Session Summaries

Management Conference

Stratford-upon-Avon
28-30 April 1985

The Butler Cox Foundation

MANAGEMENT CONFERENCE STRATFORD-UPON-AVON, 28-30 APRIL 1985

Introduction

This document contains notes on the presentations made at the conference.

The notes were taken by Butler Cox consultants during the conference and are intended as an aide-memoire. They do not represent a verbatim transcript but simply represent as faithfully as possible an interpretation of the main points made by each speaker. For the sake of brevity some points have necessarily had to be condensed or omitted.

The notes are accompanied, where appropriate, by a selection of the visual aids used by the speaker.

We have also included a brief summary of the main points to emerge overall from the conference.

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MANAGEMENT CONFERENCE STRATFORD-UPON-AVON, 28-30 APRIL 1985

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SUMMARY OF THE CONFERENCE

In opening the conference on Sunday evening, Roger Camrass of Butler Cox said that the real challenge of the 1980s was to bring the wide range of emerging new telecommunications services into an organisation. Almost inevitably this will mean a change in the role and importance for a telecommunications group and its position in the management structure.

There is evidence of a swing away from mainly cost-saving private voice or data networks to more services-oriented, integrated networks that in many cases could have a major influence on the business. After putting forward a useful categorisation of private networks and how they should be managed, he discussed how these new networks should be planned.

On Monday, the theme was inter-site data networks, focusing on SNA versus OSI. Three speakers provided a broad perspective — on SNA, on OSI and on heterogeneous networks in general — before the debate on OSI in the afternoon.

Mike Armitage of Communications Solutions Limited said that SNA is definitely "the way ahead" for IBM users. Nevertheless, many users do not have a pure IBM network and so have to integrate SNA in a multi-vendor environment. He described how some non-IBM vendors were implementing parts of SNA and adding value to it. He gave some guidelines on implementing SNA in a future-proof manner bearing in mind such aspects as host support and network management.

He then covered three current issues: first the various ways of connecting an IBM PC into an SNA environment; then six recent SNA announcements (three extensions to the architecture and three hardware products); and finally the yet-to-be-launched IBM value-added network which will be based on SNA.

Mike Watson of ICL put open systems in perspective in terms of a users's IT strategy and future network. He highlighted three key issues. First, OSI is very much in the public domain so that user organisations can see what is coming. Second, the wide range of parties that are involved — governments and PTTs, as well as computer and office automation suppliers. Third is the prospect of independent conformance certification of OSI products.

He said that several international IT suppliers are migrating their proprietary network architectures towards OSI, often with standard code being transferred between them. At the same time, major users such as General Motors and Boeing are insisting on open systems, the MAP initiative, for example. Thus, there is a world-wide movement for open systems that does not just involve the standards organisations.

Essentially, there are two supplier strategies for open systems. One is the OSI gateway from a closed proprietary architecture such as SNA. The alternative is to make one's proprietary architecture an open ended system; the latter is ICL's approach. For users, the FOCUS Committee has proposed three stragegies: the tactical approach (the 'half-closed eyes' approach), the single-supplier proprietary standard approach, and gradual OSI adoption.

Peter Bye of Sperry talked about the techniques involved in putting heterogeneous networks together. He explained how proprietary network architectures have emerged from the complications of interconnected networks of the 1970s. However, many organisations cannot standardise on a single network architecture and so have the problem of a heterogeneous network.

One solution is to link mixed sub-networks at the network or X.25 level. Alternatively, if one of the sub-networks uses SNA, a gateway is the answer using one of the three levels of emulation: cluster controller, network concentrator, or separate domain.

Network management in a heterogeneous network is extremely difficult.

The great debate followed. John Ward from the Prudential proposed the motion that "This house believes that OSI is a distraction". He said that the Prudential is firmly committed to IBM's SNA and sees SNA as a ten-year old product still in vigorous development. OSI may be suitable for inter-company communications in the future but for internal use would distract the Prudential from its main business.

Nick White opposed the motion with great spirit. OSI is highly desirable. Governments support it and will stipulate OSI for government contracts. He said, tongue-in-cheek, that the outcome of the debate would be important and drew a parallel with the

Oxford University 1930's debate on "not fighting for King and country".

From the floor, Ken Edwards of ICI stressed the importance of opportunities and creativity which meant that he would oppose the motion.

John Aris of Imperial Group summed up for the opposition. He produced an impressive list of existing international standards and imminent drafts, and also of suppliers who had responded to the General Motors and Boeing initiatives.

Keith Harvey of Allied Breweries, summing up for the motion, said that he had been responsible for a multi-vendor network using SNA and, in a company where customers, profits, etc. were paramount, OSI would have been a distraction.

The resolution was overwhelmingly lost, probably reflecting the choice of the word "distraction" rather than a lack of awareness.

In the last session on inter-site data networks, Dr Michael Bruton told us about the multi-organisation network Travicom. Travicom's main business has been in the business-travel area rather than leisure travel. Initially there was a choice between using a single airline computer, which would then pass on alien orders to other airlines; or a multiple-access approach in which a single terminal could be linked to one of a number of airlines. The latter approach was chosen, despite Travicom becoming the first company in the world to attempt this. He described how a recently acquired VANS licence, plus Travicom's private X.25 network, opened up interesting new possibilities.

There was now a change of emphasis to inter-site voice networks. Simon Hughes of BP Oil talked about the management of telecommunications in a large organisation. He described the changes of organisation within BP Oil that, after several years, have led to an appropriate management structure and a strategy. Part of this strategy is compatibility with System X, so Plessey's IDX tends to be the standard voice switch. Interestingly, there is a telecommunications planning department in BP Oil that is studying the integration of voice and data.

Tuesday began with Richard Jarvis of Racal Vodafone who, after a brief introduction to cellular radio technology and its benefits, described the Vodafone service. The scale of the future network became apparent with 600 base stations linked by digital trunks to the Vodafone switches and thence to the PSTN. An interesting feature is 'direct connect', which will allow a link between an organisation's private voice network and Vodafone. Another aspect, which accounts for the 'da' in the title, is data communications which, although difficult, is possible using forward error correction.

The next three speakers addressed different aspects of local networks within the building.

David Flint of Butler Cox presented an update on local area networks since his Foundation Report No. 38. He started with the merits of twisted pairs before describing the new IBM cabling scheme with its hermaphrodite plug. Ethernet appears to be the natural choice for resource sharing between microcomputers and other workstations. Broadband LANs clearly have major advantages such as combining an asynchronous network with an IBM PCnet. But for local 3270s, individual coax connections are still the best solution.

Ian Rickard of the GLC reviewed the local network developments at the GLC's headquarters. The scale and wide range of computing and office automation services places great demands on the local area network. In fact, there are two LANs: a Xionics installation and a (Xerox) Ethernet. The significant differences are in structure (dual ring or tree) and in the systems facilities (e.g. excellent graphics on Xerox 8010). Both LANs are cost-justified.

In addition, there are Wang word processors for central typing and 700 conventionally connected 'mainframe' terminals.

Lessons learnt include: the general lack of standards, especially for documents; the need for clear aims; and the need for full-time support. The size of the GLC's building makes overall cabling costs daunting: a recent estimate was £18m.

Kevin Moersch of Ztel, Inc. described a new, innovative PBX, the private network exchange (PNX). He made a compelling case for the PNX as an integrated solution that will encompass the three separate solutions of today: third generation PBX, data switch and LAN. The PNX architecture is fully distributed with interconnection between 'SPUs' provided by an IEEE 802.5 token passing ring. A major attraction is that the Ztel LAN will be compatible with IBM's future cabling scheme and LAN.

The software architecture is based on OSI levels and thus a non-Ztel node is a possibility. Network bridges will be provided to 802.3 office LANs and 802.4 factory LANs (using MAP). The use of the high-level programming language 'C' means that users and others can write additional applications.

Cost per port — voice plus data — is currently $1,100. There are 12 PNX installations at present and 24 on order, so as volumes build up and new interfaces are developed this cost may change.

In the wide area, PNX installations can be linked by conventional means and in the future by digital trunks and ISDN pipes.

The final presentation was made by Edward Vulliamy of Butler Cox and covered voice/data integration in the wide area. He said there were three main levels at which voice and data were being integrated: transmission, switching and applications. Although one can find examples at all three levels, it is only at the first level, transmission, that users in the UK are gaining practical experience and saving money today. They are doing this by sharing Megastreams and other digital services between their private voice and data networks.

At the switching level, there will be slow progress, but users will have to ask themselves whether circuit-switched data via their PABX will really meet their requirements; and also whether it is the cheapest method.

There are many interesting possibilities in voice input and output such as unified messaging that will eventually have a major impact on computer systems and network services.

Edward concluded by advocating the integration within an organisation of those responsible for voice and data communications, so that tomorrow's integrated networks can be planned today.

In closing the conference, Roger Camrass summed up the two days under three headings: the swing to services-led networks, the need for open systems and wiring the workplace.

Everybody left Stratford a little wiser having enjoyed a most congenial conference.

DEVELOPING TELECOMMUNICATIONS SERVICES

Roger Camrass, *Butler Cox & Partners Limited*

Roger Camrass is Director of Telecommunications Studies at Butler Cox. As such, he manages the company's telecommunications consulting activities, advising user organisations on the planning and implementation of private telecommunications facilities, and suppliers on market trends and opportunities.

NEW ROLE FOR TELECOMMUNICATIONS MANAGEMENT

For those organisations who currently employ private voice, data and telex networks, telecommunications management is facing a period of intense change. Having been raised in an era in which network management was largely about reducing the size of an organisation's telecommunications bill, these departments now find themselves being required to take a wider role in their respective organisations and industry sectors.

Two factors contribute to the changes taking place:

—The rapid convergence between telecommunication and computing systems, requiring a more intimate involvement by the telecommunications group in computer network design and operation.

—The wider choice of services opened up by the liberalisation of national telecommunications markets. Liberalisation has hastened the introduction of new services such as electronic mail, videotex and cellular radio. In turn, these services are creating higher expectations amongst many managers about the role that telecommunications could play in their organisations.

Both of these factors are likely to increase the importance of telecommunications within most organisations, and place heavier demands on telecommunications management.

However, despite the growing importance of telecommunications, the future of the private network remains uncertain. Recent upward trends in private circuit tariffs may cause network users to migrate to the public voice and data networks. In addition, the recent emergence of turnkey network operators and third-party carriers such as EDS and Mercury creates a viable alternative to the internally operated private network. Finally, although general managers are slowly becoming aware of the possibilities opened up by new telecommunications services, few are ready to commit money within their own organisations to implement the new facilities.

Against this background of change and uncertainty, the telecommunications department must rapidly establish credibility if it wishes to survive and grow. To anticipate and prepare for change, organisations will need to find answers to the following questions:

—What new role should the telecommunications group adopt, and how could this affect the status of the private network, if at all?

—What impact could a change in role have on the development of new telecommunication services?

—How should the telecommunications group be constituted to carry out its new role?

Roger Camrass explored the possible long-term roles for the telecommunications activity at corporate level and proposed three different approaches towards telecommunications management.

DETERMINING A ROLE FOR THE PRIVATE NETWORK

According to recent studies carried out by Butler Cox (as part of the Strategic Studies Programme) on user motivation for employing private networks, six distinct network roles have been identified. These provide a firm base on which to plan new telecommunication activities. Three of the roles apply to large corporate facilities; the other three apply at the operating-subsidiary level or to small enterprises.

Large Organisations

For those organisations large enough to support corporate telecommunication facilities, our studies revealed three emerging network philosophies: utility-led networks, infrastructure-led networks and service-led networks.

Utility-led networks
With utility-led networks, corporate networks are employed purely as a means of saving money. By purchasing wideband facilities from British Telecom, and/or Mercury, the organisation is able to offer its users (e.g. operating subsidiaries) telecommunications facilities at a lower cost than would be available over the public network (see Figure 1). Examples of organisations commonly employing a utility-led network approach include large diverse conglomerates and government organisations.

Figure 1

UTILITY-LED NETWORKS PROVIDE BASIC SWITCHING FACILITIES

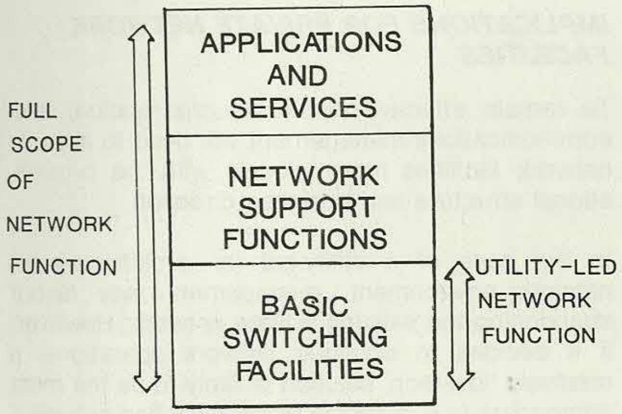
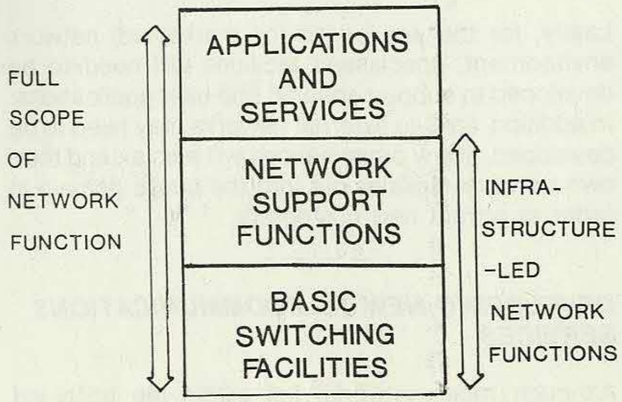


Figure 2

INFRASTRUCTURE-LED NETWORKS INCLUDE HIGHER LEVEL SUPPORT FUNCTIONS



Infrastructure-led networks
An infrastructure-led network provides links between information systems within and between different operating groups. It does so by imposing common high-level communications standards on network users. Examples include IBM's SNA network architecture, and the X.25 standards of the ISO network model. As with the utility-led approach, the network is likely to remain transparent to end-user applications, although it performs many of the network support functions associated with a computer network (see Figure 2). Examples of infrastructure-led organisations include petrochemical and information technology companies where high volumes of data are exchanged between operating subsidiaries.

