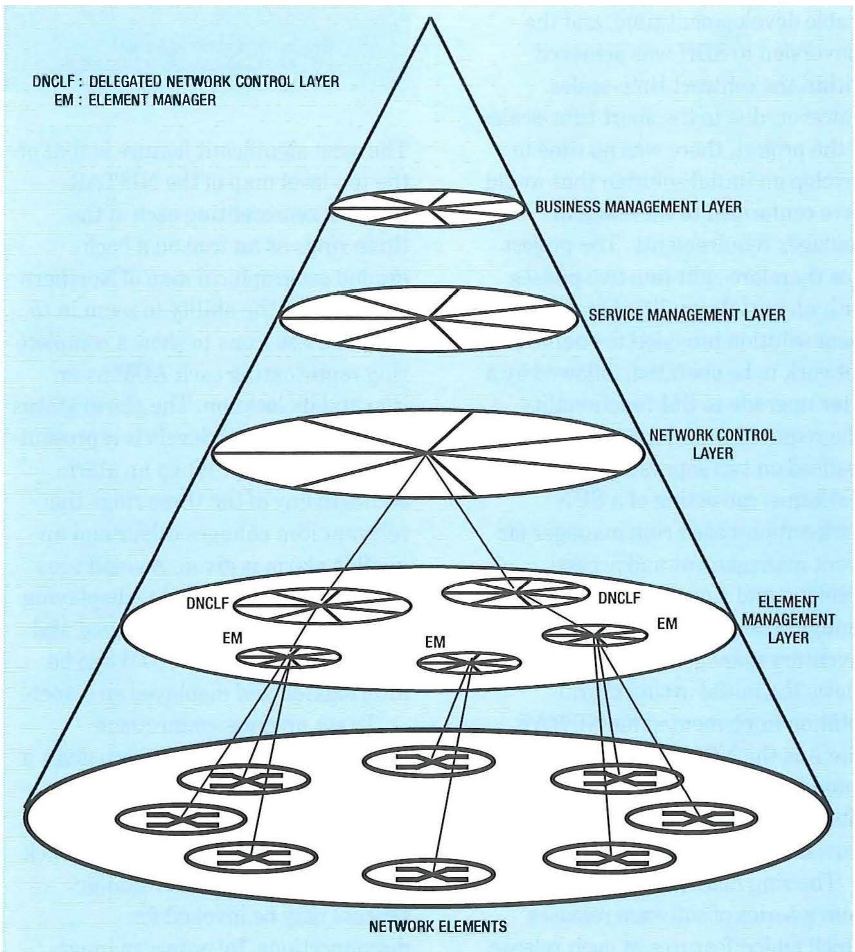
Double failures of synchronisation normally result in some part of the SDH ring being isolated from network reference quality timing. This however is not catastrophic. Each SDH equipment has its own clock which is capable of 'holding' the last frequency that the equipment was synchronised to. While this method is not accurate enough to allow synchronisation transport to continue (for example, to subsequently synchronise a large 64 kbit/s switch), it does allow data to continue transmission unaffected. The double-failure scenario should also be regarded as a very rare event.

NISTAR Management

Architecture

At the time of the NISTAR tender, BT was formulating its requirements for SDH management, and the international SDH management specifications were far from mature. The architectural requirements were very much as they stand today and were based on the then emerging CCITT telecommunications management network (TMN) architecture implemented in conformance with BT's cooperative network architecture for management (CNA-M) requirements (Figure 7).

Figure 7—CNA-M with DNCLF



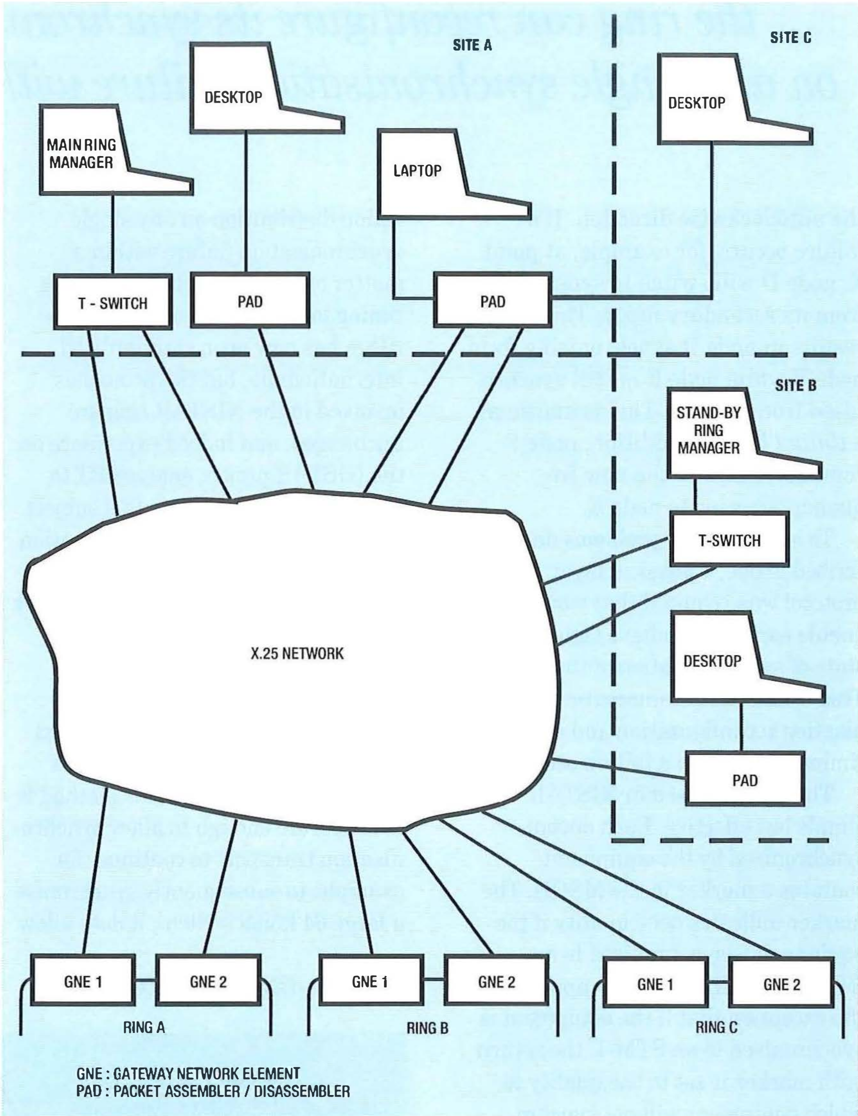


Figure 8—Initial NISTAR management structure

The resulting architecture has as its bottom layer the managed network elements, in this case SDH add/drop multiplexers. The first layer of management consists of *element managers* (EMs) that contain a managed object representation of the network elements and logs of alarms and performance parameters. Above the element managers is the *delegated network control layer* (DNCLF) which is a sub-network manager capable of providing a networked view of a number of SDH network elements. The DNCLF interfaces to the BT network control layer (NCL) that manages the whole network. For the NISTAR contract, no NCL interface was specified or required.

Initial solution

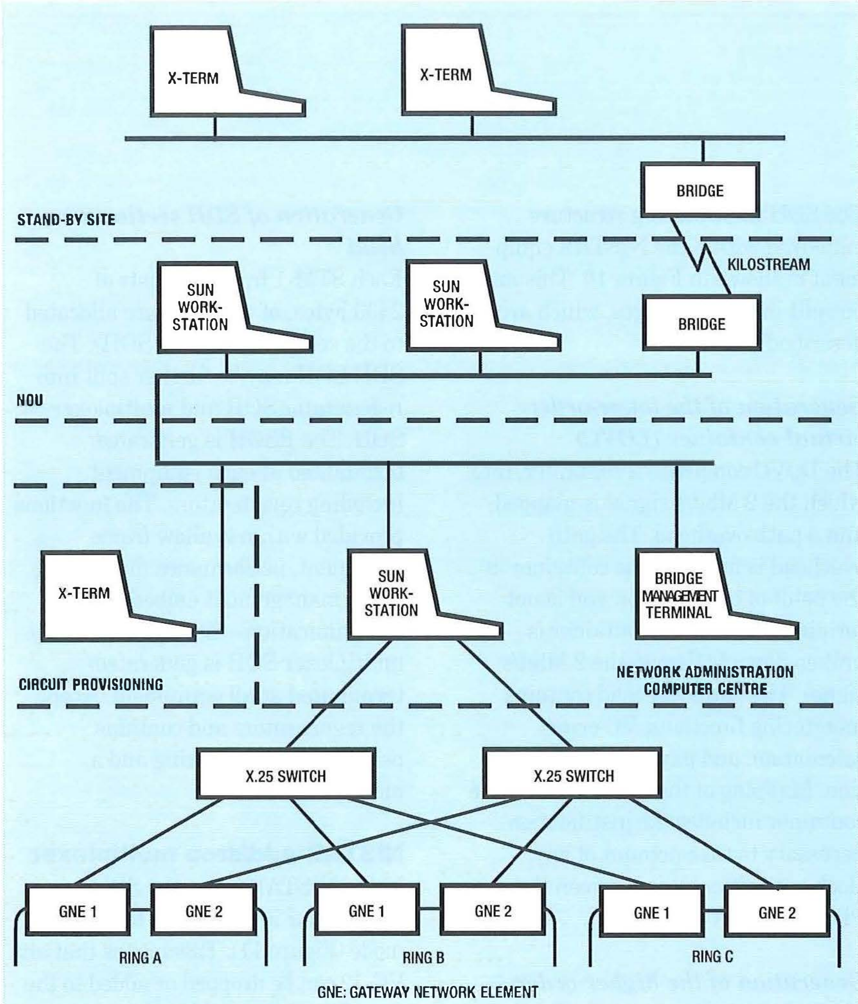
The Fulcrum/Fujitsu offering for the NISTAR contract was based, where possible, on existing management products used for managing SONET network elements. This saved considerable development time, and the conversion to SDH was achieved within the contract time-scales. However, due to the short time-scales of the project, there was no time to develop an initial solution that would have conformed to the element manager requirements. The project was therefore split into two phases, with an initial simplified management solution provided to enable the network to be operated, followed by a later upgrade to EM functionality. The required initial functionality was realised on two separate management platforms, consisting of a SUN workstation-based ring manager for event management and access security, and a desktop PC for configuration, performance and inventory management. Figure 8 shows the initial architectural solution implemented for NISTAR. Site A is the NOU, Site B provides a stand-by management capability and Site C is provided for specific circuit-provisioning activities.

The ring manager was developed from a series of software releases which added features at each release. The most significant feature is that of the top-level map of the NISTAR network representing each of the three rings as an icon on a background geographical map of Northern Ireland, and the ability to zoom in to each of these icons to show a complete ring representing each ADM as an icon and its location. The alarm status of the icons at both levels is represented by their colour. When an alarm occurs in any of the three rings the relevant icon changes colour and an audible alarm is given. A small area on the screen is devoted to displaying the most recent alarms received and the alarm logs for any ADM can be interrogated and displayed on screen.

To set up cross-connections through an ADM, the desktop gives a screen display of a map of the cross-connection matrix, and connections can be achieved using point-and-click operations of a mouse. A similar process may be invoked for disconnections. Inventory management utilises a screen display depicting the front view of the equipment showing the cards and their alarm status. By using mouse point-and-click operations or a pull-down menu, it is possible to investigate the properties of any of the cards fitted in the ADM. Performance parameters from the ADMs may also be interrogated from the screen display menus.

A significant amount of testing and retesting was necessary to ensure the correct working of each release and highlight any problems that arose with a particular release. A test network of three ADMs was used to test the software and this was used in two basic configurations depending on the type of test being performed. Configuration 1 was with the three ADMs connected in a ring configuration with one ADM as the GNE. This allowed the testing of alarm reception from the gateway ADM and alarms from the other ADMs via the embedded communications channel within

Figure 9—Enhanced NISTAR management architecture



the STM-1 signal. With this configuration it was also possible to test the effect of loss and recovery of communications to each of the ADMs. Configuration 2 was with the three ADMs each acting as a GNE. This was necessary to ensure that the ring manager could receive alarms from the three rings within the NISTAR network. It was also a test of the communications capability of the ring manager. Access security testing was also conducted on both configurations.

The desktop PC was tested with the same ADM configurations as the ring manager. However, it was more important that configuration 1 was tested for path configuration through an ADM ring. This was achieved by using 2 Mbit/s testers on selected tributary ports of the ADMs and checking that, when configuration commands had been sent to the ADMs, the 2 Mbit/s path was connected through from one ADM tributary to a tributary on a different ADM.

Communications links

The network management interface on the GNEs was specified to be based on IEEE 802.3 LAN technology. However, the products being offered had X.25-based interfaces. The network adopted provided a duplicated solution as shown in Figure 8. Each of the three ADM rings has two management gateways into the X.25 network and the ring manager was provided with a T-switch to provide duplicated access to the X.25 network. Duplication of the desktop was provided by a separate laptop. A stand-by site was also catered for in this architecture.

Upgrade to element manager

As a result of the initial implementation, an upgrade was required to conform more closely with the originally specified requirements for an element manager. The essential change required was that all management functionality should be provided from the SUN workstation platform and that this platform should support all the required different classes of user. The proposed architecture for the upgrade is illustrated in Figure 9. The SUN workstation platform has become a server for a number of workstations and X-terminals, and effectively becomes an embryonic element manager. LAN technology is employed for communications between the workstations and terminals and the SUN workstation.

Conclusion

The NISTAR network has now been operational and carrying live 2 Mbit/s traffic from a number of sources for several months, and uses the initial management implementation described. Measurements of traffic performance conducted by using specialised monitoring equipment in addition to the inbuilt functionality have identified no unexpected errors during the whole of the test period, and plans are well advanced for the element manager upgrade.

In addition to providing BT NI with an advanced telecommunications capability, experience gained during the introduction and subsequent use of the NISTAR SDH network has played a significant part in influencing BT's longer-term SDH plans and has enabled BT to make important contributions to emerging international standards.

Appendix—A Brief Guide to SDH Principles and Terms

This Appendix provides a brief description of SDH principles and structures. For a fuller account please refer to the July 1991 issue of the *Journal*, which contained a range of articles on the subject[1,2,3,4,5].

Line rates

SDH networks are currently specified to operate at three line rates: 155·52 Mbit/s, 622·08 Mbit/s and 2488·32 Mbit/s. These are known as *STM-1*, *STM-4* and *STM-16* respectively. For NISTAR, only STM-1 is used.

NISTAR multiplexing structure

All tributary signals follow a defined process of mapping and multiplexing for assembly into their correct position within the STM-1 line signal.