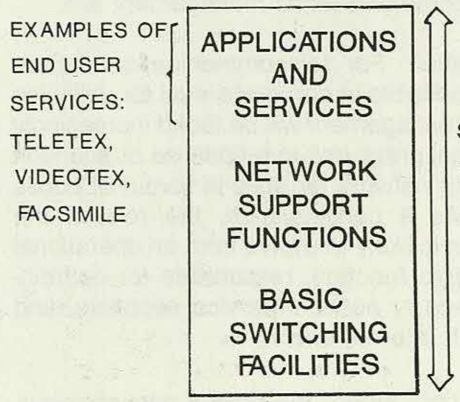
Service-led networks
A service-led network is used to generate extra revenue from new, specialised services offered to internal and external users alike (see Figure 3). In many ways, this category is similar to the development of third-party services within large corporate computer centres that took place in the 1970s. Few organisations have yet adopted such an approach, although many are considering doing so.

Operating subsidiaries or smaller organisations

At the level of the operating subsidiary, or within smaller, more integrated enterprises, an additional three classes of private network were identified within the Butler Cox network study: evolutionary-led, applications-led and market-led networks.

Figure 3

SERVICE-LED NETWORKS PROVIDE END-TO-END APPLICATIONS AND SERVICES



Evolutionary-led networks
The evolutionary-led class of networks is a catch-all for those organisations who have no coherent development plan for networks. The evolutionary approach resembles closely that adopted by utility-led networks at corporate level.

Applications-led networks
With an applications-led approach, the network is designed around a mainframe or microcomputer, and is supportive of a specific application such as point-of-sale. There is a strong similarity to the infrastructure-led approach, especially when several computers are interlinked within a single application.

Market-led networks
Market-led networks are frequently encountered as a natural development of applications-led networks, where the network links extend out to third parties such as suppliers and customers. As with the service-led approach, the network contributes directly towards the business.

The difference between these six network approaches shows up most strongly when considering the factors involved in the selection of new equipment. Cost is all important for utility-and evolutionary-led networks. Conformance to standards dominates infrastructure- and applications-led networks. Impact on the business is the key criterion for service- and market-led networks.

IMPLICATIONS FOR NETWORK MANAGEMENT

Having recognised that private networks fall into different categories, the reasons for employing different management approaches can be more clearly understood. Three different approaches towards network management are beginning to emerge in response to changes in the external environment. These have a direct corresponsence with the network categories described above. At corporate level, the alternative approaches available for telecommunications management are:

—Rationalisation: For telecommunication departments responsible at corporate level for utility-led networks, management will be faced increasingly with external pressures to rationalise or abandon their private network facilities in favour of public facilities. As a consequence, the role of the department is likely to evolve from an operational to a strategic function, responsible for coordinating third-party network service suppliers, and liaising with internal users.

—Amalgamation: Where the private network plays a central role in interconnecting information systems (i.e. infrastructure-led), telecommunications management will need to work more closely with other areas of the information systems department in order to provide effective facilities. In this sense, telecommunications management will need to be fully amalgamated with the information systems function.

—Diversification: If a case can be made for expanding the private network into a separate revenue-earning business (i.e. service-led), telecommunications management will need to take a more proactive role. Identification of new services, together with effective marketing to general management, will become an integral part of the network management activity.

The approaches associated with corporate networking are equally applicable at the business unit or smaller enterprise level.

IMPLICATIONS FOR PRIVATE NETWORK FACILITIES

To remain effective within an organisation, telecommunications management will need to align its network facilities more closely with the organisational structure and business direction.

In the case of a utility-led (or evolutionary-led) network environment, management may favour abandoning the existing private network. However, if it decides to continue network operations, a relatively 'low-tech' solution is likely to be the most appropriate (e.g. a simple digital switched network). Such a network will provide all the necessary basic switched services to support user-driven applications cost effectively. It should also discourage subsidiaries from doing their own thing.

For an infrastructure-led (or applications-led) environment, more sophisticated facilities will need to be embedded into the network to ensure interworking between systems. These may include packet-switched facilities based on X.25 standards.

Lastly, for the service-led (or market-led) network environment, specialised facilities will need to be developed to support specific end-user applications. In addition, links to external neworks may need to be developed. Many organisations will also extend their own network facilities out into the public domain in order to attract new customers.

DEVELOPING NEW TELECOMMUNICATIONS SERVICES

Although most networks fall within the utility-led applications-led or infrastructure-led categories, management may be forced to pursue a service-led (or market-led) approach in order to strengthen its long-term position. The benefits of adopting such a proactive approach include:

— Independence gained by generating external revenues and profits, and thus more scope for developing high-level marketing and technical skills.
— Wider influence and involvement in the organisation itself.

The key factor for success in adopting a service-led (or market-led) approach is the ability to understand and satisfy business requirements. To achieve this, telecommunications management will need to recruit business specialists within their teams or employ outside consultants to analyse the needs of the operating units directly. In addition, telecommunications management should recognise that it will need to take an active role in educating the users in the new service possibilities.

In conclusion, telecommunications management will need to take an increasingly active part in business and systems planning if it is to escape the threat of rationalisation or amalgamation. Only by actively marketing services will it be able to build a viable network operation on which to diversify its interests and thus capitalise on the wave of current changes and opportunities.

SNA: POSSIBLE DEVELOPMENTS

Mike Armitage, *Communications Solutions Limited*

Mike Armitage is a director and co-founder of Communications Solutions Limited, an independent company specialising in the provision of SNA products and services. His presentation was in three parts:

—SNA migration today.

—A checklist for SNA compatibility.

—Current SNA issues.

SNA migration today

About 65 per cent of the IBM UK user-base has now implemented SNA and is faced with the considerable task of migrating its existing systems to the new environment and meeting user needs for new business systems (see Figure 1). Inevitably this involves connecting a variety of applications-orientated equipment that may not have in-built support for SNA and this often leads to a complex communications environment with parallel netwoks and 'black boxes' (see Figure 2).

Consequently there is a variety of hardware and software products to assist in network integration (although these will inevitably require some form of compromise). The products can be categorised as follows:

—IBM front-end processor software products.

—Third-party host software products.

—Protocol converters.

—Emulation by PCM equipment.

—Bespoke developments, based for example on IBM Series 1 computers.

The use of these products, though it may solve some problems, has significant disadvantages. It is costly, gives only limited access to the benefits of SNA, has limited growth potential and is thus likely to be only a short-term solution.

Management is, therefore, faced with a dilemma. It may either commit to SNA and accept limitations on

Figure 1

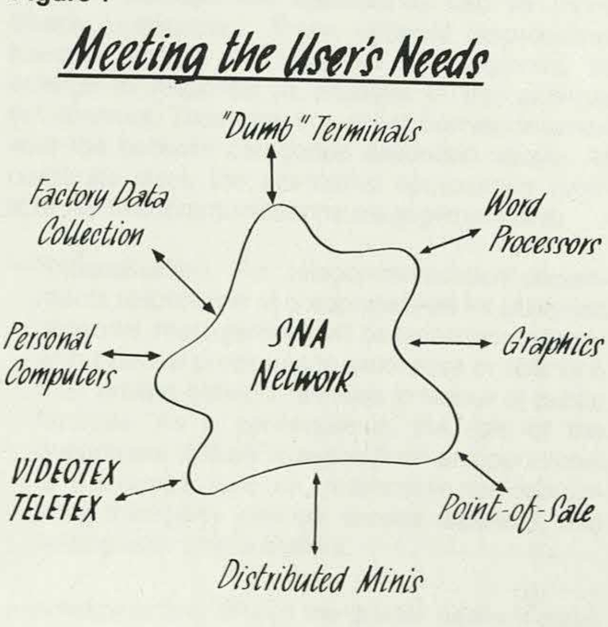
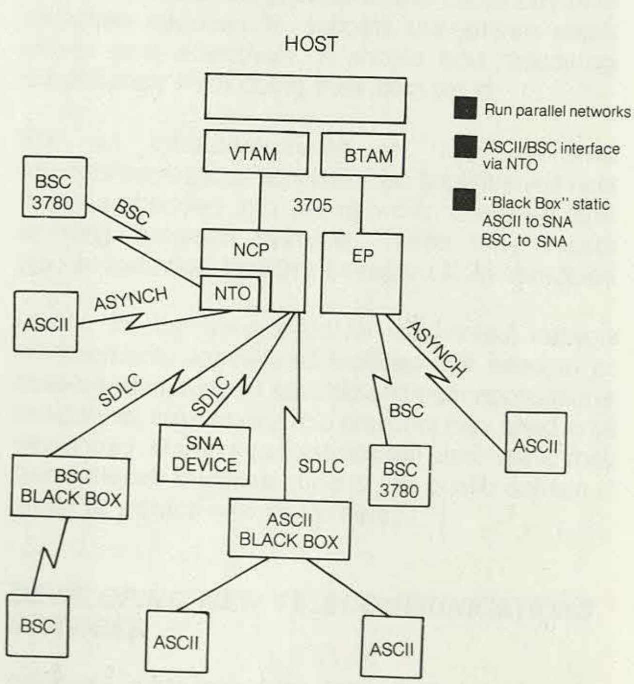


Figure 2 Existing solutions



peripherals, or retain the choice of peripherals but lose the benefits of SNA.

A checklist for SNA compatibility

Vendors of distributed and terminal systems are spending vast amounts of money on developing and marketing SNA-compatible products, but not all of these offerings provide the IBM user with the tools to integrate and extend its systems. The factors to be considered when evaluating these products include:

—Whether the product is 'future-proof'. The implementation should be layered, perhaps as shown in Figure 3, to allow development to support new protocols and device types.

—Whether the product provides host-support and network management facilities (see Figure 4).

—The user interface. This may make the network easier to use than the corresponding IBM interface.

In summary, the message for the IBM user is that SNA is the way forward, and that other vendors providing SNA products must add value to compete with one another and with IBM.

Current SNA issues

Three key issues for the UK SNA user were identified:

—The connection of IBM (and IBM-compatible) PCs to an SNA network.

—The impact of new IBM SNA products.

—The implications of IBM's value added network.

The PC communications market has spawned a vast industry, with most of the products originating in the United States and with prices fluctuating accordingly. The range of products spans the simple coax 3270 connection through to clustering with protocol converters (see Figure 5).

However, many of the products are operationally inflexible and may not support future PC developments, such as the introduction of Xenix.

The appropriate product for a particular application will depend upon the circumstances.

Recently announced IBM products (see Figure 6) will provide increased support for non-SNA devices and concentration outside the front-end processor. They will influence users' approaches to SNA through the new options they introduce.

IBM's value-added network has yet to be formally launched but already has considerable contracts

Figure 3

SNA architecture vs. *An SNA implementation*

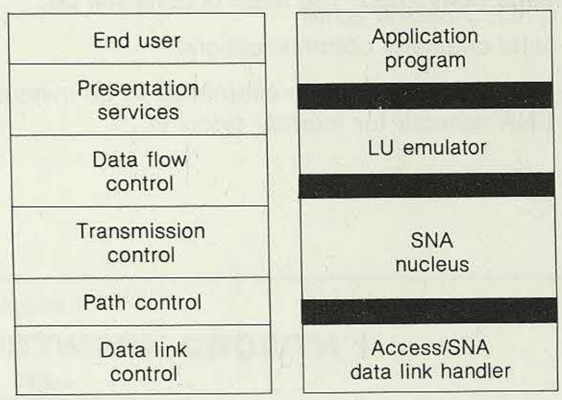


Figure 4 Host support/network management

- Downline load/upline dump
- File transfer
- Messaging/mail
- Remote operation
  - — System commands
  - — Hardware/software diagnosis
  - — Audit/recovery
- NCCF/NPDA hooks

Figure 5 SNA connectivity for IBM PC s

- Coax boards
  - Single screen
  - Window support
- 3270 boards
  - Single station
  - Clusters
- Multi-function PU/T2 boards
- 5250 boards
- Protocol converters

Figure 6 "New" IBM products

- 3710 network controller
- 7426 terminal interface unit
- SNA network interconection (SNI) (Extended network addressing)
- SNA distibution services (SNADS)
- VM native mode support
- 7171 ASCII device attachment control unit

signed up. Its key features are shown in Figure 7. It will provide new opportunities for organisations without their own SNA network, as well as for those already committed. The main options will be:

—Inter-company communications.

—Use of the VAN as an alternative to an in-house SNA network for internal systems.

Figure 7 IBM's value added network (VAN)

- SNA-based with gateway facilities
- Industry community marketing
- Network provision for:
  - intra-company facilities
  - inter-company (private and public)
  - inter-community
- Pass thru or application processing
- YET TO BE FORMALLY LAUNCHED

THE ROLE OF OSI

Mike Watson, *ICL plc*

Mike Watson is Technical Director of International Computers Limited and was appointed to the board of ICL plc in October 1984 following the merger with STC.

He began by saying that the rapid growth of IT and its application poses several new issues for users. A strategy for information is an essential part of their overall business strategy. A key issue concerns the decisions about the design and control of the computer network. Policies implemented now will shape the future direction of IT exploitation into the next century.

Within the next ten years (maybe less), the projected growth in electronic terminals means that they will become as common in offices as telephones are today (see Figure 1). At the same time there will be increasing pressure to automate information transfer to and from other organisations, with links to value-added networks and public information services. By the 1990s networks will consist of a hierarchy of inter-network connections ranging from departmental office networks to private or public national networks for information exchange between organisations.

Against this background the continuing development of OSI has vital implications for both users and suppliers. For users, it offers a real basis for formulating IT strategy, because:

- —OSI is a public standards forum: the future direction is visible.
- —OSI provides a wide framework of standards, encompassing public services, data processing and document transfer.
- —Because it is vendor independent, OSI offers the prospect of genuine compatibility between different vendors' products.

Substantial progress has already been made, as the shaded areas of Figure 2 show. The future direction of many other functions is also clear, even though formal standards have not yet been ratified. The framework is complete, however, and the addition of individual functions will be evolutionary.

Figure 1

NETWORK GROWTH 1

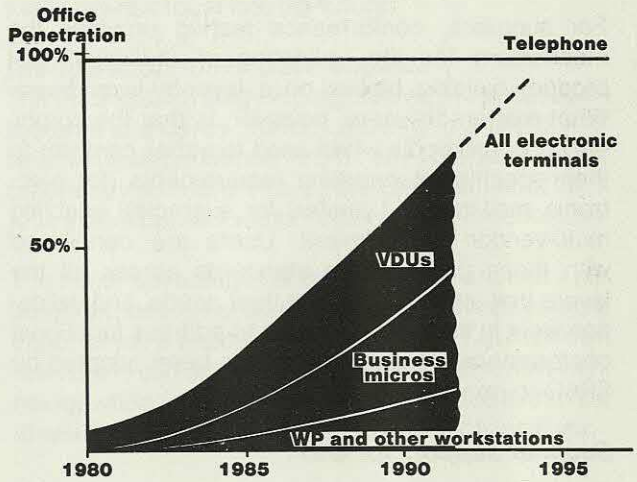
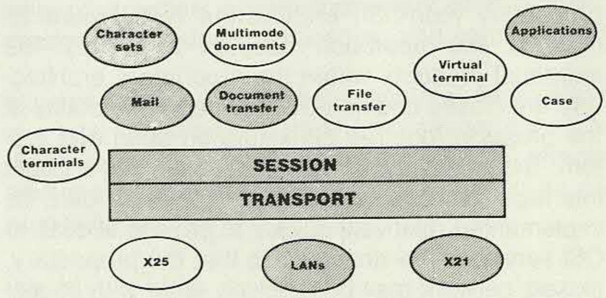


Figure 2

PROGRESS ON OPEN SYSTEMS



In many areas, the focus has now shifted to standards' application. The Standards Promotion and Application Group (SPAG) comprising 12 European suppliers has published a draft guide reflecting a common view on how the various standards should be applied to meet particular user requirements.

There is also worldwide activity in the area of conformance testing and certification:

— In the United States, the National Bureau of Standards was the first organisation to offer a testing service for some of the lower OSI layers.

— In the UK, the National Computing Centre, under the auspices of the DTI, has established a series of conformance tests.

— Similar facilities are becoming available in other European countries and the European Commission is coordinating the evolution towards a unified European approach.

— The work under the Esprit Program, by SPAG and by the CEN/CENELEC organisations is important in defining conformance criteria.

For suppliers, conformance testing provides the mechanism for the validating of individual OSI product building blocks on a layer-by-layer basis. What matters to users, however, is that the combination of protocols when used together conform to their specific interworking requirements (for electronic mail or file transfer, for example), enabling multi-vendor procurement. Users are concerned with those parts of the standards across all the layers that together achieve their needs, and validation work in this context needs to address functional conformance. This approach has been adopted by SPAG in its work on user profiles.

Supplier support for OSI

A large number of suppliers have now announced their commitment to support Open Systems Standards, and in general this can be done in one of two ways.

The first strategy is to support a gateway function, or specific OSI interface, at the boundary of a proprietary (non-OSI) architecture (see Figure 3). (This is the approach adopted by IBM.) The individual products within the proprietary architecture are closed and non-OSI, although the totality of the products together constitute an open end system. The advantage of this approach is that a single interface on one product or gateway can be implemented relatively quickly to provide access to OSI services. The drawback is that the proprietary, closed, network may be relatively large with consequent problems of flexibility and of attachment to individual products. Furthermore, interworking to any individual product within the closed network will be constrained by the functionality present at the gateway.

The alternative strategy is to support open system interfaces across all products as part of the mainstream network architecture and to provide gateway functions to other non-OSI environments with which interworking is necessary (see Figure 4). This is the exact inverse of the previous strategy and has the major advantage of offering flexible attachment using OSI standards at any point within the network, enabling each product to support the individual set of standards particularly appropriate to its role in the network. This, of course, requires support for the open systems environment across all key networked products. (This is the approach adopted by ICL as the basis for its Networked Product Line.)

For example, the recently announced range of System 39 distributed mainframe products (DM1) is based on this principle and contains support for OSI protocols up to layer 4. The Osnet local area network system is also based on the same set of protocols, and implementations on other key products are also substantially completed.

ICL has also been active in making available coded implementations of key standards such as the Transport Layer. Nearly fifty copies of this code have now been taken up by other suppliers world-

Figure 3

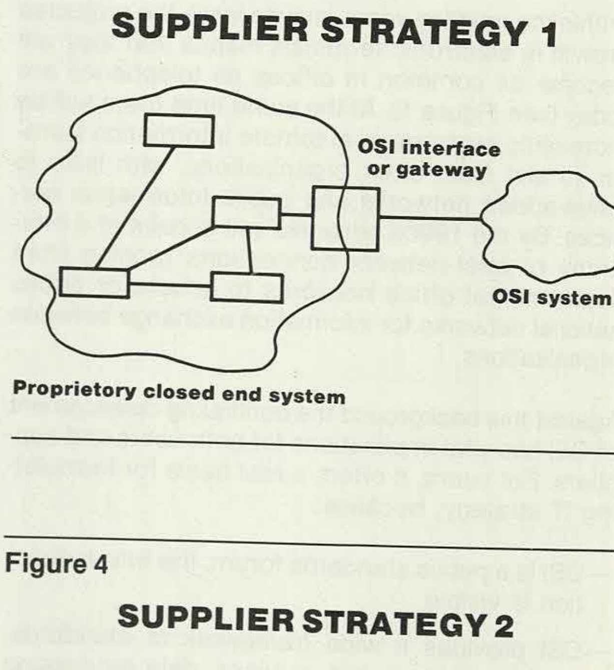
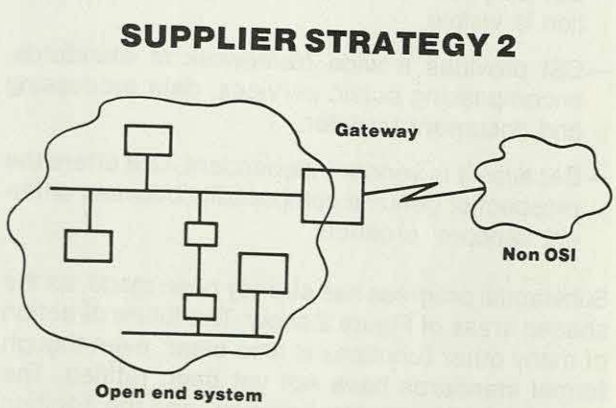


Figure 4



wide. The company has also been actively involved with the silicon industry in investigating ways of transferring code into chips.

Several demonstrations, showing the practical achievement of OSI interworking have already been organised. At the Las Vegas National Computer Conference in 1984, ICL, along with eleven other companies, demonstrated interworking between a variety of equipment connected over local area networks.

ICL is also a major partner in several Esprit multi-vendor network projects that have an OSI commitment, and has been actively exchanging and integrating implemented standards with its European partners.

Finally, ICL has been working with other European IT vendors and national agencies to formulate a common approach to the requirement for conformance certification of the implemented standards.

User strategy choices

Turning from the suppliers' view of open systems to the users' view Mike Watson drew attention to some extracts from the Focus report for Private Sector Users on the User View of Communications Standards (Figure 5).

This report identifies the importance of standards, both proprietary and open, and offers recommendations to users on the pros and cons of a number of alternative strategies relating to their use.

It sets out three broad scenarios for a user standards strategy: the tactical approach; the single-supplier, proprietary standard approach; and the gradual adoption of OSI approach.

The tactical approach

The first strategy is to do nothing about communications standards and to solve each problem as it comes up. In the short term there is nothing wrong with this approach but, in the longer term, some painful transition problems will have to be faced.

Nonetheless, this approach does have some merit where a particular part of a network will be replaced at a known future date. In this situation, simple ad hoc solutions can be adopted to solve short-term problems. But this approach does clearly leave the major strategic issues as tomorrow's problems.

The single-supplier, proprietary standard approach

The second major strategy is to adopt a manufacturer's proprietary set of standards and rely on that supplier to provide a coherent framework for future IT needs. This approach should provide a relatively easy, ready made approach to the problems of equipment interworking.

For those organisations who are happy to move forward at the rate dictated by their prime supplier and to procure equipment predominantly from that supplier (or pcms), this represents a safe if unadventurous strategy.

But there are drawbacks. Future planning may be limited by a lack of a clear statement of the supplier's future direction, and the user organisation may have to pay a premium for certain hardware and software. Also, the business potential for using IT may be held back if the supplier is late in moving into a new area of technology.

Nevertheless, this strategy does represent a safe, relatively low-risk route into the future.

Gradual adoption of OSI standards

The third user strategy is progressively to adopt open systems standards, thereby moving to a position of relative independence from any manufacturer's proprietary standard. This is the broad direction of ICL's future development within its Networked Product Line.

The major advantages of this approach are that it enables competitive procurement and, perhaps of more importance, it enables users to exploit IT at their own rate. Users can opt for early use of innovative new technology when appropriate, without being tied to the rate at which a single supplier introduces such facilities.

Nevertheless, a sensible transition strategy is essential. There will need to be a certain amount of education and planning, and this will require a close working relationship with the future suppliers.

For users, the benefits of an open systems approach are clear: freedom of choice, public visibility of direction, a wide framework of standards, vendor-independent certification, and so on.

Mike Watson concluded by saying that information is a vital resource and must be managed by each organisation to its maximum effect. The OSI choice now merits the most serious consideration by all organisations.

Figure 5

A STRATEGY FOR USERS

"Communications standards are coming"

"They will enable users to procure their components from the best source"

"This could mean a 15% saving in overall user costs"

"There are three possible broad strategies"

HETEROGENEOUS NETWORKS

Peter Bye, *Sperry*

Peter Bye is Director of Technical Marketing and Research for Sperry Network Systems International, London.

Sperry announced its Distributed Communications Architecture (DCA) in 1976, and has followed this with products, most notably the Telcon networking system. These products form a baseline set of components for specific networks. However, Sperry realised that, while its range of standard communications products was suitable for many of its customers, networking, especially in larger-scale systems, poses problems of its own. Special facilities are often required, typically to handle different equipment interfaces. Even if no significant new features are needed, the process of installing a major network presents considerable difficulty. The correct amount of equipment must be ordered and installed, and a smooth change from any existing system must be made.

Sperry Network Systems (SNS) was formed early in 1984 in recognition of the special nature of networking. SNS provides services up to complete turnkey installation of networks. It uses Sperry standard products, complemented with components, special developments and external products as necessary to solve user problems. SNS's services include consultancy, network design, performance modelling, software development, network integration and support. Particular emphasis has been given to certain technical areas, where a range of components and products have been and are being developed. These include gateways and interfaces to SNA, DDN and OSI standards, network management and Videotex systems.

THE NATURE OF HETEROGENEOUS NETWORKS

Early real-time systems tended to be implemented with a point-to-point communications network connected in a star pattern. The terminals, often asynchronous and using ad hoc protocols, had in many cases a rather close interface with the applications systems they accessed. This was often necessary because of the limited memory and other hardware resources then available.

Lines and terminals would be added to the point-to-point network until the mainframe system supporting the application was unable to handle more traffic. Expansion or new applications, therefore, required a new system, with a new network to support it. The result of such expansion was several mainframe systems, each with its own network. Interconnection between mainframes, or to other systems, required further networks.