The SDH multiplexing structure employed within the NISTAR equipment is shown in Figure 10. This may be split into three stages, which are described below:

Generation of the lower-order virtual container (LOVC)

The LOVC comprises a container, into which the 2 Mbit/s signal is mapped, and a path overhead. The path overhead is added to the container at the point of construction and is not terminated until the container is broken down to demap the 2 Mbit/s signal. The path overhead contains monitoring functions, VC error calculation, and payload identification. Mapping of the tributary into the container includes the justification necessary to take account of any clock-rate differences between the PDH and SDH equipment.

Generation of the higher-order virtual container

The HOVC in this instance comprises 63 LOVCs and a path overhead providing error monitoring and payload identification facilities. Each LOVC can float with respect to each other LOVC and to the HOVC. To allow this to happen, each LOVC is assigned an address. This address is commonly called the *pointer*. The pointer and LOVC are collectively called a *tributary unit* (TU). In Figure 10, there are stages named *tributary unit groupings* (TUGs). These are effectively flexibility points where LOVCs of differing sizes can be mixed in an orderly way; for example, the TUG-2 allows mixing of VC-2s (6 Mbit/s carriers) with VC-12s (2 Mbit/s carriers) and VC-11s (1·5 Mbit/s carriers), while the TUG-3 allows mixing of any TUG-2 with VC-3s (34 Mbit/s carriers). The NISTAR equipment deals with only VC-12s and hence these stages are largely redundant. The HOVC can float with respect to the STM-1 frame. To allow this to happen, the HOVC is assigned a pointer. The pointer and HOVC are collectively called an *administrative unit* (AU).

Generation of SDH section overhead

Each STM-1 frame consists of 2430 bytes, of which 81 are allocated to the section overhead (SOH). The SDH SOH may be further split into regenerator SOH and multiplexer SOH. The RSOH is generated/terminated at each equipment, including regenerators. The functions provided within it allow frame alignment, performance monitoring and a management embedded communications channel (ECC). The multiplexer SOH is generated/terminated at all equipment except the regenerators and contains performance monitoring and a management ECC.

NISTAR add/drop multiplexer

In the NISTAR rings, the SDH multiplexer is configured to add/drop mode (Figure 11). This means that any VC-12 can be dropped or added to the ring. Normally the VC-12 is subsequently passed in one direction around the ring to its drop point. If high resilience is required, the VC-12 can be passed in both directions around the ring, the terminating node working from the primary VC-12 or on failure switching to the secondary VC-12.

Acknowledgements

The authors are grateful to their colleagues in BT Worldwide Networks, BT Northern Ireland (Jim Russell and David Galbraith) and Fulcrum for their contribution to the success of the project.

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Figure 10—NISTAR equipment multiplexing hierarchy

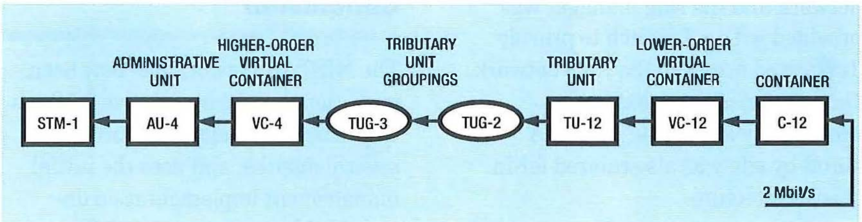
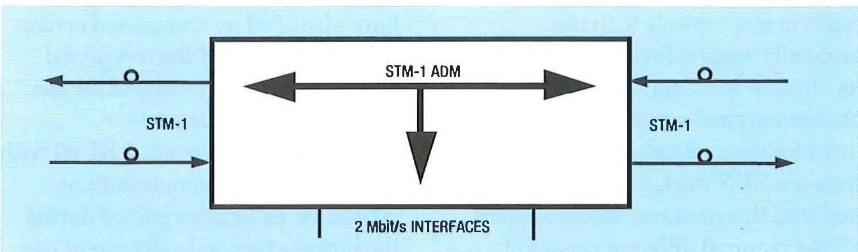


Figure 11—NISTAR add / drop multiplex



Biographies

Mike Andrews
BT Worldwide Networks

Mike Andrews joined the then PO in 1971, and has held a number of posts in transmission network development and systems engineering, including responsibility for early KiloStream multiplex equipment, supergroup and hypergroup codecs and transmission test equipment. He has been actively involved in international standards, chairing committees in both CCITT and ETSI. He heads the core SDH multiplex and management team in BT Worldwide Networks and led the engineering team responsible for the specification, evaluation and installation of the NISTAR network. Currently Mike is responsible for all technical aspects of a major contract to build BT's core SDH transmission network. He is a Chartered Engineer.

M. Asif Anwar
BT Worldwide Networks

M. Asif Anwar joined BT in 1981. He has had technical responsibility for second- and fourth-generation PDH higher-order muldex equipment and 120/140 Mbit/s convertor equipment, and was responsible for system aspects of the automatically switched digital service protection network project (ASDSPN). More recently he has played a key role in the development and specification of STM-1 and STM-4 SDH muldexes and the embedded software requirements for all SDH network elements. He currently chairs a committee responsible for all technical aspects of SDH muldex, line system and radio associated with BT's long-term SDH implementation strategy. He is a Chartered Engineer.

Roger Cole
BT Worldwide Networks

Roger Cole is an engineer in Network Design and Service Launch, part of BT Worldwide Networks. He joined BT in 1969, initially working on exchange maintenance and line transmission duties. He was subsequently involved in the approval of first-generation 30-channel PCM equipment and in the development of digital sound programme equipment and acceptance testing of KiloStream ACE and Mk2 SAS for the FAS project. More recently he has played a key role in formulating BT's requirements for a managed transmission network based on SDH. Currently he is involved in element and network management for SDH and plays an active role in various projects aspiring to CNA-M conformance.

Guy Reiffer
BT Worldwide Networks

Guy Reiffer joined BT in 1989 after graduating from Sussex University with a degree in electronic engineering. Initially he joined the Digital Network Standards Group where he was involved in SDH specification within ETSI. In 1990 he moved to his present post of manager for transport layer functionality and interfaces. Here he is part of a team responsible for the specification of generic SDH network element requirements.

Glossary

ADM Add/drop multiplexers
AIS Alarm indication signal
AU Administrative unit
BIP Bit interleaved parity
CCITT International Telephone and Telegraph Consultative Committee
CNA-M Cooperative network architecture for management
DNCLF Delegated network control layer
ECC Embedded communication channel
ETSI European Telecommunications Standards Institute
GNE Gateway network element
HOVC Higher-order virtual container
HSCH High-speed channel
ITU International Telecommunications Union
LAN Local area network
LOVC Lower-order virtual container
LSCH Low-speed channel
LSSW Low-speed switch
MLDM Multiplexer/demultiplexer
MPU Microprocessor unit
MSOH Multiplexer section overhead
MTBF Mean time between failures
NCL Network control layer
NISTAR Northern Ireland STAR
NMI Network management interface
NOU Network operations unit
PDH Plesiochronous digital hierarchy
POH Path overhead
PWR Power supply unit
RSOH Regenerator section overhead
SAC Shelf alarm
SDH Synchronous digital hierarchy
SOH Section overhead
SONET Synchronous optical network
STAR Special Telecommunications Action for Regional development
STM-1 Synchronous transport module level 1
TCU Timing control unit
TMN Telecommunications management network
TSA Time-slot assignment
TU Tributary unit
TUG Tributary unit group
VC Virtual container

Mick Head, Paul White and Neil Morgan

SuperJANET—A Strategic Partnership

This article describes the technical and strategic importance of SuperJANET, a collaborative project between BT and the academic community. The article gives an overview of the network topology and the technology used, and describes some of the applications that are under development within the universities and teaching hospitals.

Introduction

The SuperJANET network is being implemented by BT for the Higher Education sector within the UK. *JANET* is an acronym for *J*oint *A*cademic *Net*work and is presently a network that connects most of the UK's academic establishments at transmission rates of from 64 kbit/s up to 2 Mbit/s. SuperJANET, the next stage in the evolution of JANET, provides a high-speed plesiochronous digital hierarchy (PDH) and synchronous digital hierarchy (SDH) network for collaborative research, and BT's new switched multi-megabit data service[1] (SMDS). This article describes:

- the market need for advanced networks,
- the rationale for collaboration with UK academia in this field,
- a description of the applications already running over the network; and
- an explanation of the technology underpinning the project.

Market Need

There are a number of key trends identifiable in the development of networking in the UK and internationally:

- growth in data is outstripping growth in voice networking (40% per annum versus 5% per annum);
- local area network (LAN) and workstation technology and advancements have been rapidly adopted, driving the need for equivalent wide area network (WAN) performance;
- rapidly increasing demand for networks to support high-resolution image, video and multimedia applications; and
- concentration of customers on core business activities, and hence outsourcing of activities; for example, management of communications.

These trends mean that BT must be more responsive, by providing better value for money, switched networking for high bandwidth applications, and a market solution that will allow easy migration to new services and technology platforms in the future.

BT's strategy is to provide virtual private networks (VPNs), which offer economies of scale through shared infrastructure; enable focus to be given to providing service solutions (that is, independent of technology platforms); and the immediate prospect of international connectivity.

BT's first realisation of this strategy is through the impending launch of the switched multi-megabit data service (SMDS), currently planned for the first quarter of 1994.

SMDS and SuperJANET

It is BT's standard practice to test new products and services through a limited 'pilot' launch, prior to full national launch. This need was particularly strong for the SMDS, as it is based on technology platforms and infrastructures new to BT, and required administrative systems (billing, network management, *This presented a major opportunity for BT to undertake a pilot launch of SMDS with a customer who would use the new service operationally*

support procedures) to be developed to support a commercial service.

At the same time as these issues were being considered by BT, the Joint Network Team (managers and operators of the UK higher education's Joint Academic Network, JANET) was in the process of upgrading its network infrastructure to meet the demands of its user community for a network which would support their needs in to the next decade/century/millennium.

This presented a major opportunity for BT to undertake a pilot launch of SMDS with a customer who would use the new service operationally, and would run a wide range of new and complex applications to take advantage of the capabilities of the service.

BT and Higher Education

BT's relationship with higher education, in terms of graduate recruitment, employee development, research funding and business activity, has a strong historical basis.

This relationship has been strengthened recently through the development of a clear and articulate policy for BT's dealings with higher education, its overall relationship managed by BT's Higher Education Advisory Group.

This valued relationship has allowed BT to provide additional benefits to the customer beyond the implementation of the SMDS network, including the following:

- Limited provision will be made on BT's higher-order PDH line systems, with planned upgrade to future technology platforms to facilitate future research opportunities.

- SuperJANET will embody all of BT's high-speed networking platforms, thus permitting the additional funding of research programmes within the university community, by migrating projects from BT Laboratories in to a live networking environment.

- The opportunity is available for higher education to become involved in BT's international network developments, such as European asynchronous transfer mode (ATM) trialling.

Further benefits to both BT and higher education arise from the scope and range of contacts in all areas of industry and commerce within the UK, and the ability of academia to respond to ideas with imagination and innovation.

These characteristics are essential for the early development of new applications which can exploit the benefits of the new services and the technologies on which they are based. These applications will stimulate the take-up of SMDS and other new services within the UK.

BT takes particular pleasure from the new early applications which have been developed to support the teaching and learning process within higher education, some of which are described below.

The SuperJANET Network

SuperJANET provides the UK academic community with a high-performance, multi-service network. The project provides a high-speed upgrade to several locations currently served by the existing JANET X.25 network.

SuperJANET comprises two discrete networks: a managed high-speed data service to 45–50 customer sites which is supported on BT's pilot SMDS network, and a high-capacity PDH/SDH transmission network provided to up to 16 key customer sites using an exclusive network carried on BT's core transmission network.

The SuperJANET network is being delivered to the customer in a number of phases:

- PDH pilot phase, which will provide 140 Mbit/s PDH capacity to six customer sites in the first quarter of 1993 (note that eight sites were delivered);

- SMDS Phase 1A, which will provide service to 12 sites in the third quarter of 1993;

- PDH Phase 1B, which will provide service to a further four sites (12 in total) in the third quarter of 1993;

- SMDS Phase 1C, which will provide service to a further 33 sites (45 in total) in the fourth quarter of 1993; and

- Phase 2, in which the PDH service will be migrated onto an SDH based network.

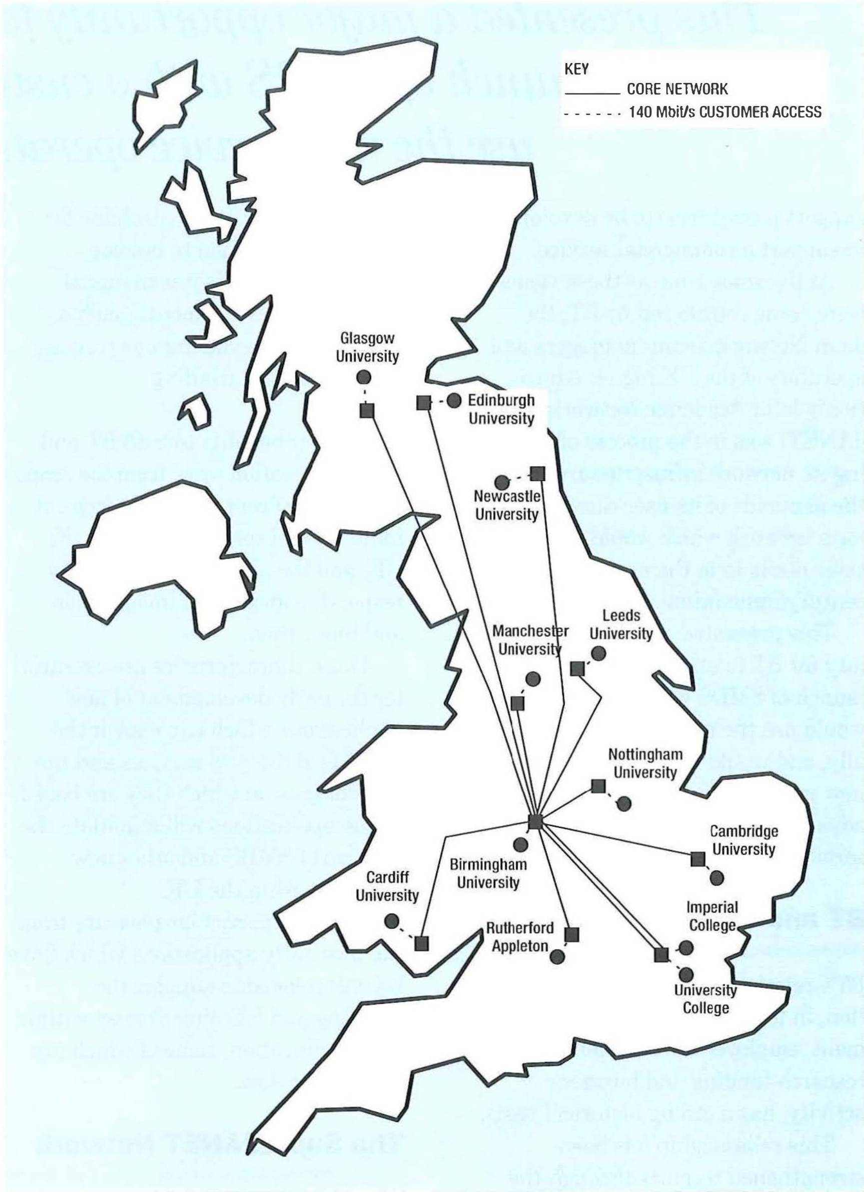
SMDS Pilot Network

The BT pilot SMDS network provides the managed high-speed data network which supports a wide range of teaching and learning activities that are required by UKERNA. These new and developing applications require large bandwidths which are not provided by the existing JANET network.

The BT pilot SMDS network is provided using *metropolitan area network* (MAN) technology which utilises a cell-based transmission method as standardised by the IEEE 802.6 committee. This technology has been adopted by ETSI, European SMDS Interest Group (ESIG) and BellCORE for SMDS standards and will support a service which is fully compliant with BellCORE SMDS specifications[2].

The IEEE 802.6 MAN standard defines the *distributed queue dual bus* (DQDB) principle upon which the equipment's architecture is based. The DQDB technique uses a dual-bus network built up from two contra-directional optical fibres. At the head of each bus, a circuit is installed which generates empty cells onto the bus. Each station on the bus sends data messages on one of the buses, dependent on the location of the sink relative to the source, prefixed with the 'address' of the sink. Messages are delivered to all stations encountered on the way, but only the station whose

Figure 1—SuperJANET Phase 1 (PDH)



address matches that in the message header accepts the information.

Access to the bus is controlled by means of *request* and *busy* bits located in the cell header combined with a number of counters maintained by all stations on the bus. The *busy* bit is set if the corresponding cell is busy, and the *request* bit is set by a station to indicate that it wishes to send data. If a station wishes to transmit on the A bus it will set the *request* bit on the B bus, thereby identifying to all stations 'upstream' that it is awaiting an empty cell.

Each station is equipped with two counters, a request counter and a count-down counter. The request counter is incremented if a down-stream station requests an empty cell and decremented if an empty cell is allowed to pass the station. As a result, the request counter indicates the number of downstream stations that have not been satisfied with an empty cell. To request an empty cell, a station sets the *request* bit on the bus in the upstream direction. The contents of the station's request counter are also transferred to the count-down counter and the request counter reset to zero. The count-down counter is decremented for each empty cell which passes the station, and when the count-down counter contains the value 0, the station can send its data into the next cell.

The DQDB mechanism provides a fair access system if the transmission delay between stations is limited. Longer distances are covered by using point-to-point connections between subnetworks.

The BT pilot SMDS network consists of a number of strategically placed MAN subnetworks which provide coverage to most of the UK. Each SuperJANET site is connected to a subnetwork via a dedicated 34 Mbit/s optical line system which will support a sustained information rate (SIR) of up to 25 Mbit/s of user data. Each subnetwork is interconnected to a minimum of two other subnetworks by using dedicated capacity within BT's core transmission network.

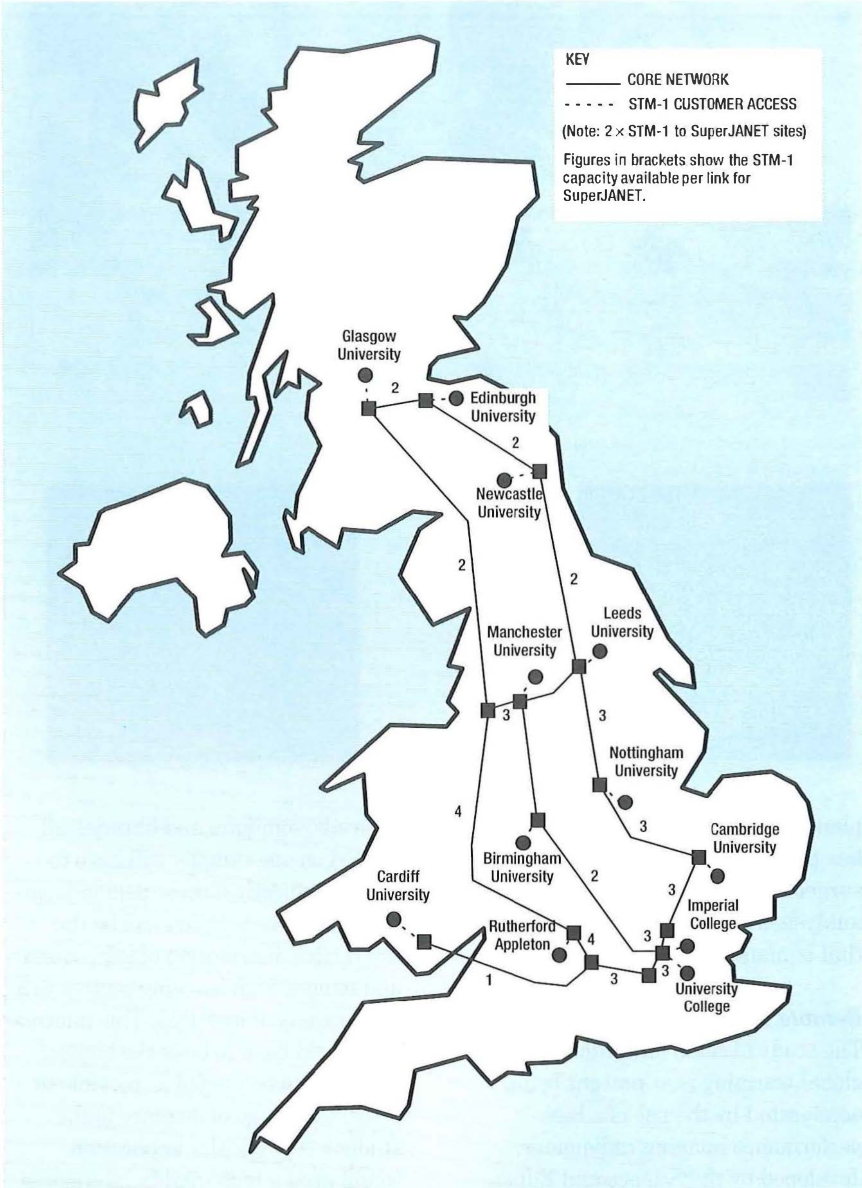
The pilot SMDS network is managed centrally from one of BT's network management centres. The MAN management application is hosted on a fault-tolerant Tandem computer with a back-up system located at BT Laboratories. The Tandem manages the network via three separate high-level data link control (HDLC) links, each to a different subnetwork. If an HDLC link fails, all information can be transferred between the network and the management system over any one link.

PDH/SDH Network

The PDH/SDH network provides a high-bandwidth platform over which new multimedia applications can be transported and research into new networking technologies such as asynchronous transfer mode (ATM) performed. These research activities are to be performed on a collaborative basis between BT and UKERNA.

The initial network will be provided by using the PDH configured in a star configuration which facilitates interconnection between all the SuperJANET sites via a central BT flexibility node (see Figure 1). 140 Mbit/s digital blocks are provided between each SuperJANET site and the BT flexibility node. At each SuperJANET site, and the BT flexibility node, the 140 Mbit/s block can be configured to provide a customer interface at 1 × 140 Mbit/s or 4 × 34 Mbit/s. Reconfiguration of the customer interface data rate and site interconnection is achieved via manual patch panels located at the SuperJANET sites and the BT flexibility node. A combination of manual and automatic protection at 140 Mbit/s within BT's core transmission network enable restoration in the event of a link failure.

Figure 2—SuperJANET Phase 2B (SDH)



The PDH network will evolve onto SDH as BT's core transmission network migrates to this technology. Each SuperJANET site will be connected to a BT serving node with a 155 Mbit/s path with capacity provided in BT's core transmission network to interconnect all serving nodes (see Figure 2).

SDH technology will form BT's managed transmission network and will offer network management capabilities that will evolve during and beyond the SuperJANET project. *Multiplex section protection* (MSP) will be used within BT's core transmission network which will provide restoration in the event of a link failure.

Applications

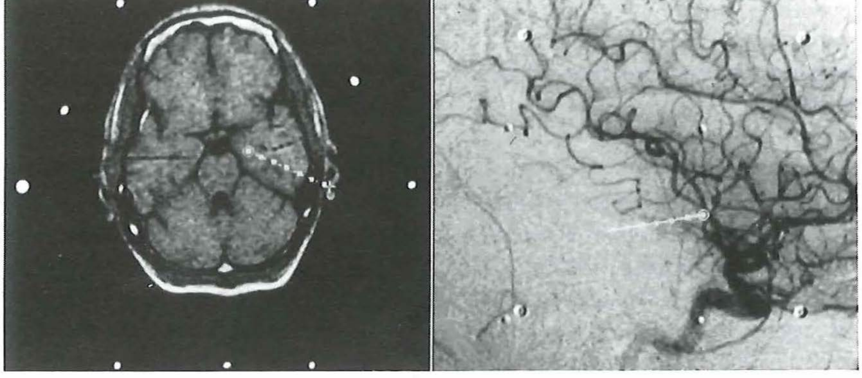
The SuperJANET contract presents BT with an unparalleled opportunity to develop, in collaboration with the academic community, broadband applications that are suitable for commercial exploitation. This section describes some of the planned development areas and identifies some specific applications that have already been examined over the pilot SuperJANET network.

Access to remote facilities

Brain imaging

Hammersmith Hospital in London has helped to pioneer facilities for obtaining human brain images that identify not only physical structure but also the extent of functionality while the patient is performing different mental activities. Magnetic resonance (MR) techniques are used to produce detailed images of brain structure while positron emission tomographs show areas of high neural activity. The development of these images requires ever-increasing amounts of data to yield sufficient amounts of detail and therefore they have been limited to use within the research establishment or remotely by the transfer of magnetic tapes. SuperJANET has enabled these facilities to be shared by allowing the remote acquisition of whole-brain images every few milliseconds (see Figure 3). Further developments will enable the remote site to manipulate three-dimensional brain images in real time. SuperJANET will also allow pre-surgery brain scans of a patient showing different images, including brain structure and arterial location, taken at different hospitals, to be brought together, and overlapped on the one PC screen. This will allow precise identification of brain entry points and trajectory angles for neurosurgery, reducing risks, time, costs and enabling operations to be

Figure 3—Brain imaging



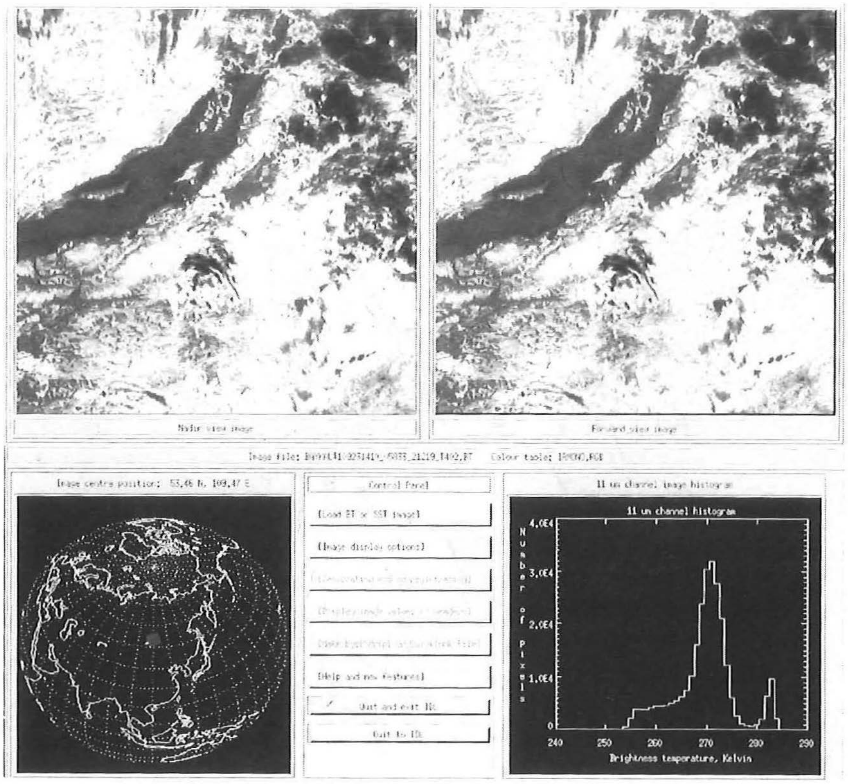


Figure 4—Geophysical imaging

planned more effectively. This task has previously been performed by the surgeon conducting comparative analysis from X-ray images or data that is manually transferred.

Remote sensing data
The study of cloud formations and global warming is at present being accelerated by the use of a high-performance imaging radiometer, developed by the Science and Education Research Council (SERC), and currently flying on board the ESA ERS-1 satellite. The transmitted images of the earth's surface are held on a database at Rutherford Appleton Laboratories for use by its geophysical facilities. (See Figure 4.) The availability of SuperJANET will disseminate the use of this utility plus additional geophysical datasets to other remote research sites, a practice previously prohibited by the slow speed of the existing academic networks.

Distance-based teaching and learning

Theseus
The 1990s presents a major challenge to the academic institutions of the UK. The number of students is rising rapidly along with a strong demand for improvements in the learning process. The traditional methods of lectures, tutorials, seminars and libraries all located on one campus will have to change radically if these demands are to be met. One solution will be the interactive distribution of text, sound and images from learning centres to a wide variety of locations. This information would have to be of the highest quality, and be as real as possible to dispel the image of distance to the student. A particular application would need a high-quality interactive system and a powerful network. John Moores University in Liverpool has developed a system, called *Theseus*, that pulls together the multimedia environment required for distance learning for presentation to the student on a single PC screen. The system is fully interactive, permitting a two-way flow of information, and allows explanatory text and slide images that can be focused in the same way as if the individual student was using a microscope. With the introduction of SuperJANET, it is now possible to disseminate the Theseus system to many different colleges and universities to give students the facility to learn remotely and in their own time. Although at present the main learning package has been developed for medical training (cytological screening) it is planned to develop many different training packages for many different subjects. This allows the expertise of leading academics to be distributed remotely to many thousands of students and negates the need for individual lectures to many people in one location.