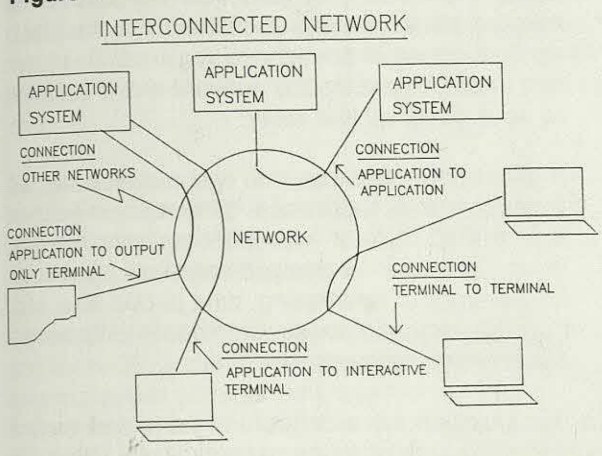
From the users' point of view, one of the main problems with such expansion was the duplication of terminal equipment. It was not unusual to find a location with several terminals, one for each application to be accessed. Sometimes, different networks might even access different applications on the same mainframe. This situation was brought about by the lack of agreement on communications protocols and access methods. These problems persist in some cases to the present day.

Such duplication of equipment is expensive and inconvenient. Users must not only buy more terminals than they need; they must also pay for unnecessary communication lines. What is required is a separation of communications and applications, where the communications facility becomes a free-standing entity into which terminals and applications may be freely connected. Full interconnection between the various components should be provided, subject only to operations restrictions, such as security. For its operation, the communications facility should be independent of any of the attached systems. Sperry refers to this free-standing communications as an Interconnected Network (see Figure 1).

Such networks can be built according to locally defined rules and standards and many have been implemented and operated successfully. But general agreement on protocols and conventions is necessary, and international or widely accepted standards are required.

The set of standards for interfacing to networks,

Figure 1

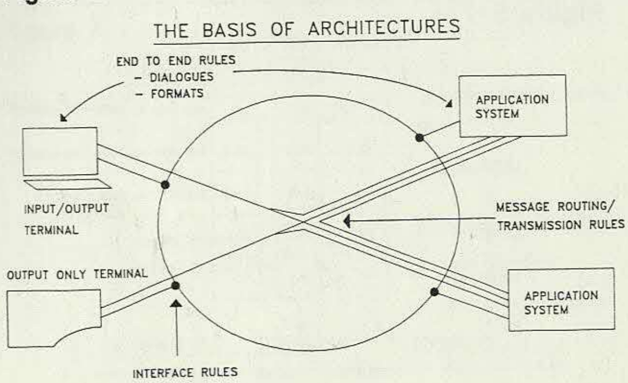


routeing traffic through them, and importantly, end-to-end rules such as dialogue control and data formatting, of course form the basis of a communications architecture (see Figure 2). Examples include IBM's System Network Architecture (SNA), Sperry's DCA and the International Standards Organisation's Open Systems Interconnect model (ISO-OSI).

Any system developed according to an architecture can in principle be connected to any other system developed under the same architecture. In an ideal world, only one architecture would be used. This is the ultimate goal of international standardisation. Networks implemented according to just one architecture are referred to as homogeneous networks.

The real world, however, is rather more complicated, and this state of affairs is likely to continue for some considerable time. There are instances of uniform, homogeneous networks, but many users, especially the larger organisations, have a variety of equipment that must be integrated together to form such an interconnected network. The variety may arise as either a result of previous purchases, or as a result of operational need or because of policy. For example, various applications essential to the users' operation may not be available on the same machines or on systems with a uniform architecture. And many large users deliberately maintain multi-vendor policies.

Figure 2



Within an overall or global network, the following variations must be accommodated:

— Multiple different sub-networks for transporting data.

— Non-architectural equipment such as teletypes or other terminals. An enormous number of non-architectural terminals are in use throughout the world.

— Complete, but different, architectures e.g. coexistence of SNA with Sperry networks.

— The various external services often needed by network users (e.g. SWIFT). These services usually require their own interface methods that do not always fit within the users' overall architecture.

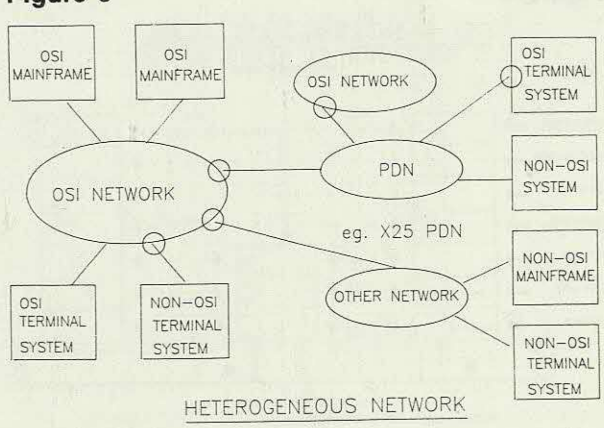
Networks accommodating such mixed equipment are referred to as heterogeneous networks (see Figure 3).

CONNECTING DIFFERENT EQUIPMENT TOGETHER

Peter Bye then discussed the various approaches to interconnection, using the ISO-OSI model as the basis for architectural description, although other architectures were used for illustration of specific cases.

The architectural variations that occur in heterogeneous networks can be resolved into two major

Figure 3



groups: those where the end systems are compatible; and those where the end systems are incompatible. In this context, an end system is defined as one containing layers 4 to 7 (transport to application). Incompatibility at the end-system level implies an overall difference, including dialogue control, data formats and codes, and recovery mechanisms. In this case, the problems are considerably less straightforward than incompatibility at levels 1 to 3 only. Incompatibility at the lower levels is in general more straightforward because it only requires different sub-networks (such as leased line and X.25 public data networks) to be handled in the same overall architecture.

The architectural principles underlying ISO-OSI, and other architectures, allow for such variation. The principle used in converting from one structure to another is referred to as bridging. Although a bridge can be built at any level, to resolve incompatibility at lower levels two major types of bridge need to be considered:

—A network-level bridge, to cope with different sub-networks.

—An application-level bridge, to cope with incompatible end systems.

End systems compatible; different sub-networks

If two OSI systems are communicating directly, each layer in one system has protocol sequences equivalent to those in its peer layer on the other system. In this case, the network layer functions are uncomplicated, because the network between the two systems is as simple as possible.

Interconnection of such systems may be complicated in two ways:

—An intermediate node may be introduced for geographical reasons if the end systems cannot be connected directly (see Figure 4). The two sub-networks are assumed to be of the same type (leased lines, for example). The intermediate node, therefore, only performs the function of relaying data from one sub-network to the other; no conversion of any kind is required. This function is performed by the network and is referred to as a geographical relay.

—If the traffic between the end systems has to traverse sub-networks of a different type (leased line to X.25 PDN or X.21 PDN etc.) the network layer will be more complicated, because conversions of addressing, data packet size, etc. may be required to accommodate differences between the sub-networks.

In this situation the architectural principles involve sub-layering at layer 3 (the network level). There are three sub-layers (3A, 3B and 3C).

Figure 5 shows that the highest sub-layer is 3C, and offers a global network service (that is, transport services) to its users. Thus all the end systems in a global network would have a global network address that is used to route traffic to its ultimate destination. Because traffic will cross different sub-networks in traversing the global network, differences of addressing may be required. The 3C sub-layer therefore performs the role of mapping from one sub-network to another.

The lowest sub-layer is 3A, and performs sub-network specific access protocols for appropriate layers 2 and 1. Examples include X.25 packet, X.21 call-control, or user-specific protocols.

The third optional sub-layer (3B) is known as the subnet enhancement layer. Its purpose is to fill in any missing functions that may not be present in the subnet-specific access protocols (converting connectionless to connection-orientated, for example).

End systems incompatible

The interconnection problems are substantially more complicated if the end systems are incompatible. The

Figure 4

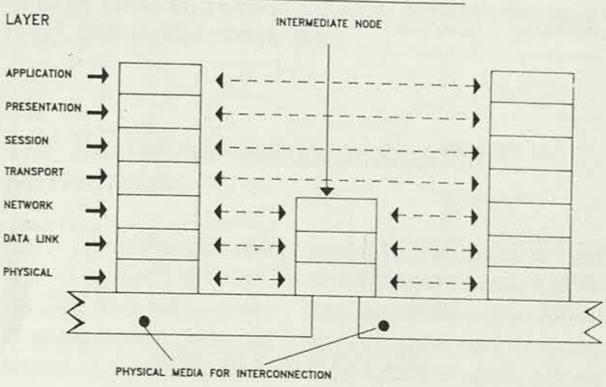
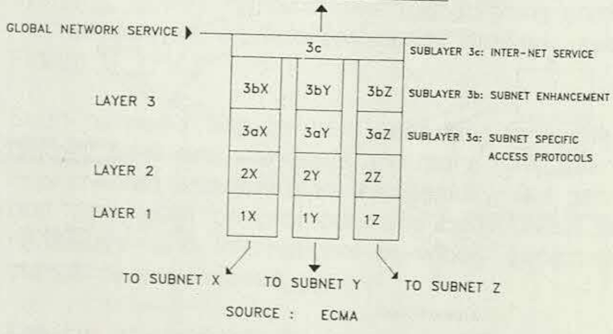


Figure 5



sub-network differences discussed above are contained within an overall uniform architectural structure. Incompatible end systems imply different architectures, however. Nevertheless, the bridging principle is still valid, but it must be applied at a higher level.

It is possible to bridge at layer 4 (transport) if layers 5 to 7 are compatible (Figure 6). In general, however, layer 7 bridging is needed. Such a bridge is also referred to as a layer 7 relay (see Figure 7).

If the network itself conforms to the OSI architecture, and some OSI systems are attached to the network, a heterogeneous environment may then be created in one of two ways.

First, non-OSI systems may require to communicate with OSI systems. The non-OSI systems may range from simple non-intelligent terminals, through systems with ad hoc architectures, to complete but different architectures. In each case, a layer 7 bridge or relay can be used to convert from one architecture to another. The complexity will of course vary considerably (SNA to OSI is much more complex than a glass teletype to OSI) but the principle is the same. In the simple cases, many of the layers on the non-OSI side of the bridge will have null functionalty.

Figure 6

OSI GATEWAY – LAYER 4 RELAY

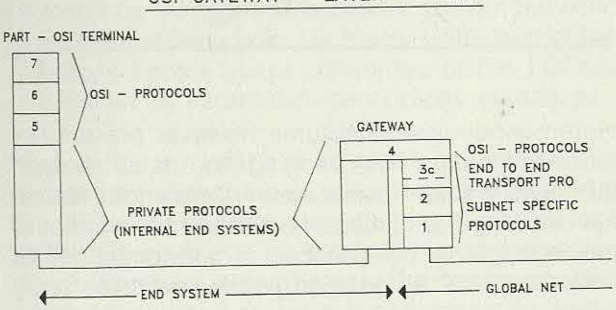
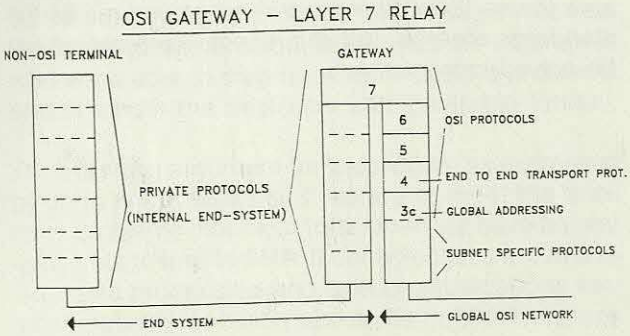


Figure 7

OSI GATEWAY – LAYER 7 RELAY



Second, two non-OSI systems may wish to communicate across an OSI network. In this case, the two end systems are compatible, but the traffic is being carried on a different type of network. Each end system will need to believe that it is communicating with a network of its own type. Messages to set up phase-control sequences will need to be sent, for example. During the data phase, each end system will communicate with a network gateway. The network itself will then carry data according to its own rules.

Note that, while the term 'OSI' has been used, other specific architectures could also be substituted.

Communication with SNA can be achieved by four methods:

—Emulating an SNA terminal.

—Emulating an SNA cluster controller.

—Emulating a network node.

—Emulating an SNA domain.

The first of these is relatively basic. The examples given in Figures 8 to 10 illustrate the above principles in the other cases, using Sperry's DCA as the architecture in the network. These figures show how DCA may be interfaced to IBM's SNA.

NETWORK MANAGEMENT

The above discussion concentrated on the handling of data exchange in heterogeneous environments. This can normally be achieved via the various bridging mechanisms discussed. However, network management presents more problems.