Remote consultation and diagnosis

Pathnet
The interpretation of images is essential in many forms of medical diagnosis. Image transfer at present takes the form of distribution by post of microscope slides to consultants in the relevant field. Histopathology is one of the medical areas where this practice is most prevalent owing to the severe shortage of pathologists and the fact that they are usually resident in the main medical centres. An issue that compounds the problem is that histopathology is a subjective interpretive field, and therefore some pathologists will be more expert than others relevant to their particular experience and skills. Sending microscope slides by post can often take weeks or even longer. The challenge is to distribute images over the SuperJANET network of a sufficient quality to allow a medical diagnosis to take place. This has been achieved by connecting a microscope with a colour TV capability to the network. At the receiving end, the images, of bone tumours in this particular case, are reproduced on a visual display unit (VDU) and allow the consultant pathologists to make instant diagnoses or give second opinions. It is hoped to develop this application to the point where the pathologist can have full interaction with the distant end, ultimately leading to the possibility of conducting operations remotely.

Interactive collaborative research

Molecular modelling
Molecular science is becoming more and more dependent on the fast and effective transmission of information based on the three-dimensional structure and properties of molecules. Enormous time and therefore cost

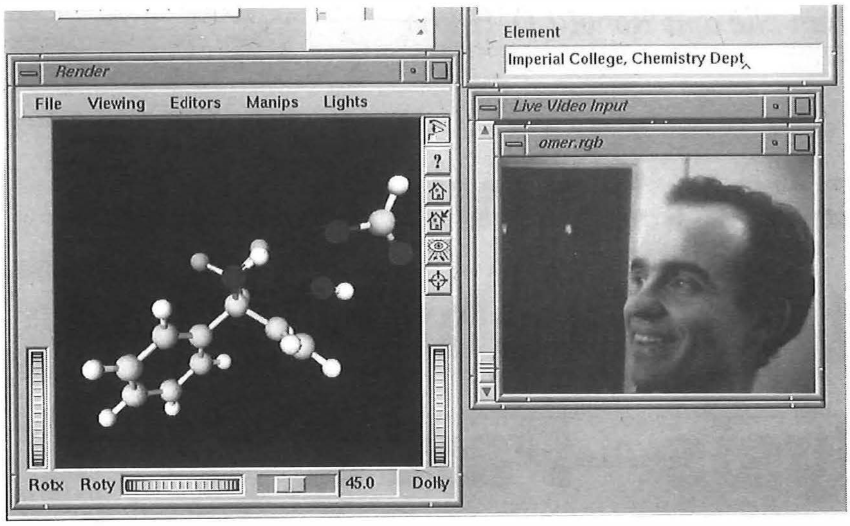


Figure 5—Three-dimensional molecular image manipulation

advantages can be achieved from the simultaneous interaction of a number of research groups when modelling molecular structures. With the advent of the SuperJANET network, it is now possible for crystallographers, theoretical chemists and synthetic chemists in different locations to interact in real time, manipulating the three-dimensional molecular image in unison. This chemical engineering function is enhanced by the addition of videoconferencing between the sites to allow for communications between the operatives. (See Figure 5.)

Conclusion

The above text only identifies a small cross-section of the applications that are at present under development, many more are at present under experimentation or in the pipeline. Many of the applications discussed above are appropriate to the academic and medical sectors but could easily be evolved to suit many commercial applications. The limitations of commercial applications development using SuperJANET are only bounded by the extent of the imagination.

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Biographies

Michael Head
BT Product and Services Management

Michael Head joined the company in 1975 as a Trainee Technician Apprentice. He worked on various engineering duties including exchange maintenance and PABX installation and maintenance. In 1984, he moved on to manage the private services control for Northern London, and in 1988 was seconded to the Action 88 Programme, working within a small team tasked to improve the delivery of private services to customers nationally. In 1989 he moved on to provide operational and procedural support for the KiloStream product range. In 1990 he was appointed to his present post as the product launch manager for high-speed data services within P&SM Services Development Division, where his responsibilities include programme management for the SuperJANET contract.

Paul White
BT Worldwide Networks

Paul White joined the North East District as an apprentice in 1978. He moved to London in 1987 to work on international private leased circuits (IPLCs) in British Telecom International and was involved in several projects including the introduction of IPLCs onto the first transatlantic optical cable, TAT8. Since November 1991 he has worked in Worldwide Networks on the development and implementation of broadband networks, providing inputs into the emerging European SMDS Interest Group (ESIG) specifications and deploying BT's SMDS trial and pilot networks.

Neil Morgan
BT Business Communications

Neil Morgan joined BT in November 1985 as one of the founding members of Government National Accounts. Prior to joining BT, he worked for 10 years as a buyer responsible for Government IT defence-related contracts. While with BT, he has provided account management to a number of different Government departments. He moved on to the Higher Education Sales Team in 1990 and has filled several roles including business development manager. He is currently the account manager responsible for the development and growth of the SuperJANET contract.

Tun Chun Nie and Ronald D. Hilton

Outsourcing Service and Information Technology Analysis—Part 2

The fundamental aspect of outsourcing service lies in the application of information technology (IT), which empowers the corporation to gain competitive business advantages. It is increasingly judged upon the criterion of how well it fits into the way an organisation does business. Part 1 of this article examined IT from the business-application perspective. This second part provides an overview of key development trends in the computing and communication technologies.*

Introduction

The acceptance of PCs and workstations as the desktop computer has changed the infrastructure of information systems in corporations. Distributed processing architecture, which is considered to be the preferred platform to organise business applications, will generate a different type of traffic demand on the communications network.

This second and concluding part of the article analyses some of the key technology development trends in the computing and communications areas. The paradigm shifts in technology and business to become increasingly more cost-effective to compete in the global economy has made outsourcing an opportunity to be a part of the corporate business solution.

Distributed Paradigm

Distributed computing paradigm, in general, means that the process execution and information storage of business applications are distributed in a local and/or remote networking environment which encompasses various process platform and protocol technologies that are transparent to user access. The transparency of multiple processors to the application users is achieved through the operating system software, which is the pivotal part of the distributed system.

The basic philosophy is to separate the application or data into parts, and process them on different machines. The application improves performance by running each part on the most appropriate processor, and information access becomes more efficient by storing frequently accessed data at local level to reduce communication traffic and costs. It is believed that distributed computing is at the heart of aligning IT with the changing business processes that require the flexible use of computing power and scalable deployment of technology investment to empower businesses to compete on their terms.

The adoption of distributed applications in the corporate business environment is becoming increasingly popular. The current implementations are primarily based on a mixture of several prevailing alternatives, which, in general, fall into one of three network-based distributed computing architectures as illustrated in Figure 6, and described as follows:

- *Client-server computing model* The fundamental components of this model are the client, server and network. It uses technologies such as graphic user interface (GUI), PC, workstation, server and local area network (LAN). The application operates cooperatively, with one part executing on user workstations as the front-end user interface client, and the other part running on a separate powerful multi-tasking machine as the back-end

* Tun Chun Nie and Ronald D. Hilton. Outsourcing Service and Information Technology Analysis—Part 1. *Br. Telecommun. Eng.*, July 1993, **12**, p. 132

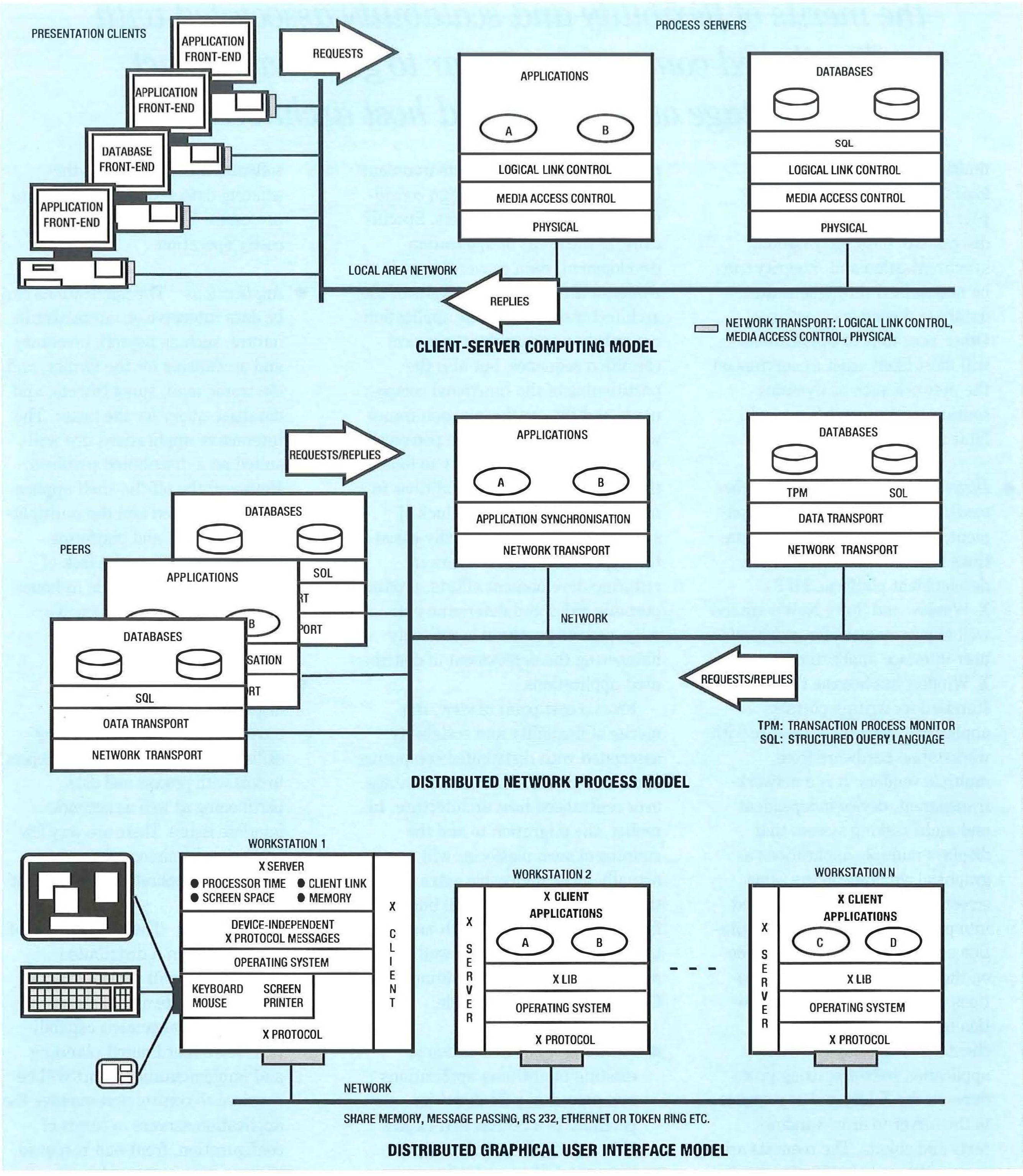


Figure 6—Distributed computing models

process server in a network environment. Communication always takes the form of request-reply pairs, with the client requesting process from the servers and the server only replying to requests from clients. The popularity of the database server may have been what made this model more prevalent. The appearance of GUI-based front-end tools that could access data in multiple servers seemed to further solidify the acceptance. It is also well suited for applications where the emphasis is on user interaction with corporate information, such as decision support, statistical analysis and automated work-flow system.

- *Distributed network process model* This model shares many similarities with the client-server architecture. It differs in the role of communication where the application is equally distributed in the network and operating in a peer-to-peer mode. The application can play either the requesting role or replying role. This model is suitable for implementing the distributed database management system that allows databases at *the merits of flexibility and scalability associated with distributed computing appear to give it a distinct advantage over centralised host architecture*

multiple sites to appear as one logical entity. With the peer-to-peer functionalities equally distributed, data distribution, synchronisation and integrity can be maintained throughout the database during transactions. Other peer-to-peer applications will most likely exist as services on the network such as dynamic routing, protect switching and fault isolation functions.

- *Distributed graphical user interface model* In the engineering environment, graphic windowing workstations have been the norm as the development platform. MIT's X Window and Sun's NeWS are the well-known systems for graphical user-interface applications. X Window has become the accepted standard for writing portable application software to operate with workstation hardware from multiple vendors. It is a network-transparent, device-independent and multi-tasking system that displays multiple applications as graphical windows on the same screen. The application is divided into processing client and presentation server parts that could reside on the same or separate workstations on the network. This definition is the exact opposite of the client/server model. The client application software, using procedures in the X Lib, makes requests to the server to draw windows, texts and objects. The requests are sent in the packets of instructions conforming to the X Protocol, which is a network-transparent graphics description language. The server handles the actual drawing of the screen, windows management and user communications with the clients via a keyboard and a mouse.

Moving away from the traditional centralised host/dumb terminal architecture to the distributed computing platform has presented several challenges. The interworking between the various parts of the application in a network environment becomes an important design consideration for the programmers. Specifically, in the areas of application development, data conversion and response time are direct results of the architectural change. The application not only has to consider the logical execution sequence, but also the partitioning of the functional components and the synchronisation issues which directly relate to the perceived performance and the ability to handle the various exceptional conditions in a networking situation. The lack of software tools to methodically assist the application programmers in reducing development efforts, produce portable codes and determine optimum process partition is seriously hampering the deployment of distributed applications.

From a cost point of view, the merits of flexibility and scalability associated with distributed computing appear to give it a distinct advantage over centralised host architecture. In reality, the migration to and the running of such platforms will actually incur noticeable extra cost on the information system (IS) budget. In fact, companies end up with more traffic and applications as well as additional support and training costs. Contributory factors include:

- *Planning* The evaluation of existing mainframe applications and procedures for downsize potential is a critical and expensive activity. It includes application suitability/availability analysis, networking issues, cost analysis, performance and user interface requirements.

- *Conversion* The data, files and procedures designed for the mainframe host must all be converted to operate in the distributed network environment. The conversion ensures that records and their fields will respond to the database query language used in the network operating system. The application software has to duplicate the existing data retrieval and update processes. This is a tedious and costly operation.

- *Applications* The applications can be data intensive or interactive in nature, such as payroll, inventory and accounting for the former, and electronic mail, spreadsheets, and database query for the latter. The interactive applications are well-suited on a distributed platform. However, the off-the-shelf applications are limited and the multiplicity of protocols and platforms involved, as well as the lack of software tools, has made in-house development a very expensive undertaking.

- *Training* The architectural disparity requires new design considerations and programming skills from the application developers to deal with process and data partitioning as well as network interface issues. There are very few professional training courses in 'distributed application development'.

- *Management* The proliferation of applications in a distributed environment will place a greater demand on network communications and management capabilities. More coordinated planning and implementation effort will be required to control and manage the application servers in terms of configuration, front-end response time requirements and access security.

Distributed computing technology is still in its infancy, and true distribution of applications to multiple processors over multiple networks is rare. A single application server for multiple clients over a specific network is the common implementation of today. The next-generation distributed computing system will be based on emerging technologies specifically in the middleware and object-oriented design.

With the existing network, and with a fair degree of certainty of what the future might be, the challenge lies in the necessary evolutionary steps in between.

Middleware is a common set of communication services that will enable application programs to operate in a distributed, multi-platform and multi-protocol computing environment. The most widely recognised middleware is the Open Software Foundation's Distributed Computing Environment (DCE) which provides remote-procedure call services for communication among components of a distributed application; name services for locating servers and application components; and security services that authenticate the requests for access to servers.

Object-oriented technology will enable applications to be developed in a fraction of the time it now takes by using objects, which are sets of independent software modules that represent arbitrary complex concepts. Each *object* comprises data, functions it performs and attributes it characterises. These three components form an object's internal implementation and are encapsulated into a software module. Developers use these objects to build their applications without having to understand the object's internal details. It is the fundamental technology that promotes software reusability.

The real benefit of distributed computing lies in the potential versatility of the system to unlock the central applications and data to put power into the hands of the user. Adaptability and scalability are the fundamental driving factors behind this phenomenal paradigm shift; adaptability as a long-term evolutionary platform to embrace new emerging technologies, and scalability as a cost-effective implementation that preserves initial investment and adds increments as the needs grow. The cost advantage will only be attained as the technology becomes more mature, specifically in the middleware tools and object-oriented design.

Network

It has been widely accepted that the network in North America will evolve from today's primarily T1-carrier based time-division multiplex (TDM) networks to the future asynchronous transfer mode (ATM) switching architecture based on synchronous optical network (SONET). With the existing network, and with a fair degree of certainty of what the future might be, the challenge lies in the necessary evolutionary steps in between. The growing availability of new networking equipment and services based on the emerging technologies is veering this transitional period into an era of networking trial. Carriers are experimenting with new product and service technologies. Corporations are trying out the various networking solutions with the available service offerings to suit their specific applications needs.

This transition will be driven by customers' changing needs and new technologies, as well as by how soon they can be deployed. Network infrastructure renovation is a major endeavour. The current estimates of the US national copper loop plant asset is about $60 billion. Investment in technology has to be justified in business terms, and it will be influenced significantly by the depreciation policy under state and federal regulations. Carriers tend to be more conservative in this respect with a given depreciation period of no less than 15 years, while private sectors are encouraged with a 3–5 years period. It is no surprise that the industry is forecasting that corporate networks will most likely be the proving-ground for this new technology and will play an important part in driving this transitional period.

The corporate network in the US has evolved from a core of 2·4 kbit/s to 64 kbit/s private leased lines of the 1970s to a mixture of T1, fractional T1 and public switched services ranging from switched data to fast packet services that constitute the hybrid network of the 1990s. As the result of AT&T divestiture, competition has driven down the cost of long-haul T1 services in the USA, while at the same time, service provisioning has become more complex due to the regulatory arrangements. These were the two primary factors that encouraged the growth of corporate private networks. It was estimated that about 80% of Fortune 1500 companies employed a T1-based backbone network as the means to achieve cost-effective, reliable and flexible connectivity to meet their communications needs.

In general, private networks in today's corporate environment can be categorised into three types of configuration, as illustrated in Figure 7. These configurations can be viewed as a networking progression that directly reflects the status of IT development in a corporate business as well as its willingness to embrace new technologies and services, as follows:

- *Integrated voice and data network* Data and voice applications are conveyed on the same physical backbone network. This is the typical configuration of the 1980s' private corporate network. The computing applications supported are largely transaction processing based. Centralised computing architecture was the norm for corporate data processing centres. The corporate databases and application processing ran on the hosts in the centres and served a distributed population of user terminals through the network for access at 9·6 kbit/s. Corporate voice applications were based on PBXs interconnected through the same backbone for enterprise communications. Although LANs started to move into remote corporate premises at departmental or divisional levels in the late 1980s, the requirements for LAN–LAN interconnection were still very limited.

- *Distributed data network* The advanced features and potential cost-saving associated with the virtual private voice network services introduced by the carriers in the late 1980s have encouraged

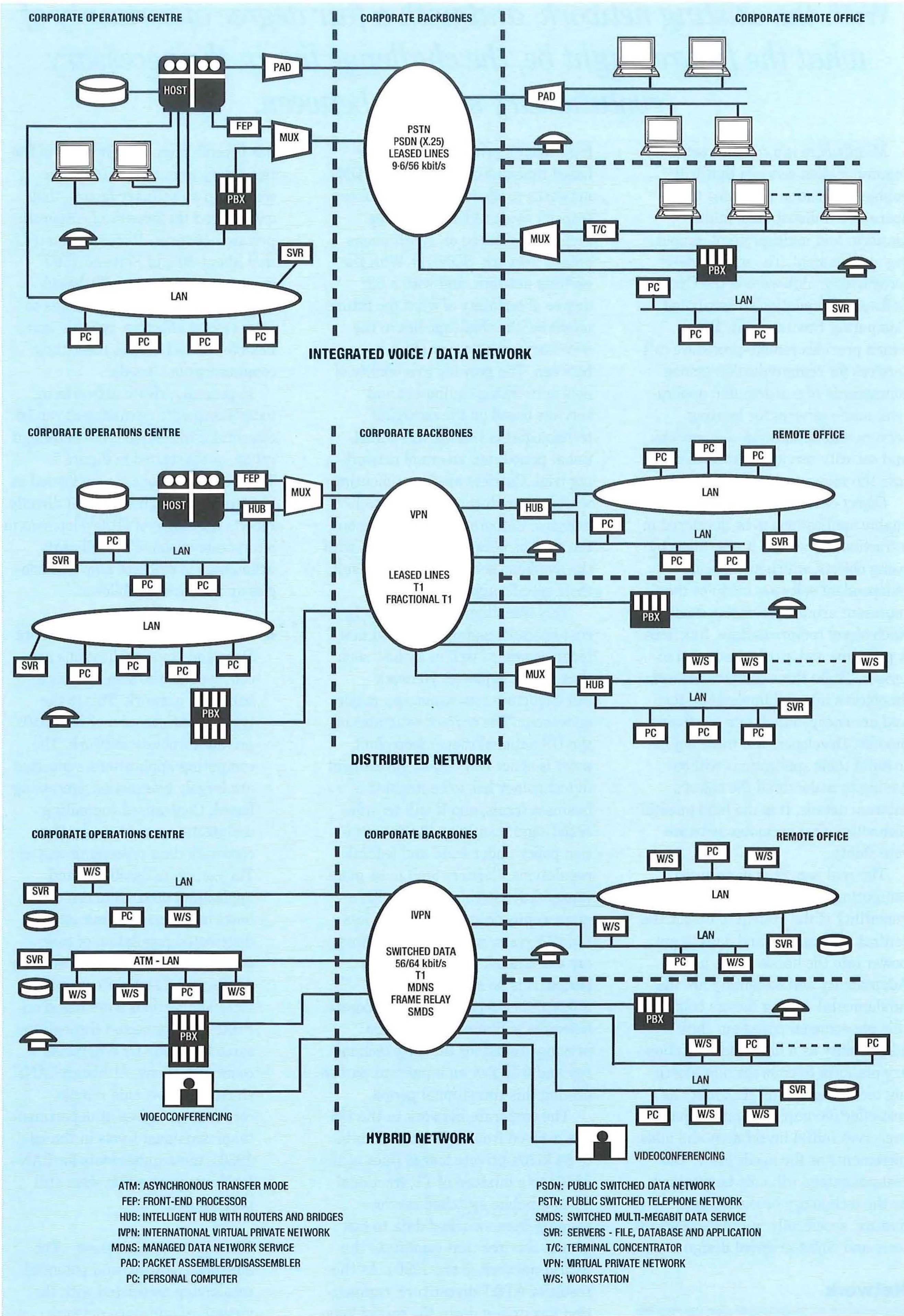


Figure 7—Corporate network evolution models

Cost continues to be the most significant factor in driving corporate networking strategy.

the corporations to migrate their entire voice communications onto the public switched networks. This will allow them to meet the growing needs of data communications that have become more critical to the business. With the phenomenon of corporate IT paradigm shift, and the change in business climate, computing architecture is moving towards a data-driven LAN-based distributed platform. Business applications have started to move into distributed PCs and servers over LANs, while corporate databases have largely remained on the centrally located hosts for payroll and accounting data processing tasks, which can be accessed remotely. Meeting the demands of LAN-to-LAN traffic has become one of the key factors in shaping the future of corporate enterprise network.

- *Hybrid Network* Cost-effective switched and managed data networking services have been introduced since the early 1990s by many carriers. These services can be based on X.25, systems network architecture (SNA), transmission control protocol/internet protocol (TCP/IP), frame relay, or switched multi-megabit data service (SMDS) network architectures, with increasing global connectivities, to suit the specific networking needs of different business applications. Emerging technology such as ATM is also likely to be deployed for LAN replacement to interconnect super workstations. The corporate network of the 1990s is transforming into a hybrid of private and public enterprise-wide networks.

The corporate computing environment of the 1990s will continue to place growing demands on network utilisation in terms of bandwidth, connectivity, response, reliability and flexibility. To design and to operate an increasingly complex and high-capacity backbone network require highly skilled planners, automated design tools, sophisticated engineering and advanced operations environments. Although the availability of many emerging services can be advantageous to the corporate business which is willing to deploy multiple technologies to optimise various segments of the network, it adds a greater challenge and complexity to design and operation tasks.

Cost continues to be the most significant factor in driving corporate networking strategy. Increased complexity associated with growing demands and new multiple technologies will command a considerable increase in the communications budget that will have to be justified rigorously in terms of business value. Specifically, the human aspect of running a network, in terms of staffing and training, could amount to 40% of the total communications budget.

As the corporate network evolves through the 1990s, more networking services and management options will become available at lower cost, wider geographical spread and a higher degree of reliability. Networking trends are, therefore, moving towards increasing use of carrier services and system integrators' options to strive for an optimal balance in the cost-versus-performance equation. These options can range from the various public switched data services, managed data network and virtual private network (VPN) to system consultation, implementation, facility management and outsourcing.

Public switched network, or carrier-provided, services in general have also experienced a major transformation since the late 1980s, specifically in introducing intelligence into the networks, adopting a usage-based pricing structure and strengthening the capability to support data networking applications. This is partly driven by the revenue protection strategy against bypass industries and partly driven by enabling technologies such as fibre optics, software-controlled transmission/access equipments and advanced switching network with common-channel signalling capability and distributed database architecture. These technologies offer advanced functions such as customer dialling plans and service management with growing access choices, whereby cost is no longer the only criterion for carrier services selection.

The major benefits associated with the carriers' services are primarily the ubiquitous connectivities afforded by the public networks as well as the potential cost savings which typically result from the economy-of-scale and competition. This is evident from past experience in the following commonly deployed carrier facilities and networking services:

- Analogue dedicated circuits.
- Digital dedicated circuits.
- Fractional T1 circuits.
- DS1 circuits.
- DS3 circuits.
- X.25 packet switched service.
- Virtual private network services.

To meet the increasing corporate communications demands, many long-haul and local carriers have introduced new networking services with increasingly more user-accessible management and control functions in terms of configuration and performance monitoring capabilities. These new services can be categorised in a generic sense as follows:

- switched data services—56 kbit/s, 64 kbit/s, 384 kbit/s, T1, T3;
- bandwidth-on-demand networking services;
- customer-controlled configuration services;

With this global service platform, carriers will be better placed to provide the level of service transparency required by customers

- managed data network services—frame relay, X.25, SNA, SMDS;
- international virtual private network services; and
- videoconferencing services.

Corporations have been using VPN service as an alternative or adjunct to the private voice network since the late 1980s. It offers increasingly more powerful call features at lower cost than those available in private networks, where expensive facilities can be off-loaded to carry growing data traffic which is more critical to the corporate core business. These features include functions such as custom dialling planes, preferred routing, call blocking, abbreviated dialling and authorisation code. Another significant advantage of VPN is that switched access can bring remote sites onto the corporate network much more cost-effectively and quickly (in a few days). Access to the VPN management system is provided to the customers to manage call statistics, number identification, restriction, feature modification and performance data through a low-cost terminal or PC at the corporate premises. The associated billing facility is also becoming more sophisticated, with flexible invoicing arrangements and traffic management forecasts that can be customised to suit organisational structures.

In general, VPN covers Centrex, domestic and international services. Centrex provides virtual PBX services for small business intra-site communications, whilst domestic and international VPNs, served as a closed-user group on a public switched network, can extend that coverage for national and global inter-site communications. As the global economy continues to drive today's business climate, international VPN (IVPN) service becomes increasingly important to major corporations worldwide.

Initially, IVPN was offered as an extension to the carriers' domestic VPN services to yield savings of up to 25% on international direct dialled calls. It has evolved from merely offering basic voice grade circuits and now includes advanced call features with selective blocking/forwarding and switched 56 kbit/s data that extends to more than 20 countries. The move of call intelligence, such as numbering and routing, away from being switch-dependent, and the standardisation of call processing and feature creation will continue to provide carriers with unprecedented flexibility in offering customised voice services.

Although corporate voice traffic is being moved back to the public network, mission critical data applications still largely remain on private networks which are primarily based on leased-line options. This is changing as switched data services are becoming readily available for high-capacity connections. At the low-end of circuit switched data are 56 kbit/s or 64 kbit/s circuits. They are being offered and priced at VPN level with international connectivity, and frequently used for leased-line replacement, back-up and $N \times 64$ videoconferencing with an inverse-MUX. At the high-end, 384 kbit/s, T1 and T3 circuit switched services are also available for high-definition videoconferencing, file and image transfer. As the cost continues to decline, these high-speed switched data services may become an integral part of the VPN portfolio.

As a category by itself, managed data network service (MDNS) can be considered as a virtual private data network service. It provides packet-switched data services, and the same advantages as the VPN and IVPN for circuit-switched voice services. Market researchers are forecasting a rising demand from major corporations for these managed services. MDNS, in general, is based on a carrier backbone network shared by customers who own or lease equipment situated on their premises. These backbone networks are technology specific and predominantly based on X.25 or SNA switching architectures. Fast packet-switched services based on frame relay and SMDS technologies are also becoming increasingly available at a higher data rate suitable for LAN interconnections. Network customisation and single-point-of-contact for provisioning and maintenance are the key features associated with the MDNS. Flexible billing and customer access to service management systems are becoming a part of the service offering.