Network management is concerned with the functions necessary to maintain the greatest

Figure 8

IBM PU2 TO IBM PU4/5

SET UP PHASE ARCHITECTURE

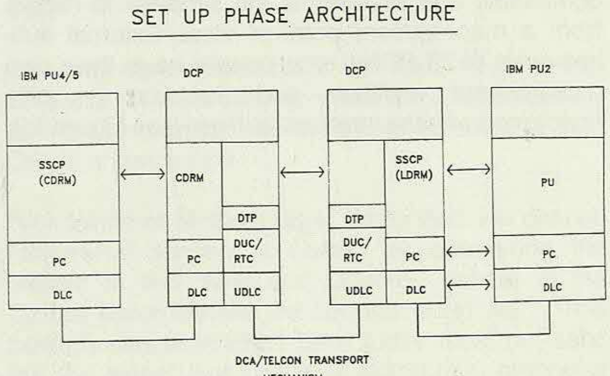


Figure 9

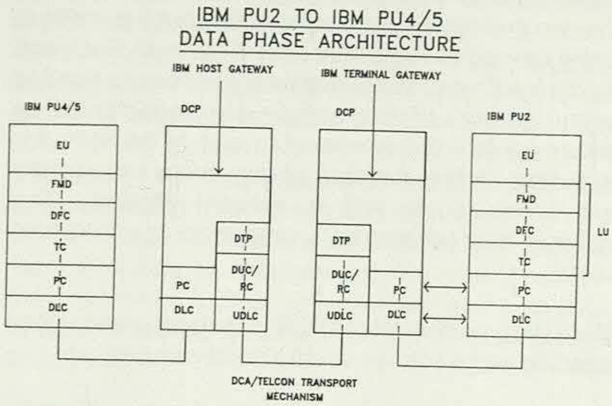


Figure 10

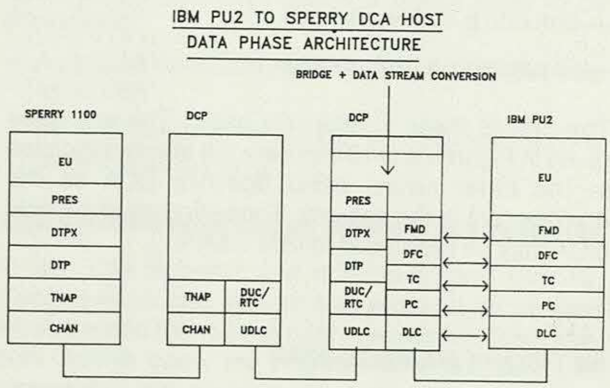


Figure 11

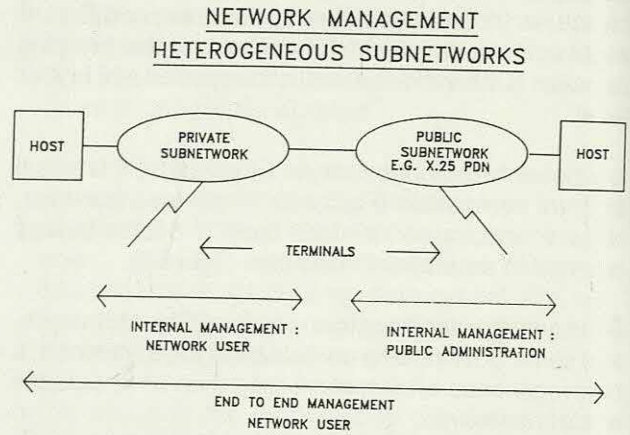
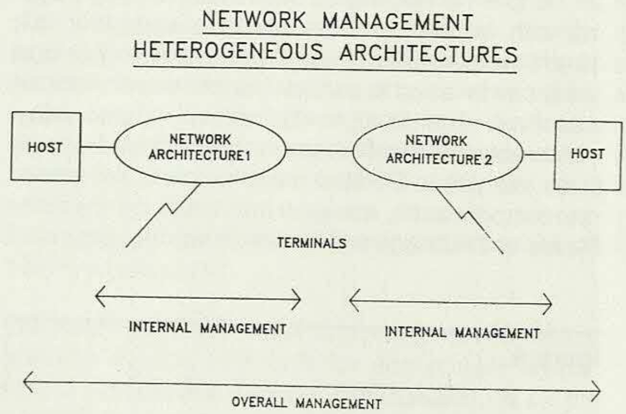


Figure 12



possible availability within a network. Network management is implemented within each of the various layers in an open system, and at a system or controlling level. The layer managers each interface with the system level in their particular open system, and the open systems interface with each other for management reasons.

The case of heterogeneous sub-networks with compatible end systems is the simplest to handle from a management point of view. External sub-networks (X.25 PDNs etc.) usually have their own management facilities, and the user is only concerned with the interface to them (see Figure 11).

Heterogeneous architectures, however, present a lot more difficulty. The bridging for data transport purposes requires format conversions and so forth. A full exchange of management data requires that all the management sequences in both directions be understood and acted upon (see Figure 12).

In general, this problem is not simple to solve. The international standards world is still at an early stage in defining network management features, although progress is being made. It may be that management bridges between architectures will be able to use ISO-OSI management structures as the standards emerge. But at present, each case must be solved individually.

DEBATE: IS OSI A DISTRACTION?

Chairman: David Butler, *Butler Cox & Partners Limited*

During this session the motion "This house believes that OSI is a distraction" was debated. Speakers for the motion were:

—Keith Harvey, production director for Allied Breweries Management Services Limited, where he is responsible for operations and operations support for a variety of mainframes, minicomputers and microcomputers.

—John Ward, who manages the Technical Support Group at Prudential Assurance. He is responsible for computer and telecommunications, strategic and capacity planning, software, network and hardware installation.

Speakers against the motion were:

—Nick White, Group Telecommunications Manager at Midland Bank, where he coordinates voice and data communications worldwide.

—John Aris, Manager, Group Management Services of Imperial Group plc. He is also Chairman of the Private Sector Users committee of the FOCUS initiative on information technology standards.

Held in an atmosphere of mock solemnity, the debate had something of a lighthearted overtone. For the sake of provocation the four speakers took rather more extreme positions than one suspected they really held. Nonetheless, the forum enabled several interesting views and arguments to be put forward.

Regardless of the wording of the motion, the debate inevitably focused on the issue of SNA versus OSI. The proponents of the former presented themselves as the hard-headed practitioners, living in the real world; the proponents of the latter as the visionaries who were able to step back form today's problems and see both the desirable and inevitable future.

The essential argument for the motion, as expressed by John Ward, was that if we are to meet the business problems that exist today then we have no real option but to turn to SNA. If our objectives are to provide data processing and telecommunications services, reliably, securely and at the right price, there is no alternative.

He spoke, he explained, from experience. In the past few years he had been obliged to put together a heterogeneous network. Going any other route but SNA would have meant spending time and effort integrating both equipment and protocols. And it would have meant pioneering. To have looked to, and waited for, OSI would indeed have meant distraction.

Interworking with least technical effort comes from IBM. IBM may not always provide the best individual items of equipment; they may not be the cheapest; but they are the least distractionary.

Moreover, if you look to the future, Mr Ward explained, this situation is not about to change. SNA may be 10 years old but it is still under vigorous development. Also IBM is building bridges for other suppliers to link into SNA: not convergent maybe, but certainly allowing interworking.

Mr Ward rounded off this argument by pointing out that in practice standards would be determined by those that made money out of systems, not by committees made up of interested observers. Two categories made money out of systems — suppliers and users — and in practice these were clearly setting and introducing the real standards.

Moreover, he argued, SNA is a secure approach. Half of BT's leased line use currently came from IBM users. There are 20,000 SNA users worldwide. Two-thirds of all UK insurance industry users are IBM; most use SNA. Are these going to convert to OSI?

OSI may materialise, but it will have to fit in with SNA when it does. Maybe osmosis will subsequently take place between the two systems, but until then OSI is a distraction.

Nick White of Midland Bank responded. He opened (somewhat tongue in cheek) by comparing the debate to the 'King and Country' debate in the Oxford Union before the second world war. "This powerhouse of intellect here today must not send out the signal that OSI is a distraction, otherwise we'll simply encourage IBM ..."

He then, rather more seriously, put his finger on the hub of the pro-OSI argument: firstly stressing the desirability of OSI (which few would contend) with its ability to make life more comfortable for everyone, prevent corporate lock-outs and so on; and secondly (with somewhat more difficulty) arguing for its credibility.

He insisted that OSI was being implemented. Products were being designed around it. Many important bodies and corporations, including the British and American Governments, were endorsing OSI and some using it. "All major manufacturers are now designing products around OSI, and even IBM is coming to terms with it", he concluded. OSI was a reality.

Contributions were then taken from the floor.

One question, addressed to John Ward, was whether he was too closely focused on today. His objectives excluded mention of creativity, market share, risk, competitive edge and so on. In this respect to support his motion would appear to be turning our backs on what most of the delegates were employed to do.

Mr Ward replied that he and his department were certainly interested in new opportunities, including those that didn't involve SNA, and that his role was by no means entirely defensive. But the fact is that to spend a lot of time tying together a lot of incompatible boxes was still a distraction from today's problems.

It was suggested by another delegate from the floor that IBM's reign might be collapsing like the Roman Empire. Recent profitability was, relatively, below other suppliers. Were we (switching metaphors) "hitching our wagon to the wrong star?" Telecomms standards would still endure, the delegate suggested, long after IBM had gone. This idea was warmly, but not too seriously, received. If most delegates liked the idea few obviously felt that they would be around to see it reach fruition.

Several speakers then contributed views in favour of the motion. The fact that an OSI chart (unlike SNA) isn't covered in product numbers was cited as showing that OSI was still only a concept and thus a distraction.

An obvious question was posed. If the majority — 60 per cent — of the world's current equipment is being designed around a particular standard, why develop another? Are we inventing the wheel again? Are we suffering from the 'not-invented-here' syndrome?

A harsh commercial reality — at least as far as the particular delegate would have us believe — was also put forward. OSI is promoted by technicians: SNA is promoted by salesmen. The latter, a driving force in our industry, are paid on what they sell and they sell what is available now.

Another speaker from the floor, seizing the moment for which he had obviously been waiting for some years, opened "I have a dream ..." and closed, more down to earth "... in the end the battle will be won by those with the money!"

A further speaker countered for OSI, by stressing that his company, an oil giant, was going for OSI because it would enable the company to reach all of its customers.

Clearly the debate had centred on an issue where views were held quite passionately, with the audience falling into two distinct categories.

The Chairman then called upon the two remaining platform speakers to sum up.

First, John Aris spoke against the motion. He focused on countering the argument that it was "too early to do much about OSI", in other words the OSI credibility issue.

He used several slides to illustrate that OSI was a reality and already upon us. Standards, he stressed, do exist, at both upper and lower levels. The 'talking shops' that are hammering out further standards are talking effectively. Two conformance testing services exist already and five more are currently being planned.

Mr Aris substantiated his argument by listing the suppliers who were connected to Boeing and General Motors' OSI trials last year.

He concluded that there was clearly a momentum — and a will — behind OSI. This was further illustrated by the fact that the DTI was currently looking for individuals (on a paid basis) to run OSI demonstrator projects.

John Aris rounded off by touching on another argument that probably deserved wider attention and would probably have got widespread support from both sections of the audience. One value of OSI was that the existence of a standard other than the de facto standard would keep the 'major power' on its toes.

Keith Harvey then summarised for the motion. Again he adopted the 'realistic practitioner' stance of those in favour of the motion.

He explained that he had agreed to speak at the debate because he had actually managed a multi-vendor SNA network for the past five years.

The business had depended on it. It had worked. It was not a concept. It was not a plan. It was here now. In other words: "you can all talk about it, but I've had to do it."

He also felt that to make something a success in the wide market — and by implication to introduce an effective industry standard — it needed a single company's profit-motivated drive: SNA.

The motion was then put to a vote and, not surprisingly in terms of the way the motion was worded, defeated by a substantial majority. Those against the motion probably saw this as the conference having the vision to recognise the way the world would and should be going. Those for the motion probably saw it as a victory for the 'hearts over the minds'.

In the words of the Chairman, "God knows what effect this will have on IBM's strategy".

VANS: A CASE HISTORY

MIKE Bruton, *Travicom Limited*

Mike Bruton is technical director of Travicom Limited. His project responsibilities have included a multi-access reservations system linking 38 airlines to UK travel agents, the new X.25-based communications network now being introduced, and a database project to be introduced in the Autumn of 1985.

Over the last twenty-five years there has been enormous growth in air travel with many millions of passenger journeys now flown per year. The travel industry caters for leisure travel (principally straightforward package tours) and business travel, which requires a more flexible approach with each journey being tailor-made for the passenger concerned. The business-travel sector is more complex, with a higher financial yield, but requires a rapid response and flexible arrangement.

Between 75 and 80 per cent of all business travel arrangements in the UK are handled by travel agents. In the past the traditional approach has been to use brochures for leisure travel, and flight guides for business travel, and then to use the telephone to make the arrangements with the carriers and operators concerned.

The last twenty-five years has also seen an explosive growth in the use of computers, particularly by the airlines who now have multi-million pound investments in major real-time mainframe computers. The tour operators have more recently followed the same path, but in both cases the service is provided primarily to the operator's own staff to help them to take either telephone bookings or walk-in sales from the street.

It was inevitable that the travel agents themselves would begin to be mechanised. The problem was how best to carry out this mechanisation. Each system provider has his own unique and separate system on offer, and it was clear that a proliferation of computer terminals in a travel agency office was out of the question. The choice was basically either:

—A single-access approach relying upon a major airline or supplier of a mainframe system to act as a single point of contact, or

—A multi-access approach using switching technology to access a large number of individual host processors (which is the preferred option within the UK).

Aims of the Travicom service

Travicom was founded in the mid-1970s with the aim of using a full multi-access philosophy to service the travel agencies. The objective was to serve individual small agency shops via a single terminal that provided connections to a very large number of travel principals.

This requirement has resulted in a completely new technology requiring the following elements:

—A message switch system.

—A switch computer that can receive and process a vast range of communications protocols used to access mainframe systems.

—A translation system that can cope with widely varying procedures, so that the travel agent does not have to learn how to use many differing procedures and languages.

—Common input processing and standard entries.

—Procedures for converting the large number of differing response formats to standard displays.

—System initiated actions e.g. user security, message (queue) handling, etc.

—A range of ancillary services such as ticket production, database features, etc.

Travicom was the first company in the world to attempt to solve the multi-access problem in the travel industry. The agents are equipped with a simple asynchronous ASCII VDU which, at present, uses a display convention of 16 lines by 64 characters. A ticket printer capable of producing the industry standard neutral ticket is also provided. Because of the recent growth of Viewdata systems, a Viewdata presentation has been developed, with the Travicom standard language and procedures being translated into Viewdata displays.