These existing managed data and voice services are typically aimed at niche applications as well as being technology specific. Globalisation of these services has been heavily hinged on technical and operational practices agreements between domestic and overseas carriers to maintain uniformity in service definition, management, standard, billing and planning. It is believed that these uniformities can only be achieved more effectively from a single and integrated (voice, data and video) global switched service platform with an infrastructure that provides seamless transition to the future broadband switching and transmission technologies. With this global service platform, carriers will be better placed to provide the level of service transparency required by customers and to be more focused in their core business at cost levels which justify their economics.

Management

With the wide deployment of T1-based corporate networks in the 1980s, the task of management has progressed from the simple monitoring of a network of modems to the complex control of diverse and interconnected intelligent multiplexing and switching nodes. The proliferation of such networking equipment has made efficient communications possible. However, growing functionalities, in terms of configurability, testability and measurability, often come with various implementation approaches

The proliferation of client / server computing and LAN interconnections in today's corporate environment is influencing the perception of future network management architecture.

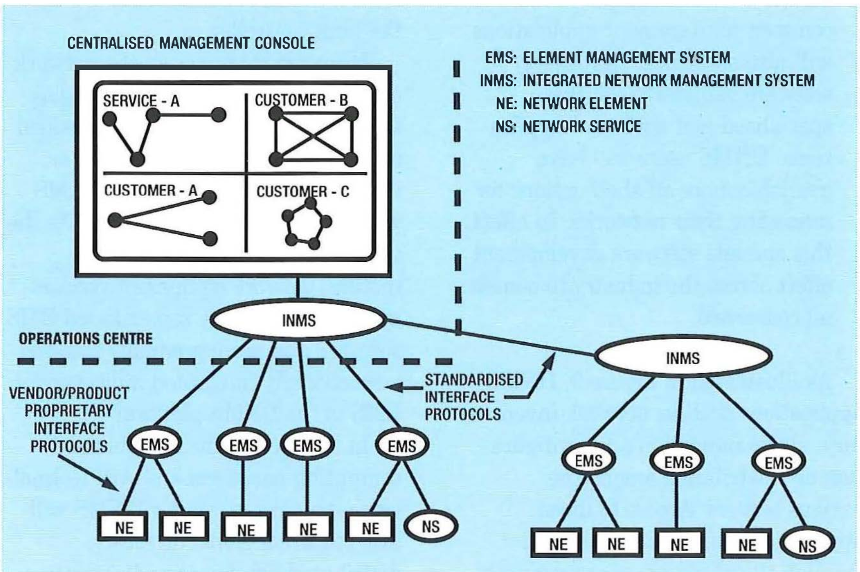
resulting in fragmented management systems that are vendor as well as product specific. As the network has evolved with technology, the number of management systems and the operators required have increased continuously to a level where the investment has resulted in a diminishing return in overall network manageability.

The integrated network management system (INMS) architecture, also known as the *manager-of-managers* or *umbrella management* technique, has been the solution pursued to consolidate the various low-level management systems and to operate from a single integrated system. As illustrated in Figure 8, this is a three-tier hierarchical management structure. The lowest level consists of various network elements and services such as multiplexers, packet switching nodes, PBXs, VPN and managed data network services. The middle layer comprises element management systems (EMS) which control and monitor operating functions, such as alarm detection, bit error ratio, protect switching and call feature changes, that are element or service specific. The top level is the INMS that aggregates the network-wide alarm, diagnostic and configuration information from the EMSs and provides a single operational view of the network.

The interfaces between EMSs and the managed elements or services are typically vendor specific and proprietary. Communication between INMS and EMSs is achieved over a standardised interface protocol such as Open Systems Interconnect-Network Management Forum (OSI NMF) or simple network management protocol (SNMP) over TCP/IP. To make management inter-operability possible, however, a correlated set of management applications has to be realised on both sides of the management system. With this interface structure, it is technically possible for an INMS to inter-operate with any network elements and services, through the mediating EMSs, as long as a common interface architecture is observed and there is a correlated management function established between the two. The management domain can also be extended horizontally by interworking with other INMSs to cover a wider geography or with other networks having different architecture.

The goal of this architecture is to integrate all inter-operable management functions and to centralise operator interfaces associated with the various management systems on a single INMS that covers the entire physical network with one console. With centralisation, it is also possible to bind the various physical elements in the network to create a logical end-to-end view of sub-networks or services by using advanced GUI software and database applications. Well-known systems such as BT Concert, AT&T Accumaster Integrator, IBM NetView and Nynex Allink were implemented based on the concept of INMS.

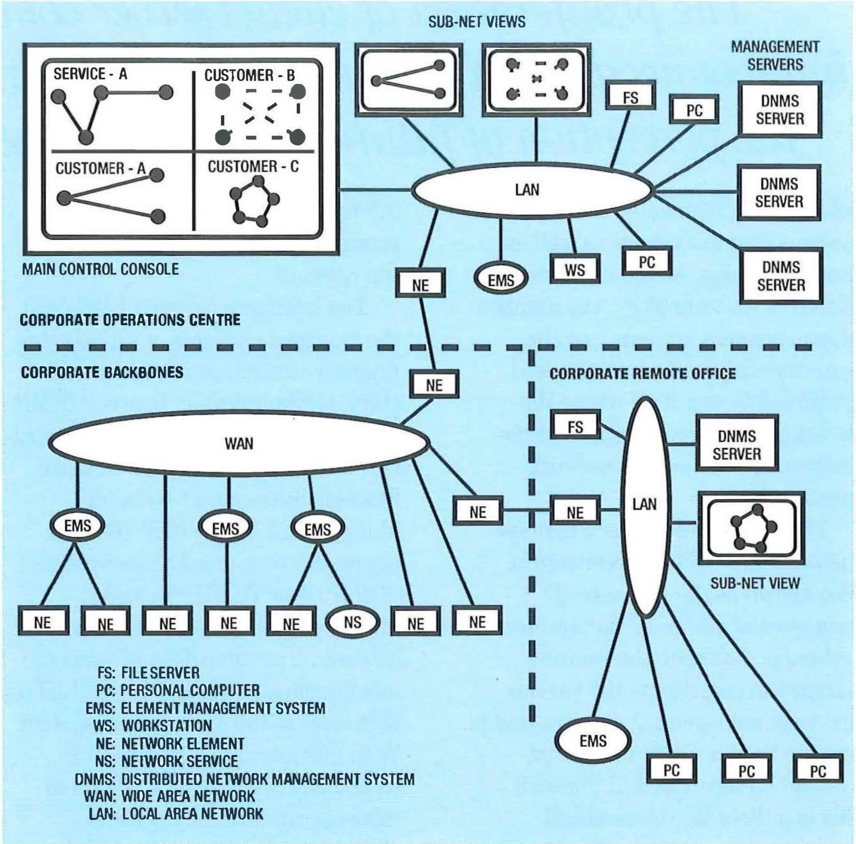
Figure 8—Integrated network management architecture



Although INMSs have demonstrated their potential, the actual deployment of these systems in the corporate networks is limited (with the exception of NetView) and the development experience has been slow and uncertain. This is due primarily to the development complexity involved, particularly in the software. To perform all management applications on a single system requires a very powerful computer. Very sophisticated and complex software would be required to analyse the vast amount of event data collected from the EMSs to perform network or service level fault isolation and end-to-end provisioning applications. If these applications are to be performed cooperatively between INMS and EMSs to off-load some of the central processes, a joint development program has to be established with the EMS vendor. This application level (as opposed to protocol level) cooperation is vendor specific, and as such it has to be developed on a per-vendor basis. This will almost inevitably add further complications and uncertainties to the development.

As more elements are added to the network and as higher-level functional integrations (or automations) become necessary, the processing power of a single computer quickly reaches its practical limits and continuous investment in software effort will only result in steadily diminishing returns. Furthermore, in the wake of the corporate computing paradigm shift towards distributed architecture, the concept of centralised management is seriously being re-examined.

Figure 9—Distributed network management architecture



The proliferation of client/server computing and LAN interconnections in today's corporate environment is influencing the perception of future network management architecture. The network has become an integral part of the computing platform that includes gateways, routers and bridges. Consequently, the management domain is extended and its functions are also required to reach to those devices which are typically located in the corporate premises where business applications are used. It has become obvious that benefits associated with the distributed computing platform for the business application are also directly applicable to network management functions. As management functions further extend into the LAN domain where servers, workstations, PCs and desktops are an intimate part of business applications, it is evident that distributed applications will need decentralised management functions.

While a standard protocol has provided a common basis for communication between management systems, a daunting task lies ahead in the application cooperation which has been vendor as well as platform specific. This has severely hindered progress towards a pragmatic vendor-independent environment. Distributed network management system (DNMS) architecture is built on the foundation of the distributed computing paradigm. It adopts the concept of client/server model, such that applications can be partitioned to run on a computing platform with more than one computer. Most importantly, it promotes a standard application programming interface (API) for the management application to access services of an operating system, a database system, a communication protocol driver and other applications (client or server) in a generic way, such that software can be developed independently of vendor, platform and protocol. The key benefit associated with the DNMS lies in the following two fundamental aspects:

- *Scalable platform* As management applications expand, new servers can be deployed to partition or off-load the application in a distributed fashion. This is hereditary from the client/server model that precisely unravels the computing bottle-neck associated with INMS single platform architecture.

- *Portable software* The adoption of a standard API will allow software to be ported and reused on different platforms to extend the scalability further into the multi-vendor domain. Standardisation of common management applications will also encourage third-party software vendors to develop specialised and advanced applications. DNMS users will have available more off-shelf options for managing their networks. In effect, this spreads software development effort across the industry to benefit all concerned.

As illustrated in Figure 9, DNMS applications such as network inventory, alarm indication and configuration are distributed among the various servers. Access to these applications can be accomplished through the client processes running on the workstations that are typically attached to the local corporate LANs, which could be interconnected through bridges and routers over wide area network (WAN) backbones to cover the entire enterprise. Applications are configured to different servers based on the functions, network-element categories or management domains, such as inventory versus alarm, routers versus MUXs or headquarters versus remote offices. On the basis of the same arrangement, access privileges can also be configured to cover either the entire network as the main control console or a sub-network as the local controller.

Managed resources on the network can inter-operate with the managing servers directly through an embedded agent with basic API primitives, or indirectly through a mediating EMS with API management services. As the technology and standard of API mature, network equipment vendors will start to produce server-based EMS software and move gradually towards a functionally integrated multi-vendor EMS in the DNMS platform.

In addition to the distributed computing paradigm and API technology, a true multi-vendor DNMS will also require a global directory, distributed databases and security

A most important aspect of network management is the establishment of a clearly defined operations process

systems to provide a unified identification, an efficient storage and an authenticated access of all network resources. These inter-process communications and management technologies are still at an early stage of development. A set of emerging standards known as the *distributed management environment* (DME) developed by the Open Software Foundation appears to be a promising model for the DNMS. Although there are many challenges ahead, the momentum of the network management industry is heading in that direction. BT has launched a new initiative known as PLATO to embrace DNMS architecture. AT&T has also recognised this imminent future and is withdrawing Accumaster Integrator from the market.

The evolution of network management systems has been slow in providing real relief to deal with the growing networking complexity. Vendors' development efforts are enormous, and user's cost for a typical INMS, as an example, can be expected to be in the range $250–350 000. The decision to deploy such a system will not be taken lightly by any user. A most important aspect of network management is the establishment of a clearly defined operations process which guides all phases of network operation activities. This process may consist of manual or semi-automated procedures that take advantage of existing technologies. As the network evolves and as new technologies become economically viable, this process can be further automated or innovated to gain additional operations manageability.

The concept of DNMS is very much in accord with the future computing trend. It is believed that LAN interconnections, and LAN management in particular, will continue to be the technological focus of corporate communications. As this trend progresses, DNMS based on standardised distributed processing technologies will continue to grow in importance and user acceptance.

Conclusion

This two-part article has provided a general analysis of outsourcing service and IT from the perspective of business applications, computing and communication technologies.

Part 1 presented the rationale behind the outsourcing business and the high-level perspective of the service portfolio. It also examined the business engineering process and application aspects of IT. Part 2 has provided an overview of key technology trends in the computing and communications aspects of IT.

The application of IT to business environments only makes sense if it adds value to the corporation in terms of productivity and revenue. Outsourcing makes better sense to the customers if it harmonises with their corporate IT strategy. As the technologies become increasingly complex and resource-demanding, outsourcing at all service levels will continue to be a valuable and economical option as a part of the corporate IT strategic portfolio.

Biographies

Tun Chun Nie
Syncordia

Tun Chun Nie is manager for network evolution at Syncordia Corporation. He graduated from the University of Essex, England, with a B.Sc. (Honours) degree in Electronics Engineering and an associate B.Eng. from Ming-Hsing Engineering College in Taiwan. He has worked for a number of major telecommunications companies in the UK and USA. Prior to joining Syncordia, he worked as a software manager in Bell Northern Research and has led a development group for the network management system. Among other activities, he is currently involved in analysing and consulting strategic approach to corporate IT and network outsourcing.

Ronald D. Hilton
Syncordia

Ron Hilton is Director of BT Products and Services Management (P&SM) Services Development in North America. His career began in 1970 when he joined Western Electric in Dallas, Texas. After working in the operator services and digital toll switching divisions from 1970–80, he joined AT&T Long Lines responsible for switch maintenance and circuit administration of the 4ESS. In 1983, he joined DSC Communications as Manager of Technical Support for digital switching systems supplied to the new common carrier market: MCI, Sprint, etc. While at DSC, as Director of Technical Marketing Europe, he was seconded to the UK from 1989–91. He joined Syncordia in 1991 as Director Network Evolution to address the emerging multinational customer market with outsourcing solutions. He transferred to his current position in 1992.

Grupo Santander and BT to Form Joint-Venture Company for Datacomms in the Spanish Market

Grupo Santander, the fourth largest financial group in Spain, and BT have announced their intention to form a 50-50 joint-venture company aimed initially at addressing customer requirements for data communications in the Spanish market. The new company will invest £400M over the next 10 years.

The company will be headquartered in Madrid and trade under a BT name. In Spain, the company will own and operate Banco Santander's nationwide data communications network and, by the end of the year, offer an extensive range of BT's managed data communications services in more than 31 cities throughout Spain.

Establishment of the new company is the first initiative to follow the Spanish implementation of EC liberalisation directives in the national telecommunications service market.