The Travicom network

There are three major logical elements to the communications links involved in providing the Travicom services:

- Suppliers' (principals) links to Travicom's central switch.
- A distribution network from the switch to satellite locations around the UK.
- Local sub-networks linking the satellites to the agency offices.

Travicom is linked to the suppliers' systems by a variety of procedures and link types (see Figure 1). The suppliers are responsible for providing these links, but Travicom is responsible for distributing the service across the UK.

Travicom's pricing policy is common to all parts of the United Kingdom. This required the development of a substantial communications network, as shown by Figure 2. This network is based on X.25 with a private, PSS-compatible, switched network. The network has three major switching nodes (Maidenhead, London and Manchester). This backbone network services, via satellite processors, every major city in the UK, which enables communication charges and costs to be equalised. The links from a satellite to agents are provided as leased lines, dial-up connections or Viewdata dial-up (see Figure 3).

The computer systems used for the message switches and the satellite processors are manufactured by Videcom Ltd. of Henley, who devised a multi-microprocessor architecture based on Z80 processors for this purpose. This has proved to be an extremely effective and flexible approach and very highly reliable in practice, with total system failures almost unknown. Each supplier and network connection to the message switch is serviced by its own dedicated processing card, with the processing communicating across a system 'bus'.

Figure 1

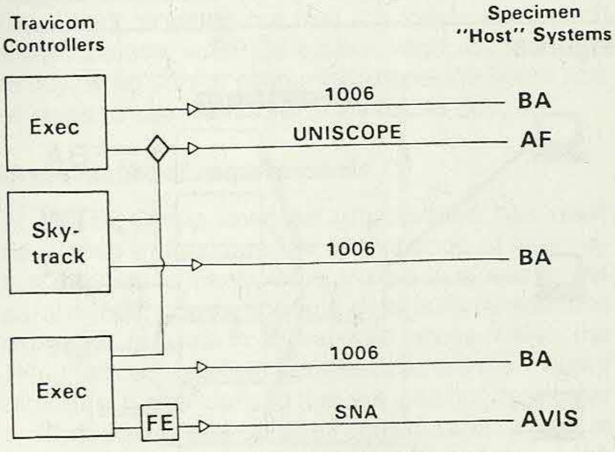


Figure 2

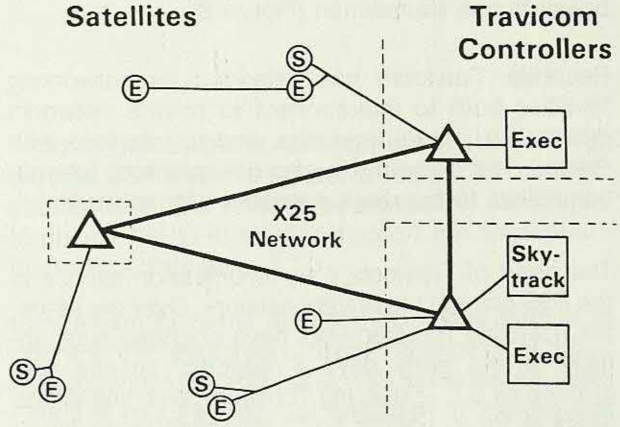


Figure 3

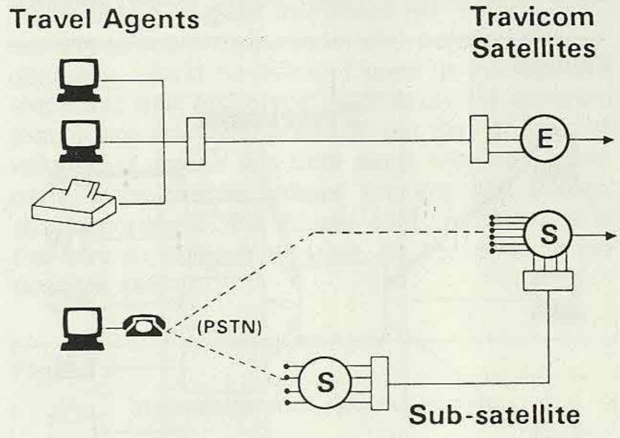
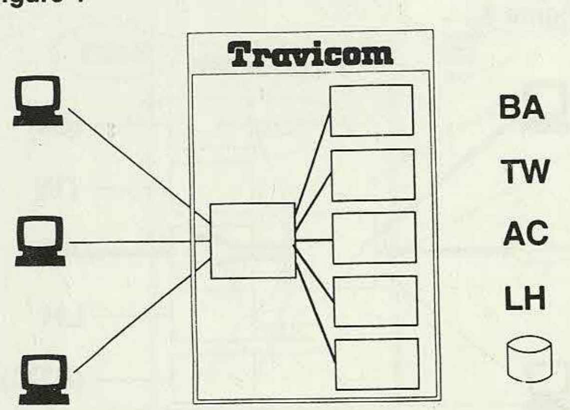


Figure 4



This structure, illustrated in Figure 4, enables a very flexible range of message processing systems to be established, from a simple connection of an agent to a selected supplier (Figure 5), through more complicated procedures involving local autonomous processing such as ticket production (Figure 6) and time-initiated processing such as airline queue handling (Figure 7), to simultaneous access to two databases in one transaction (Figure 8).

Recently, Travicom has extended its networking facilities both to interconnect to private networks provided by travel agencies, and to interface with Prestel. The company is also now planning international links to overseas suppliers and networks.

The heart of Travicom's communication service is the PSS-compatible private network. Over the years, the licensing requirements have changed substantially. In the early days a 'specific' licence was granted by BT, restricting Travicom to selling airline seats to travel agents and connecting those travel agents only to airlines. By 1980 this arrangement had been made slightly more flexible with the inclusion of tour operators in the licence but, at the same time, British Telecom was insisting on Travicom using the newly unveiled public packet-switched service (PSS). By 1982 this pressure had eased, and Travicom was able to continue with its own private network using the 'specific' licence. By 1983 the new VANS licensing procedure was available, and Travicom was one of the first to be granted a VANS licence.

The next challenge facing Travicom is to link to overseas networks and systems. Here the licensing situation is obscure, though it is expected that links to the United States will be straightforward. However, from a licensing point of view, the links to Europe appear to be very complex, with a whole mass of regulations depending very much on the country into which one is attempting to link.

Conclusion

Travicom has successfully tackled and solved many problems in linking many different suppliers to a large number of customers, using common language and internetworking technologies. The company is convinced that such technology will become widespread and commonplace in the future. It will, however, be helpful if the licensing procedures are clarified and standardised on an international basis to facilitate the international application of such techniques.

Figure 5

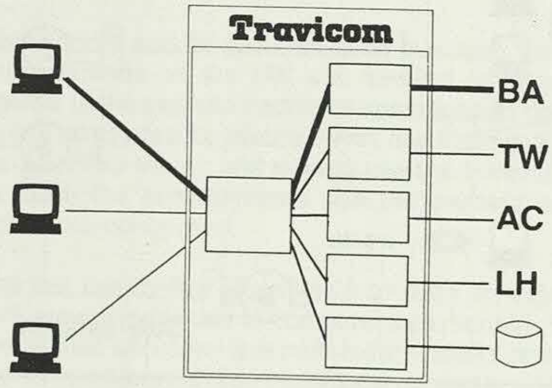


Figure 6

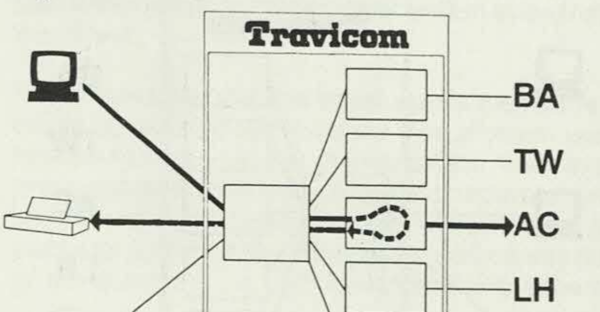


Figure 7

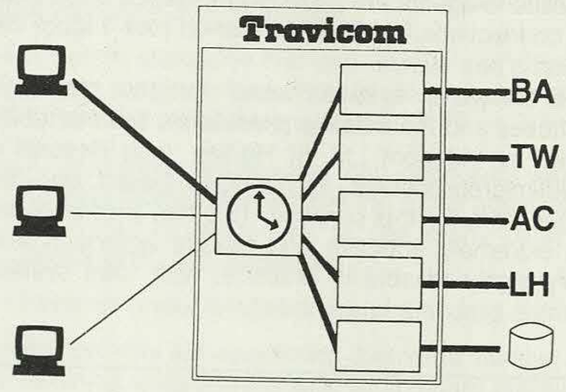
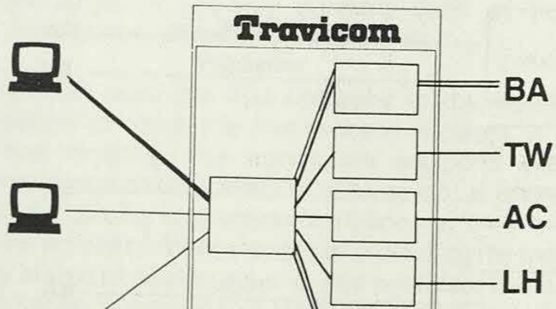


Figure 8



MANAGING IN A MULTIVENDOR ENVIRONMENT

Simon Hughes, *BP Oil Limited*

Simon Hughes is Manager, Telecom for BP Oil Limited. As such his responsibilities include telephones, PABXs, telephone network, personal workstations, cluster controllers, data communications, message switches and telegraph. All of these services, as parts of information systems, are vital to BP Oil. In his presentation, Mr Hughes covered three main topics:

—The development of an IS strategy in BP Oil.

—The development of a telecommunications strategy.

—The development of an IT organisation to facilitate the implementation of the technical strategies.

Mr Hughes covered these topics broadly in that order, but in fact the developments did not occur sequentially. Progress in the three areas at BP Oil occurred in parallel over a period of years. He pointed out that this approach is made possible by man's ability to do several things at once. However, this is easier if the workforce doing it is organised to address the problems in the most efficient manner, so the question of "who does what?" was given as much emphasis as the information and telecommunications strategies themselves.

Figure 1 shows the overall framework that BP Oil uses to manage in a multi-vendor environment. Mr Hughes discussed the five main elements of this framework, pointing out that the 'other strategies' shown include, in BP Oil's case, what road tankers to buy, what sort of refineries to operate, what sort of ships to use, what sort of sites to buy, etc.

Organisational requirements

At the BP-Group level an organisation has been developed to facilitate the interchange of information required to manage the group's business. In the early 1980s, computing and data communications expertise resided in three main areas within the Head Office, reporting to three different main board directors. It was realised that this was not conducive to IS success, and so after considerable study, at very high level, a body of senior IS people — the "Information Systems Administration" (ISA) — was created. ISA's role is to deal with policies, develop standards, guide strategies, and at the same time to ensure the IS strategies support the appropriate business strategies.

Information Systems Services (ISS) was formed to operate the equipment, thus implementing ISA's deliberations. By and large, ISS provides all Head Office IT requirements for telecommunications and computing, but has a history of using separate and therefore multi vendors.

Before going on to explain how BP Oil developed its organisation to cope with this multi-vendor environment, Simon Hughes discussed the 'fallacy' concerning telecommunications, and communications generally, which he believes goes to the heart of electronic mail and office automation. He asserted that, in any company, some 80 per cent or more of voice, text, image and data stays within the company. Many people believe that the first system should cope with that 80 per cent because that is the way to achieve at least 80 per cent of the possible savings.

Figure 1

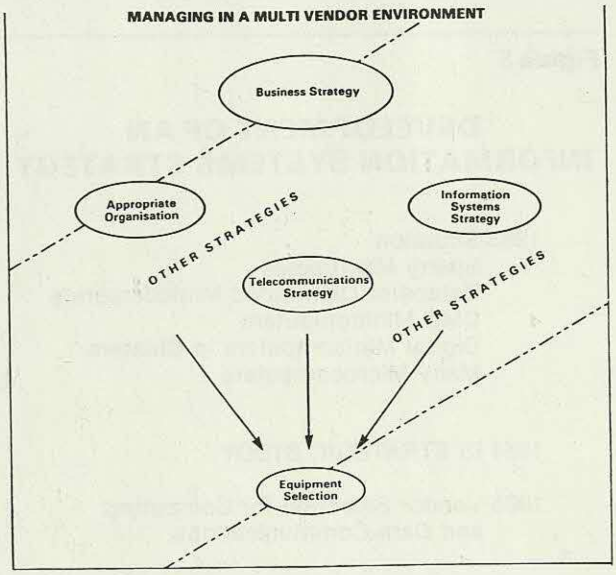
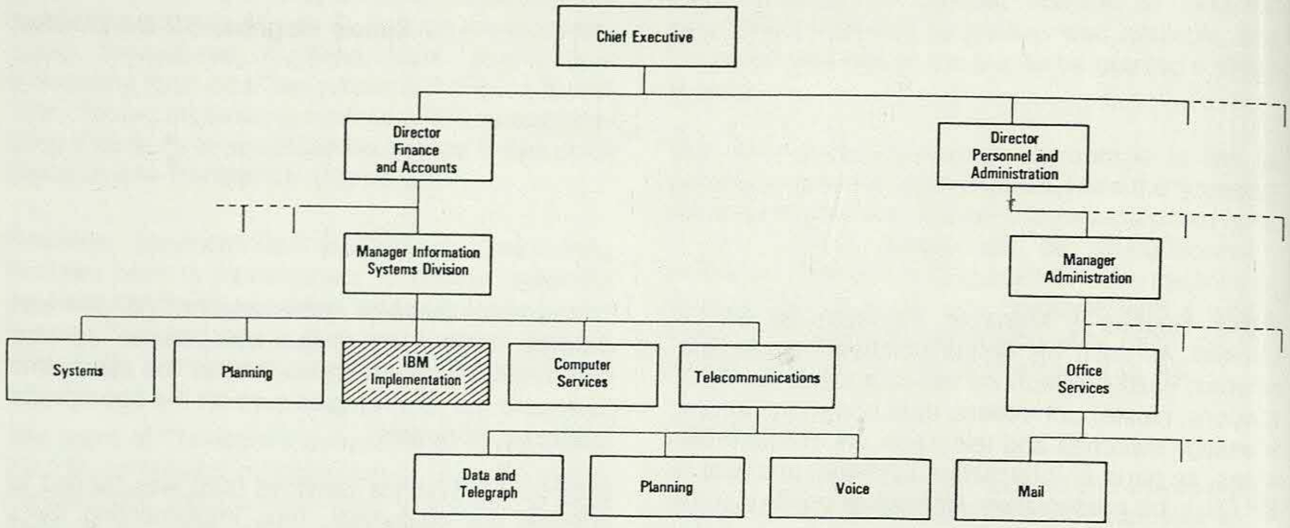


Figure 2

BP OIL ORGANISATION MARCH 1985



Mr Hughes stated the view that the important voice and text messages are, in fact, to do with customers and bosses and suppliers and banks. You should deal first with the important people — i.e. the 20 per cent. You should not build a system for the 80 per cent unless you can afford two completely separate systems everywhere.

The need for two systems can be avoided by using a national standard (preferably international). And when there is no standard, the user organisation must actively fight for one. If non-standard systems are developed, the organisation will cut itself off from the customers who cannot or will not connect to its private system.

In getting to grips with this problem, BP Oil has devised the organisation shown in Figure 2. BP Oil was created on 1 January 1976. It had, and still has, a computer centre at Hemel Hempstead and a Head Office at Victoria with a substantial private telephone network, and one data link from Hemel Hempstead to Victoria. Originally, it was only at the Chief Executive level that disputes involving telecommunications, among other things, could be resolved. In 1980 a study was carried out and recommended that one organisational unit be responsible for data processing, office automation and communications. The organisation shown in Figure 2 evolved over several iterations and now provides for the resolution of conflicts at the middle management level.

Strategy study

In 1984, an IS strategy study was carried out. One

Figure 3

DEVELOPMENT OF AN INFORMATION SYSTEMS STRATEGY

1983 Situation
Sperry Mainframes
Datapoint Distributed Minicomputers
CMC Minicomputers
Digital Minicomputers in Clusters
Many Microcomputers

1984 IS STRATEGIC STUDY

1985 Vendor Selection for Computing and Data Communications

Figure 4

DEVELOPMENT OF A TELECOMMUNICATIONS STRATEGY

1976 BP OIL VOICE AND TELEGRAPH NETWORK PROPOSALS
(Vendor Selection for Llandarcy Refinery)

1981 BP Oil TELECOMMUNICATIONS STRATEGY
(Vendor Selection for Grangemouth Refinery)

1983 BP UK TELECOMMUNICATIONS STUDY proposing GROUPNET
(Vendor Selection for Victoria Head Office)
Equipment Selection for an INTEGRATED NETWORK

of its main aims was to focus on the existing proliferation of equipment vendors.

After a year's work, strongly influenced by users and bosses, a newly focused group (consisting of representatives of all users at one below board level and ISD staff) recommended to the Board that future equipment purchases should concentrate on IBM and SNA. It is important to note that the future users made this choice, not ISD staff. The milestones in the development of the IS and telecommunications strategies at BP Oil are shown in Figures 3 and 4.

Mr Hughes summarised his discussion by stating that a prerequisite for success is a sound organisational structure that can identify and address the problem of multi-vendor telecommunications. If you do not understand who does what, or is responsible for what in your own organisation, you will be at a severe disadvantage.

MOBILE TELEPHONY

Richard Jarvis, *Racal Vodafone*

Richard Jarvis joined Racal in 1984 as Technical Director of a new Company, Racal Vodata, whicn was established to exploit value-added and non-voice services on the Vodafone cellular network.

The first licence for private-sector cellular radio was granted in May 1983 to Racal Millicom (Operating) Ltd under the 1981 Telecommunications Act. The licence is intended to run for 25 years and includes several privileges and obligations.

The privileges concern its exclusivity in respect of the private sector and permitted connection to the public telephone network. The obligations required the system to be opened for commercial service by 31 March 1985, and to comply with the government's cellular policy, summarised as follows:

—Two competing national cellular networks.

—Both networks to cover 90 per cent of the population by 1990.

—Network operators cannot sell airtime direct to end users.

—Network operators cannot sell subscriber equipment.

—Network operators must sell bulk airtime to service providers.

One very special feature of the policy is that the system operating company (now called Racal Vodafone Ltd) is limited to setting up and running the system, and is not allowed to engage in any other business whatsoever, including the retailing of airtime to the end user. Thus, the concept of separate entrepreneurial service providers is a central theme of the licence obligations. This situation is confusing to many potential users as there are already about 40 different retail organisations selling the services of the two networks.

The original 1981 licence is currently being replaced by a licence granted under the 1984 Telecommunications Act which will, amongst other things, designate Racal Vodafone Ltd as a Public Telecommunications Operator (PTO).

The technology

Cellular technology is significant because of the worldwide shortage of radio spectrum, a factor that had previously made large-scale mobile telephony impossible. Conventional technologies and wisdom had aimed to share out radio spectrum both by maximising efficiency through group usage and one-way (push-to-talk) communication, and by limiting power so that spectrum could be reused (with appropriate guard areas) throughout the UK. Mobile telephony, which cannot benefit from these techniques, had therefore been possible only for relatively few users; and at a price.

Cellular technology solves the problem of spectrum efficiency by the simple process of reusing the same fixed spectrum (channels) very frequently — often within five miles. In this way, a few hundred channels can offer service to 500,000 or more subscribers nationwide. The high reuse is achieved both by very careful network planning and by the use of intelligent 'mobiles' that are able, on command from the network, to control their transmit power level to limit radiated power to within a small zone or 'cell'.

The system problems caused by cell operation — namely locating a mobile for incoming calls and transferring a call from one cell to the next — are solved by the use of advanced computer controlled switching equipment in the network, and by microprocessor controlled intelligent mobiles. The process of transferring a call from one cell to the other is called 'hand-off' and is the critical factor in cellular network design. How well this is achieved is illustrated by modern cellular networks that can set up a new path, instruct the mobile and base stations to re-tune to a new channel and actually transfer the call, all with a break in transmission of less than one-third of a second — indiscernable to the user.

Earlier forms of mobile telephony in the UK were based on the large-area concept and were operated by British Telecom as a public monopoly. System 3, now obsolete, was the earliest system and System 4, still in service, is the direct predecessor of the cellular networks. A simple comparison of System 4 with cellular technology demonstrates that, on both price and performance, cellular is a great improvement. It is likely that as cellular coverage grows, System 4 will be phased out.

There are other non-telephony alternatives to mobile communications — for example private mobile radio (PMR), message handling and radio paging. All of these services have their place in specialised areas and can co-exist with cellular technology.

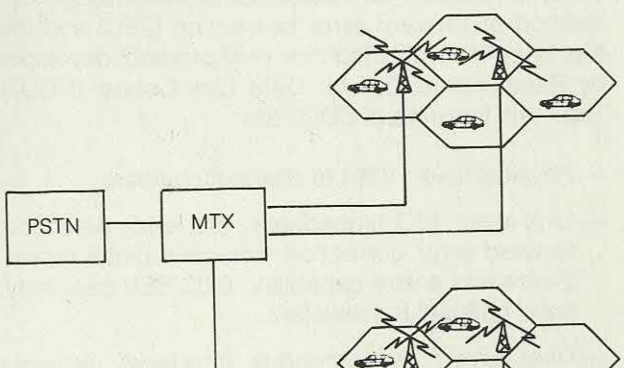
The Vodafone service

The key features of the Vodafone cellular radio network in the UK are:

- —A wide-area public network is planned to cover the majority of the UK over the next five years.
- —A fully automatic service.
- —Interconnection with the public switched telephone network.

The Vodafone network switching nodes are located at London, Birmingham, Manchester and Glasgow with others planned later. Each node, or Mobile Telephone Exchange (MTX), is a large-scale fully digital telephone exchange equivalent to a BT digital main switching unit. Each exchange is capable of supporting over 30,000 mobile subscribers or (5,000 erlangs of transit traffic). The network is fully digital and is interconnected both to the radio base station (RBS) and to the PSTN entirely by 2M-bit 30-channel circuits. Base stations operate in either omni-directional or directional mode, and by 1990 more than 200 RBSs will be in service nationwide. Figure 1 illustrates the main elements of the system.

Figure 1



Interconnection with the public telephone network

The licence permits interconnection with the public telephone network and, after many months of negotiation with British Telecom, agreement has been reached on the technical and commercial aspects of such connection. The agreement permits:

- —Automatic direct dialling by any Vodafone subscriber to any national or international number.
- —Automatic direct dialling by any British Telecom subscriber (or any overseas subscriber with IDD facilities) to any subscriber of the Vodafone system. Vodafone has been allocated the national numbering group 0836.
- —Access to recorded information.
- —Automatic direct dialling from any Vodafone subscriber to any other Vodafone subscriber or to any Cellnet subscriber (the other cellular radio service).
- —Operator services.

The system is therefore a standalone radio telecommunications system with interconnection to the PSTN and, in the future, with other PTOs.

System features and future plans

The phase 1 turnkey project is slightly ahead of schedule and phase 2 is well underway. The Birmingham switch will commence operation in mid-1985 and will be followed quickly by the Merseyside and Scottish switches and their associated cell-sites.

By mid-1986 coverage will exceed the Racal target of 70 to 75 per cent of the UK population. Thereafter, the growth will slow down, probably because of delays caused by environmentalists objecting to antennae in rural areas.

At present, the following system features are available:

- —Call forwarding (immediate).
- —Call forwarding (no reply).
- —International call barring.
- —Speed dialling.
- —Automatic re-dialling.

By 1986, the following features will also be available:

- —Conference calls.
- —Ring down.
- —Call forwarding to answering service.

—Call transfer.

—Call-time-out disconnect.

Direct connection to PABXs

One of the many exciting possibilities offered by the Vodafone network is direct connection to a private PABX network through private circuits (tie lines). Such a connection has been specifically permitted by the relevant class and operator licences issued by the DTI because of the particular technical benefits offered. This will permit an employee with a mobile 'phone to have access to all the PABX facilities available if he were at his own desk.

For example, extension-to-extension direct dial is possible in both directions. An external caller to the office can have his call extended to the mobile, and those with secretaries can ask them to call a number — from the car or even from someone else's premises!

For those users who persistently refuse even to be near a mobile 'go-anywhere' telephone, Vodafone offers a value-added service to get that vital message through. The Vodafone 'Messenger' is a voice store-and-forward system that will record messages for later retrieval. The system can automatically telephone the recipient to deliver the message, and can broadcast messages simultaneously to many users.

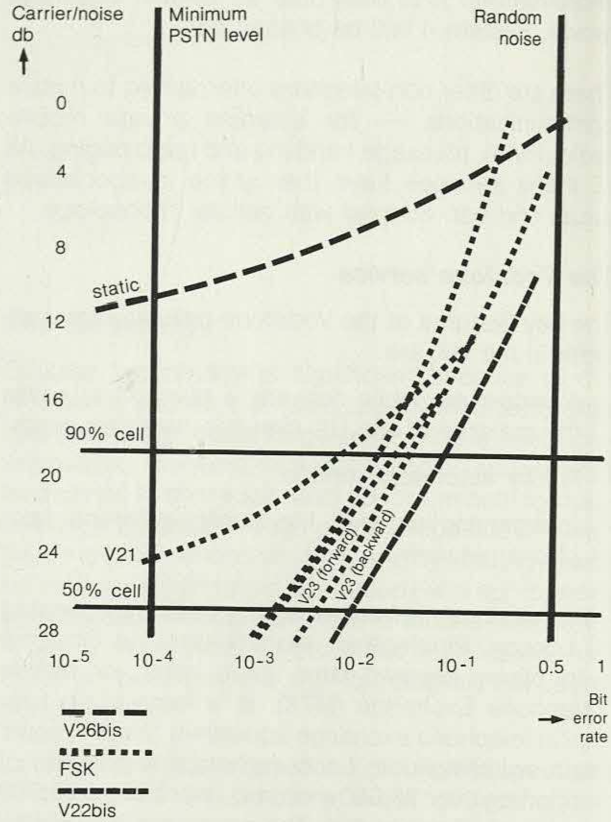
Data communications

Cellular networks will shortly be able to provide non-voice (data) capabilities as well. Unfortunately, data communications is less straightforward than voice because of the number of parties and the lack of standards. For example, data communication over telephone networks involves at least four parties — host operator, terminal suppliers, modem suppliers and network operators — with many opportunities for interworking problems.