Iain Vallance, Chairman of BT, said that the new company will combine the skills of two different, yet complementary organisations. It will bring together BT's broad experience of the telecommunications market and its understanding of customer communications requirements with Grupo Santander's in-depth knowledge of the Spanish business environment and its extensive national data communications network.

Telemedicine Technology

Several pioneering techniques for transmitting medical data and expertise over the telecommunications network have been unveiled by BT.

Developed by scientists at BT Laboratories, the new services—collectively known as *Telemedicine*—will radically improve the speed and effectiveness of diagnosis and patient treatment in the future.

Telemedicine covers everything from the simple linking of medical equipment at different locations in order to transfer patient data between hospitals to more complex scenarios such as remote diagnosis. By using the powerful integrated services digital network (ISDN), medical experts can be provided with the detail they need to make a diagnosis and recommend appropriate treatment for patients at remote locations.

Two specific applications of Telemedicine are CamNet and the Endoscope Imaging System.

CamNet comprises a conventional audio headset with a miniature TV camera and viewing screen mounted on it. The headset is worn by the on-the-spot medic in a remote location and the camera relays live pictures of the patient and his or her condition over the network to an expert. In return, the expert can send pictures and data back to the medic via the small screen on the headset. The system gives the expert the illusion of actually being present with the remote medic.

Endoscopes are used in the diagnosis of many gastric and digestive ailments, including cancer of the colon, which claims up to 20 000 lives each year. The tip of the endoscope provides the surgeon with an internal view of part of the patient's abdomen. In many cases, it is equally vital to know the path the endoscope has taken within the abdomen. It is not uncommon for loops to form, leading to inconclusive diagnosis and distress for the patient. Presently X-rays are the only way to discover this information. X-ray machines are a scarce and expensive resource and carry a degree of risk to the patient and hospital staff.

Collaborative work between Sheffield University and BT Laboratories has produced the new endoscope imaging system which uses a low-intensity magnetic field to determine the path of the endoscope inside a patient's abdomen. By placing inductive sensors within the endoscope and linking them to a conventional personal computer, the path of the instrument can be displayed on the screen. It is safer than X-rays and, furthermore, the displayed path of the instrument is in three dimensions, allowing it to be manipulated and rotated in real time.

Both systems have undergone field trials and carry the potential of being in regular use in certain areas of medicine within the next few years.

BT Makes ISDN Even More Affordable

More businesses can now afford to take advantage of the benefits offered by BT's integrated services digital network (ISDN), following the introduction of BT's first ISDN telephone, the DP2000 (see Figure 1).

The DP2000 is a digital telephone which allows computers, facsimile machines and telephones to be connected to BT's ISDN. To achieve this, it integrates an enhanced V.24 terminal adapter and an analogue port into a fully featured digital telephone.

The introduction of the DP2000 presents businesses with a cost-effective method of achieving high-speed data communications between computers over the ISDN. It also allows non-ISDN-compatible office equipment such as Group 3 facsimile machines, telephone answering machines, analogue telephones or even modems to be used via the ISDN.

Figure 1—DP2000 ISDN telephone

Using ISDN enables companies to take advantage of fast and accurate voice, data, text and image transfer as well as features such as calling-line identity, fast call connection, call diversion and call barring. As companies need to increase productivity, the DP2000 can help businesses cut costs, save time and ultimately improve efficiency.

BT's ISDN Heralds New Shopping Revolution

A powerful new application using BT's ISDN has been launched, which is set to revolutionise the way people shop. Specialist multimedia agency, Applied Interactive Marketing (AIM), has developed a multimedia touch-screen sales tool (see Figure 2), incorporating

Figure 2—AIM's new interactive sales tool, using BT's ISDN

an effective market-research device to give retailers and manufacturers a competitive business edge.

One of the advantages of the new media tool would, for example, enable a car manufacturer to assimilate everything that currently exists in its range of brochures into a single multimedia system, containing still images, video, voice and text. Dealers around the country will be linked to the central database via the ISDN and, thus, be armed with a powerful selling device. The expense of producing glossy catalogues and the problem of keeping them up to date is no longer an issue, as the latest prices and product information are instantly refreshed on screen via the ISDN.

Using a touch screen, salespeople can go straight to the subjects of interest to the customer. Once they have chosen the model they like, customers can build up an image on screen of the car fitted with all the optional features they would like to have. For example, the colour, level of trim, type of wheels and dashboard options can all be added to the image on the screen.

Recent research has shown that this interactive element, coupled with the moving pictures and sound, means customers retain around double the level of information normally remembered during sales pitches.

Ideal for use in a dealership with a small forecourt, this application can also be used as a stand-alone unit in shopping malls and airport terminals. At these locations, names and addresses of interested customers can be gathered and the data sent via the ISDN to the nearest dealership.

Ray Pritchard, ISDN Supplier Liaison Manager for BT, said, 'This new interactive selling tool signals the imminent arrival of a whole range of multimedia applications, using sound, video and image to bring benefits both to BT's business customers and to consumers. BT is currently working with a number of suppliers to encourage new ISDN business applications.'

In addition to helping the customer decide on which product to buy, the AIM system also gives highly accurate market-research information to the retailer's marketing and buying departments. The system can count how many people have accessed it and can calculate the percentage of multimedia sale conversions. It can also give information on lost sales opportunities, so the store can ascertain what the customer actually wanted compared to what was in stock.

AIM is also currently testing its interactive multimedia system with major companies in fashion, home furnishings and domestic-appliance retailing.

European Business Demands Liberalisation Now for the Completion of a Single Market

Business leaders want more choice in telecommunications services, and they want it now! That is the message that comes over loud and clear from an independent survey commissioned by BT and carried out by Harris Research.

The survey researched attitudes among 500 senior decision-makers in eight different European countries. It showed that top European companies see liberalisation in major industry sectors as an essential step towards the completion of the Single European Market. Telecommunications heads the list of sectors where liberalisation is considered vital.

The summary reveals:

- 85% of business leaders believe that telecommunications liberalisation would reduce business costs;
- 91% believe that liberalisation would improve the range of services available; and
- 92% believe that competition would stimulate improved quality of service.

Daniel Cloquest, Director at UNICE (the European Employers' Confederation), said, 'This survey gives additional strength to UNICE's view that telecommunications liberalisation must be speeded up at EC level. It is essential for European competitiveness that full telephone services liberalisation is in place throughout the EC by 1998, and not at the end of 2003.'

The majority of business leaders surveyed cited cost reduction, increased efficiency and improved quality as the main reasons for demanding liberalisation of European telecommunications. The research findings highlight a real demand for a more competitive market.

Seventy per cent of all respondents say that given the opportunity they would consider changing their current telecommunications supplier. Seventy-nine per cent said they did not think it would be a risk. One-hundred per cent of top business executives questioned in Italy and Spain were dissatisfied with their present infrastructure, with every person questioned predicting a better telecommunications service through liberalisation. The majority of companies questioned (57%) would, in fact, consider lobbying their governments to accelerate the process of liberalisation although it was generally believed that their government would liberalise through privatisation and flotation rather than the introduction of competition. Seventy-five per cent of those questioned believed that telecommunications would be the first sector to be liberalised in Europe.

According to Jonathan Rickford, former BT Director of Government Relation, it was encouraging that senior managers responsible for the economic prosperity of Europe firmly believe that telecommunications liberalisation is fundamental to the creation of a genuine single market. He added, 'BT is the only telecommunications operator in Europe to have gone through privatisation and complete liberalisation of all domestic telecommunications markets, so we know at first hand the benefits for customers and suppliers of a truly liberalised market.'

High-Speed Access to GNS Dialplus Now Available

High-speed access, including a data compression facility, at 9600 bit/s is now available to customers of BT's GNS Dialplus service.

GNS Dialplus provides users with simple, low-cost access to remote computer applications and information databases via BT's Global Network Services (GNS). Previously available from 300 bit/s to 2400 bit/s, GNS Dialplus is now being offered at 9600 bit/s in response to customer demand. Twenty companies, including ICL and BACS (the UK's Bank Automated Clearing House), took part in the beta trials.

Kevin Hart, Market Sector Manager of BACS explained that by upgrading to the faster Dialplus service (from 2400 bit/s), user transaction throughput could be improved by over 500% while retaining the key benefits of simplicity, flexibility and cost. Since they introduced Dialplus three years previously, they had seen asynchronous access into BACS' online telecommunications service (BACSTEL) grow to over 200 users and become the most popular method of connecting directly into BACS.

John Riley, Operations Consultant of ICL Customer Services, added that during the trials they had extensively tested the functionality of the 9600 bit/s service and it had been found that it gave the speed and reliability that they had come to expect from BT.

Twenty four access points, including London, Birmingham, Manchester and Glasgow, are now in operation. These sites, selected following a study of existing usage patterns, will provide high-speed local call access for 77% of BT's existing GNS Dialplus customers, and 69% of all UK business lines.

BT Maximises Meridian Call Centres

Meridian MAX Release 4 is the latest call-centre upgrade from BT. Available on the larger Meridian 1 PBXs, Option 51, 61 and Option 71, Meridian MAX is a sophisticated management system, which provides a single source of reporting for a company's call centre.

A call centre is that part of a business where a large volume of calls enters or leaves. The purpose of the call is predictable and designated agents or a voice processing application can complete the call.

On a minute-by-minute basis, Meridian MAX shows, in real-time, the call traffic on any specific queue in the system. This enables supervisors to give priority to the calls which could generate higher revenue, or those from particularly important customers.

The upgrade offers enhanced automatic call distribution (ACD) routing and customer-controlled routing. It has an expanded capacity to meet the requirements of those companies whose call centre comprises up to 1000 agents.

Further features such as access to historical data; a series of 16 standard management reports; and the recorded announcement (RAN) report which shows RAN connection usage, mean that Meridian MAX Release 4 offers greatly improved management control.

BT EDI*Net Update

Over the past year, BT has continued to update and enhance EDI*Net, its electronic data interchange (EDI) service, to offer increased flexibility and choice for its customers.

Message status reporting system (MSRS)

MSRS is an optional feature, available at no extra charge, which allows users to obtain up-to-the-minute information on the status of their EDI*Net messages, through a dial-up connection from a terminal. Alternatively, the information can be collected automatically (in the form of an X.12 message) via the user's existing EDI*Net mailbox during the course of a normal EDI session. Standard reports that are required on a regular basis can also be configured to be produced automatically.

Introduced in response to customer demand, the MSRS option complements BT's high level of proactive EDI*Net Customer Service, which was designed to reassure customers of all sizes that their EDI documents have been successfully delivered within the required timescales.

Disaster recovery

BT has introduced a second site hot stand-by disaster recovery machine. This means that, even in the event of a major disaster, the EDI*Net service can be fully restored within a maximum of four hours.

Given the critical nature of the business documents transmitted via EDI*Net, the service has been designed specifically for resilience, using fully backed up Tandem hardware specially selected for the purpose.

British Coal IT Services Business Document Print Facility

To maximise the choice and flexibility of electronic trading solutions, BT plans to provide British Coal's Business Document Print Facility via EDI*Net. The facility will allow EDI*Net customers to reach trading partners who are not yet EDI users by printing out documents from their original EDI format and then mailing them onward.

The service, which is available 24 hours a day, 365 days a year, can be fully customised to individual users' requirements. In addition, response/control reports can be produced and returned electronically, enabling the user to retain control of the documents which have been submitted, processed and posted. The recipient will also be in a position to track which business documents have been received or are still outstanding.

9600 bit/s access

Dial-up access at 9600 bit/s is now available to all EDI*Net users, at no extra charge.

EDI-to-Fax Capability

BT has announced the introduction of a new EDI-to-fax facility which will allow EDI users to automate all their outward EDI documents to all trading partners regardless of their size or technical capabilities. A single, simple connection to EDI*Net will enable an EDI user to send messages to fellow users and non-EDI users in a single session, thus doing away with the need for running parallel electronic and paper systems. Non-EDI users will receive the documents the same day, unlike some EDI-to-post services where information is not received until the following day.

EDI benefits for major customers are dependent on the rate at which their trading partners implement EDI. Companies come in all shapes, sizes and cultures and develop technical expertise at different speeds. By adding the EDI-to-fax facility, BT is able to help users to realise the benefits of EDI much more quickly by making it easier for them to communicate with all their trading partners, by whatever method is most suitable.

BT EDI*Net Interconnects with INS-TRADANET

In a move designed to hasten the adoption of electronic trading within the UK, BT has announced the interconnection of its EDI service, EDI*Net, with INS-TRADANET, operated by International Network Services Limited (INS).

With all four major EDI networks within the UK now interconnected, EDI users will be able to communicate with their trading partners regardless of the network they are using. Instead of taking out multiple subscriptions to different EDI suppliers, EDI users will be able to select the EDI network which most closely matches their own needs, rather than those of their trading partners. The increased competition between networks will also undoubtedly lead to improved customer service.

The interconnection with INS, which will be in place during December 1993, will be via X.25 using the European standard, ODETTE File Transfer Protocol (OFTP). This technology is proven, robust and is already in use for existing BT, AT&T and IBM customers for interconnection. In the longer term, BT aims to interconnect with all the major EDI networks via X.400 by September 1994.

For UK companies considering the move from paper-based trading to electronic trading, the interconnection from BT's system to INS means it is now even more cost-effective to make the change. Interconnection with INS brings the total number of networks to which BT customers can send EDI messages to 62.

Quinton-Hazell Drives into the Future with BT EDI*Net

Quinton-Hazell, manufacturers of automotive parts, has opted for BT's EDI service, EDI*Net, as part of its overall strategy to help streamline pan-European stock control procedures and hence control capital outlay.

When stock falls below certain levels at Quinton-Hazell's distribution agents (located in France, Ireland, Netherlands, Belgium, Spain, Italy and Germany), orders are transmitted via EDI to the main distribution centre in Nuneaton, UK. Internal systems then take over to load production schedules onto the manufacturing plants. Larger distribution outlets, such as France, may receive up to three deliveries a week.

Ken Collins, Quinton-Hazell's Managing Director of European Operations, said: 'As our business grew in Europe, and the size of the orders increased, we found that the rekeying of order information into our central order processing system was proving more time consuming and inaccuracies were increasing. By introducing EDI*Net between our various sites, we can now place orders more frequently and accurately. This will help shorten lead times for deliveries, increase the stockturn and reduce stock holding. Our choice of service was simplified by BT's European coverage, and the fact that we were provided with a single point of contact that could be used regardless of where a problem might arise.'

The next stage of Quinton-Hazell's EDI implementation will be to enable the various distribution agents to order directly from the overseas factories, leading to more significant lead-time reductions. Further plans include returning invoices and advice notes to the distribution companies, collection of sales information for use by central forecasting systems, and document transfer via electronic mail.

Quinton-Hazell is using STX PC software supplied by Origin, a member of BT's EDI Business Team. The PC front-end is linked via a Digital VAX Cluster with Quinton-Hazell's order processing applications.

Pager Alert System

BT has been awarded a contract to supply the Pager Alert System, the latest initiative announced by the City of London Police to increase security in London's Square Mile.

The system, the first such application of pager technology worldwide, will allow police to advise the maximum number of people of a bomb warning or suspicious device, in the minimum amount of time. It will add to existing security and communications procedures.

Pager Alert System users will be notified simultaneously by a short message on their pager. The message will give the location of vehicle bombs or other devices, and enable people within the City of London to execute appropriate emergency procedures. Pager Alert will also be used to give periodic updates of events when the police deem it necessary.

Pager Alert is aimed at the entire City community. Potential users will range from City residents and the small business population to international banks and large multinational institutions, and those who work for them.

Europe Poised for Integration

European users, large and small, will soon be able to source all their fixed and mobile communications requirements from a single operator or service provider, according to a report published by Analysys, the Cambridge-based telecommunications and economics strategy consultants.

In *Fixed / Mobile Telecoms: Integration of services and networks*, Analysys argues that the European mobile communications operators are poised to challenge the domination of traditional 'fixed' voice telephony suppliers.

Tim Harrabin, principal consultant at Analysys and co-author of the report, says that the mobile operators will soon be able to offer all the services that a telecommunications operator can thanks to their intelligent network architecture and nationwide digital networks.

The report concludes that there will be important advantages for users if they can obtain a single sourcing arrangement for their telecommunications requirements. These include one-stop shopping, lower total communications costs and advanced services.

Susan Ablett, senior consultant at Analysys and lead author of the report, says that depending on the expertise of the user, the integrated service provider could become the user-friendly interface to help with making the relevant choices. 'This will help the organisation to assess its telecommunications requirements on a national or pan-European basis, recommending and implementing a solution, and periodically reviewing the changing requirements of the organisation.

'The key issue for Europe is how to allow competition in telecommunications to develop. It may be necessary to restrict the ability of the dominant telecommunications operators to offer integrated services while new integrated licensees get their networks up and running. Regulators need to bear in mind that the competitive advantages Europe has won by implementing the GSM digital standard for mobile communications may be lost to countries where operators are already moving towards integration.'

Vodafone Launches EuroDigital

Vodafone Limited, operator of Europe's largest mobile telephone network, launched its new nationwide EuroDigital mobile telephone network in September. Vodafone claims that customers will be able to use the digital technology in the UK and most of western Europe.

The new service covers 55% of the landmass and 90% of the population. Vodafone has invested more than £120 million building the EuroDigital network and expects to spend a similar sum in further developing and expanding its digital services.

According to the company, EuroDigital customers can use their telephones in Denmark, Finland, France, Germany, Italy, Norway, Sweden and Switzerland. Roaming will be available in the 'near future' in Greece, Ireland, Luxembourg and Portugal. Other European countries will follow during 1994.

France Telecom Looks for Allies

France Telecom Chairman Marcel Roulet has recently told *Le Monde* that he would favour a change in the statutes of the telephone company that would enable it to join forces with new shareholders, such as Deutsche Bundespost Telekom.

A far-reaching long-term partnership between the two companies would be the best response to growing competitive challenges, he said, adding that the UK–US link-up was a major event that revealed two structural handicaps at France Telecom: its current statute limited its ability to develop strategic alliances and a heavy debt burden tied its hands financially.

Reform should enable the company to seal strategic alliances and make sure that the state manages France Telecom well so that it can face up to the future. Although he would like cross-shareholdings with Bundespost Telekom, he was opposed to the state giving up majority control of France Telecom, which is not on the government's privatisation list, because of the strategic importance of the firm's network.

ETSI News: Principles for IPR Adopted

At its 17th General Assembly, ETSI approved the framework for implementing its Intellectual Property Rights (IPR) Policy and Undertaking. The General Assembly confirmed that this would include the implementation of a previously adopted IPR policy.

The resolution also instructs the Director of ETSI to elaborate a set of proposals for amendment of the Statutes and Rules of Procedure.

The new principles ensure that the intellectual property rights used in standards are licensed on fair, reasonable and non-discriminatory terms and aim to minimise the risks to standardisers while, at the same time, preserving the rights of IPR holders. They substantially reduce the risk that, at the end of standardisation work, an IPR holder may exercise his right to withhold his IPR by refusing to grant licenses on fair, reasonable and non-discriminatory terms. In this case, the standard in question would have to be redesigned to avoid the withheld IPR, incurring delays and a commitment of additional resources.

The IPR Policy and Undertaking is a tool which is vital for ETSI in achieving its mission to produce the technical standards which are necessary to create a large unified European telecommunications market.

VPN—Europe's Key to Success

Virtual private networking (VPN) will be the key to success for carriers in Europe's liberalising voice communications markets according to a report issued by the Yankee Group Europe.

The report—*Beyond POTS: The Future of Circuit-Switched Services in Europe*—shows that, notwithstanding all the hype about competition and new services, PTT-dominated or monopolised POTS (plain old telephone service) still accounted for 77% of the telecommunications and 93% of the circuit switched services market in 1992.

However, the Yankee Group Europe believes these figures are set to reduce substantially to 68% and 87% respectively in 1997 as the market opens fully to competition.

Europe is set to see the gradual evolution of circuit-switched services to enhanced lower-priced more-flexible services, including freephone, premium rate calling, charge cards, automatic call distribution, computer-supported telephony, special billing services, virtual PBX services and virtual networked services.

VPN will be the centrepiece—at least for large and medium-sized customers—both as a technology, and as an example of the way in which customers can be lured and retained. On the international front, VPN presents a bewildering array of technical and services options for both carriers and users.

Emergency Calls

A review group's recommendations not to set up an independent agency to handle emergency calls from all networks has been accepted by the Director General of Telecommunications (DGT). However, the group felt that to have 999 calls handled by many different network operators would be undesirable and has consequently recommended that the joint BT/Mercury system, in which Mercury and BT handle emergency calls from other networks as well as their own, should be extended.

The DGT expressed his gratitude to BT and Mercury for offering to extend their provision of emergency call services to other operators. He has decided that these services will be provided on open and fair terms and that where other operators cannot agree terms with Mercury or BT, they will be now able to refer the matter to him for determination.

The DGT, Don Cruickshank, said: 'I believe that this is a pragmatic solution which will safeguard the high quality of the emergency call service.

'We shall certainly keep in mind options for further improvements to the service, and in particular I hope that we shall see enhanced access to the emergency authorities for users of textphones.'

Global Strategy under Scrutiny

After a meeting of senior telecommunications executives in July, a new initiative to advise the International Telecommunications Union (ITU) on priorities and strategies for telecommunications development has been established.

The new strategic consultative body—known as the *Telecommunications Development Advisory Board* (TDAB)—was set up to advise ITU member countries on how best to step up and reinforce telecommunications development across the world.

Chaired by Mr Tan Sri Dato' Dr Mohd. Rashan Hj. Baba, executive chairman of Malaysia's national operator, TDAB is expected to draw on the resources and experiences of private and public sectors.

The establishment of TDAB follows a recommendation by ITU's High-Level Committee last December. According to ITU Secretary-General Dr Pekka Tarjanne, TDAB would work with other organisations with a view to mobilising actions and resources.

'Today's telecommunications environment commands new synergies and approaches,' said Mr Tarjanne. 'If the ITU is to remain a leader in telecommunications development, it must strengthen its cooperation with the private sector and further develop new partnership schemes.'

One of TDAB's first tasks is to provide a high-level executive summary on private sector involvement at next year's World Telecommunications Development conference in Buenos Aires.

ENERGIS on the Grid

After extensive trials, National Grid has placed a number of orders for a new optical communications system for use on overhead power lines for its forthcoming ENERGIS telecommunications network.

The routes will run from North London to Weybridge in Surrey. A consortium, led by BICC Cables and Balfour Beatty, has developed the cable, which comprises 24 optical fibres wrapped around overhead ground wires using a special drum spinner pulled by a radio-controlled tug.

High-strength materials such as magnesium alloys and carbon fibres have been used to reduce weight and give the installer a greater cable payload, up to 4 km in length.

Philips Joins the Outsourcing Club

Philips has announced its aim to become a major league player in the outsourcing and value-added IT services market.

Through its Philips Communications and Processing Services arm, the company has set up procedures to handle third-party use of its global data communications infrastructure and believes it is now set to take a dominant position in the market.

Philips C&P's new managing director, John Bell, said that the company's international data communications network was one of the largest ever created. 'Our aim is to assist our customers to gain competitive advantage through the application of technology,' he said. 'With such a base of technical resource and people skills, we will become a dominant UK and worldwide outsourcing supplier.'

Boost for Cellnet

Growth on the Cellnet network is higher than at any time in the history of the cellular network according to figures recently released by the company.

September saw 37 500 new subscribers to Cellnet, bringing the total to 776 000, an increase of more than 200 000 in the previous year.

Cellnet attributes its success to high levels of customer service, and national coverage. Price cuts, simplified pricing with a new London price tariff (Citytime), and support for specialist and retail dealers are helping the public to make more informed choices.

Call for Culture Change

If engineers are to meet the needs of business, then their training processes must undergo a fundamental culture change.

This is one of the main conclusions of a discussion document, *Review of Engineering Formation*, published by The Engineering Council, and which has been circulated to more than 2500 organisations.

Three working groups drawn from academia, industry and the engineering profession produced the document after a personal initiative by Council Chairman Sir John Fairclough to investigate how engineers could best meet future professional and commercial challenges.

The document argues for a more flexible system embodying a greater variety of progressive pathways to a certified professional qualification. It suggests that professional engineering competence must be based on the twin pillars of foundation learning and lifetime learning. This approach, the document says, will mean that the existing three-tier structure for registering engineers will have to be redefined.

It proposes three new categories of professional registration, two of which will combine elements of the three existing classifications, while the requirements for the highest tier will be more demanding than those for present Chartered Engineer status.

The Engineering Council says that the new system will enable individuals to achieve professional recognition through a mix of technical ability, business and communication skills, personal effectiveness and high personal standards of conduct.

The document, *Review of Engineering Formation*, is available free from The Engineering Council, 10 Maltravers Street, London WC2R 3ER. Please enclose an A4 self-addressed envelope with an 80p stamp.

Broader Base

The Telecommunications Industry Association (TIA) has been restructured to better reflect the needs of its members. The new structure comprises eight sector-specific interest groups (SIGs), covering the interests of:

- equipment dealers,
- retailers and installers,
- cable system suppliers,
- equipment maintainers and repairers,
- equipment manufacturers and suppliers,
- network operators and service suppliers,
- pre-owned equipment suppliers, and
- consultants.

Alan Cobb, TIA's managing director, said that most of the SIGs were now up an running. 'The very enthusiastic response from the industry clearly indicates that this format has been very well received and reinforces the relevance of the TIA to its members,' he said.

TIA is the national trade association for the telecommunications industry and acts as the industry-wide representative body for liaison between industry and external bodies such as the DTI, OFTEL, BSI, European Commission, ETSI, TVSC, the Employment Department and user groups such as TMA and TUA.

World Telecommunications Conference

Key speakers at this year's annual *Financial Times* World Telecommunications conference, to be held on 7–8 December in London, will be Don Cruickshank, Director-General of OFTEL; James H. Quello, chairman of the US Federal Communications Commission; and Michael Carpentier, Director-General of DG XIII at the European Commission.

Subjects under discussion this year include the globalisation of the telecommunications industry, international alliances and telecommunications privatisation, which is currently sweeping western Europe.

BT Chairman Iain Vallance is among the many high-level contributors, and will be speaking on managing a hybrid company. Other issues being discussed are telecommunications markets, global traffic growth, global outsourcing and the mobile markets in the year 2000.

For further information, please contact Joanne Wood, *Financial Times* Conference Organisation, 102–108 Clerkenwell Road, London EC1M 5SA (Telephone: 071–814 9770; Fax: 071–873 3969/3975).

book review

Between the Lines

R. C. Morris

In *Between the Lines*, Bob Morris has achieved what so many others have only contemplated. He has actually written down the story of his career in telecommunications and presented it against the background of all that has happened technologically and managerially in the industry between the 1940s and the 1980s.

The structure of such a narrative obviously presents difficulties and, with the exception of the first and last chapters, the author has chosen to deal successively with such mainstream specialisations as switching, lines, accounting and so on, and in each of these he blends background information with personal reminiscence. Generally he has not interested himself so much in the detail of innovations as they have evolved, as in the way that they have been received at the workface and by the public and how they have affected the lives of those who have planned, installed and used them.

So who will enjoy this book? Not perhaps the technologist, as with such an immense field to cover there is little room for close detail. Nor is it for the reader with no interest in the past. The gap that is admirably filled by *Between the Lines* is the documentation of the roots from which the working practices of the present public telecommunications industry have sprung. It is about the people who saw the final stages of a manually served system and stayed to see the beginnings of the digital revolution.

Published by Just Write Publishing Ltd., PO Box 664, 9 Andrewes House, Barbican, London EC2Y 8EH.
£12·95; advance orders £10·00. 160 pp.

Reviewed by Bob Light

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IBTE National HelpLine — 071-356 8008

THE FEDERATION OF TELECOMMUNICATIONS ENGINEERS
OF THE EUROPEAN COMMUNITY (FITCE)

33rd European Telecommunications Congress

CALL FOR PAPERS

The 33rd FITCE Congress, which will be held in Dresden, Germany, from 29 August–3 September 1994, will be based on the theme:

'The European Challenge to Telecommunications in East and West'

FITCE is inviting challenging papers on this theme, covering one or more of the following aspects:

- technical and operational aspects
- commercial issues
- experience gained

If you are interested in submitting a presentation, please prepare a summary of no more than 250 words giving a clear indication of the theme and coverage of the proposed paper. The summary, which should be prepared on the standard FITCE form, should include details of your full name, place and date of birth, job function or title, company, business address and business telephone and facsimile numbers. The summary should be sent before **15 February 1994** to:

Paul Nichols, FITCE UK Papers Coordinator, Post Point G012, 2–12 Gresham Street, London EC2V 7AG (Telephone: 071–356 8022; Facsimile: 071–356 7942).

Copies of the FITCE standard form are available from the above address, and will be sent on demand.

Authors will be advised of the papers that have been selected during early-April 1994, after the final programme has been determined.

The full text of a selected paper, which is required by 15 May 1994, should be about 2000 words to allow for a 25 minute presentation and 5 minutes for questions and debate.

FITCE

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