Modems are an essential part of non-voice communication and they are required too for cellular networks because of the analogue nature of the radio channel. Modern modems are standardised by CCITT in the V-series recommendations. Regrettably, these standard modems cannot be used directly on the cellular networks because of the unusually high error rate caused by the Rayleigh fading phenomena of mobile radio propagation (see Figure 2). On the PSTN the normal guidelines for modem bit-error rates (BER) is 0.00001 (1 bit per 100,000). For most applications, such an error rate is often low enough to be ignored or at least handled manually.

On cellular networks the BER is typically around 0.001 (1 bit per 1,000) and can be as high as 0.01 to a moving vehicle. As a result, many applications will

Figure 2 Modem performance at 20 mph



suffer, unless an error-correcting protocol is employed. Many data applications use error-correcting protocols such as BSC or HDLC, but these use a block-repeat method (ARQ) that relies on a relatively low block-error rate (BLER) — typically 0.01. On a cellular radio network, the BLER can reach unity so that even these protocols are unsuitable.

What is required for reliable data transmission is a method of forward error correction (FEC) and this has been incorporated in a new protocol developed by Racal called Cellular Data Link Control (CDLC). The main features of CDLC are:

—Physical layer: V26 bis channel standard.

—Link layer: ISO procedures; ISO error detection; forward error correction; selective block repeat; 2-wire and 4-wire capability; 0.02 BER capability; hand off/blanking resistant.

—User layer: asynchronous interface; viewdata compatible data rate; true or pseudo full duplex; RS232C/V25bis standards.

The implementation of a protocol such as CDLC within a modem (the so called intelligent modem) is the basis of Racal's approach to mobile non-voice communication. Products using CDLC will be available later in 1985 and will allow users to attach most terminals, such as printers or personal computers, to both mobile and transportable subscriber equipment. These products provide a 1200 bit/s user rate for data and autodial/auto-answer capability. By the end of 1985, access to PSS will be offered as a network service to CDLC users, so the fully mobile office will become a reality. On-line access to in-house and public databases will be possible, and at a viewdata-compatible transmission speed.

Richard Jarvis concluded by saying that cellular networks are truly national networks and offer much more than a telephone in your car. For the first time, they offer reliable voice and data communications without being tied to the fixed network. They are the new dimension of communications for the 1980s and provide an opportunity for the corporate telecommunications manager to make the biggest contribution to his company's efficiency since the manual switchboard was replaced with a PABX.

LOCAL NETWORKS: THE KEY ISSUES

David Flint, *Butler Cox & Partners Limited*

David Flint is a Senior Consultant with Butler Cox specialising in telecommunications and office systems. His book on local area networks, "The Data Ring Main", was published in 1983.

THE NEED FOR A UNIVERSAL WIRING SYSTEM

During the last five years the number of terminals, microcomputers and workstations installed has increased considerably. By the end of the decade there may well be an average of one such device per office worker; and in some organisations this point will be reached much sooner than that.

This proliferation of equipment is already creating problems for communications management, including:

—Cost: on some sites it is as expensive to install and connect a new terminal as it is to buy the terminal.

—Multiple networks: many organisations now have three (or more) data communications networks on a single site (e.g. ASCII, 3270, telex, etc.).

—Delay: it often takes days, or even weeks, to install a new device or to move an old one.

Communications management is therefore looking, with increasing urgency, for a universal wiring scheme that will enable them to support all their current and anticipated future office equipment at an acceptable cost.

Regrettably, there is no such scheme. Instead there are five major options, each of which demands serious consideration. They are:

—Twisted pairs.

—The IBM cabling scheme.

—Broadband cable.

—Ethernet.

—Proprietary LANs.

TWISTED PAIRS

Twisted-pair cable is the commonest cabling found in offices but it comes in a variety of forms. The cheapest is the unscreened cable used for telephones. For data, however, heavier and more expensive cables, often with screening are used.

Twisted pair is a well-understood medium and has the great advantage that it is sometimes possible to use spare pairs on the telephone system, thus avoiding the need for new cable installation. If there are no spare pairs then a data-over-voice system like Grapevine may be used.

The main limitations of twisted-pair cables are the modest operating speeds possible at acceptable error rates with economically feasible line drivers. Moreover, being only a transmission medium, twisted pairs provide no assistance with interworking between various office machines.

In many cases switching may not be needed, and need not be paid for. Where it is needed, it may be provided either by a PABX or by a data switch. In our experience as consultants the latter is almost always cheaper and the features are generally more appropriate. There is also some advantage in the resilience provided by having separate data and voice networks.

Whichever form of switching is used, the twisted-pair medium has several characteristic limitations:

—It is suitable for terminal support, but not for the resource sharing that may be needed between microcomputers.

—It cannot substitute for the coaxial cable used to support synchronous terminals.

—Voice and data are not integrated.

THE IBM CABLING SCHEME

In 1983 IBM announced a cabling scheme with the objective of providing a universal solution to the wiring problem. The scheme being promoted in the US provides, in a single jacket, wires for both data and telephony together, optionally, with optical fibres. The scheme announced in Europe (and supplied, in the UK, by BICC) is based on cheaper cables and only supports data transmission (see Figure 1).

Amongst the most distinctive features of the scheme, which seems to be very well engineered, is the hermaphrodite plug (i.e. each plug can connect to any other plug) which may be used either loose or, with a faceplate, as an integral part of the building wiring.

The network topology is also distinctive. The special IBM cable will run from a faceplate next to every desk to a central wiring closet (usually one per floor). A variety of special adaptors (called 'baluns' — standing for balanced-unbalanced) allow desktop equipment with coax, twinax, RS422 and IBM loop interfaces to be connected to the cable through the faceplate. In each case a corresponding balun will be needed at the other end of the connection, which will be to a computer port. The wiring closet contains a patch panel but provides neither electronic switching nor any protocol conversion. The cabling scheme is purely a substitute for conventional cables.

The IBM cabling scheme has been designed for use with the long-awaited IBM token ring LAN. IBM has not yet announced this product, though continues to talk about it, but a very similar product, which also uses the IBM cabling scheme, is available under the name Pronet.

A 250-outlet IBM cable scheme network was installed at Carnegie-Mellon University, Pittsburgh, in 1983. The installation was technically successful but cost $400 per outlet. The University has calculated that it would cost between $7 million and $9 million to wire the whole campus and that 40 rooms would have to be used as wiring closets. As a consequence, it is currently reconsidering its intention to commit to the cable scheme.

Figure 1

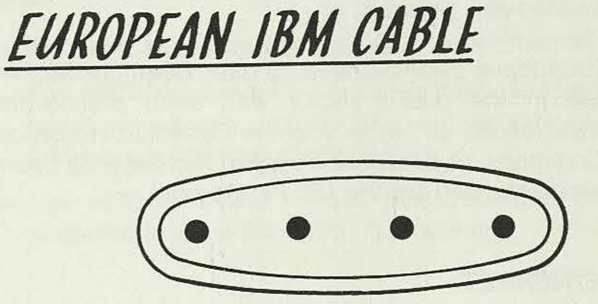
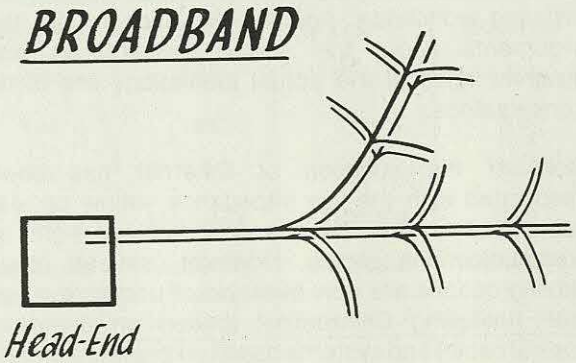


Figure 2



BROADBAND CABLE

Broadband cable systems comprise a tree of CATV-grade coaxial cables, usually with frequency convertors and network management equipment at the head-end (see Figure 2). Major manufacturers such as General Motors have been installing broadband networks in their factories for 20 years and they have an established place in factory automation.

There are no clear standards for data transmission on broadband cables as yet. The IEEE 802 Committee has defined several standards, none of which has yet gained widespread support. The largest existing broadband networks use proprietary products that do not comply with any standard, current or proposed.

With careful planning, a broadband cable installation need not be expensive. One large UK organisation quotes £20 per office as the cost of wiring a modern office building. Once in place the cable can carry almost any mixture of data, text, image, voice and video. Broadband cable is also the medium required to support IBM's new PC Network, a fact that will doubtless encourage many organisations to consider it more seriously. This requirement is having a similar effect on suppliers — Apple is now discussing support for the Macintosh with Sytek, the supplier of the IBM PC Network. Broadband systems do require fairly skillful planning and management, however.

Although the wiring and installation for a broadband system need not be expensive, the electronics often are. As a consequence, a broadband LAN is more expensive than a baseband system operating at the same speed and providing the same functions.

However, under favourable conditions a broadband system may be cost-competitive with a switched twisted-pair network.

Broadband systems have, to date, been concentrated in the public sector with such prestigious installations as NASA and the Canadian House of Commons. (A broadband system has recently been recommended for the UK Parliament.)

ETHERNET

The greatest advantage of Ethernet is that it is now both a de jure and a de facto standard. There are now 200 suppliers, offering a wide range of products ranging from minicomputer interfaces to public network gateways. Thousands of Ethernets have now been installed worldwide. Against this background, the arguments about the relative advantages and disadvantages of the actual technology are of no consequence.

Most of the success of Ethernet has been associated with the low impedance yellow coaxial cable that is now becoming a familiar sight at communications shows. However, several other cabling options are now available or under development including Cheapernet (based on standard coaxial cable) and systems based on standard broadband cable and optical fibres. These products will increase the attractiveness of Ethernet to some users, thereby increasing the market for Ethernet products.

A majority of the installed Ethernets are used to support resource sharing between personal computers, and Ethernet is now the leading LAN for microcomputer networking. In this area suppliers are now converging on Xerox Network Systems (XNS) protocols as the de facto standard. XNS provides a high level of compatibility between computers, servers and gateways — allowing users to benefit from a competitive market. No other network technology has yet come this near to fulfilling the original objectives of the LAN pioneers.

And Ethernet is also a viable option for terminal support. Although badly matched in purely technological terms, there are now many successful terminal networks based on Ethernet. One of the largest in Europe is that at the Ecole Polytechnique de Suisse, Lausanne where four hundred terminals are supported on 6 km of cable.

PROPRIETARY LOCAL AREA NETWORKS

In addition to the broadband and Ethernet LANs discussed above, there are proprietary LANs provided by a wide variety of suppliers. These products may be divided into two groups: those delivered as integral parts of an application system and those designed as communications products.

Systems-based LANs

Systems-based LANs have been devised to support resource sharing between attached computers. These computers may be ordinary personal computers (e.g. HiNet Plan), or machines specialised for applications such as office automation (e.g. XiNet ARC) or CAD (e.g. Domain). They are thus a necessary, though often minor, part of the total computer systems.

These LANs are often poorly designed from a communications viewpoint, with little thought having been given to wiring and management aspects. And they are almost all non-standard. However, despite this, they include some exciting technologies and form the basis of some very successful installations.

Communications-based LANs

Communications-based LANs have been designed to support the terminals that have already been installed in user sites. They fall into two groups:

— Inexpensive systems like Clearway, R-Loop and Multilink, which allow a small number of terminals to be connected in a limited area. These products can be very cost-effective provided that their limitations are accepted.

— Highly functional, and expensive, systems like HYPERbus and LocalNet. These are usually well engineered, but are not often cost-effective.

Most of these LANs do not comply with any accepted standards. The decision to install one is therefore a committment to interface standards such as V.24 and IBM 3270.

CONCLUSION

None of the networks meets the criteria identified at the start of this presentation:

— Twisted pairs have limited transmission speed and do not help with interworking.

— The IBM cabling scheme is complex and expensive and, in Europe, does not support voice or video communications.

— Broadband systems lack standards for interworking and require significant planning and operating skills.

— Ethernet is expensive for terminals and does not support voice or video.

—Systems-based proprietary LANs are often poorly engineered from the communications viewpoint and usually support only a restricted range of equipment.

—Communications-based proprietary LANs are either expensive or provide limited functionality, sometimes both. And they are non-standard.

The features of the various cabling options are compared in Figure 3.

Even though there is no general panacea for the local network problem it is possible to offer some guidelines:

—For a real, resource-sharing, LAN — use Ethernet.

—For ASCII equipment — be pragmatic. Twisted pairs are usually appropriate, but proprietary LANs are sometimes cost-effective.

—For 3270 terminals — use IBM coax (but be prepared to solve the resulting problems).

Figure 3 Comparison of local cabling options

Feature	*Telephone cable*	*Shielded twisted pair*	*IBM cabling scheme*	*Broadband*	*Ethernet*
Material costs	Low	Moderate	High	Low	Moderate
Labour costs	Low	Moderate	High	Low	Low
Can individual offices be pre-wired?	Yes	Yes	Yes	Yes	No
Do individual offices have to be pre-wired?	No	No	Yes	Yes	No
Terminal-to-host costs	Low	Low	Moderate	Moderate	High
Micro-network costs	n/a	Moderate (proprietary)	Moderate (Pronet)	Moderate	Moderate

LOCAL NETWORK OPTIONS: A CASE HISTORY

Ian Rickard, *Greater London Council*

Ian Rickard is Technical Planning and Local Development Manager with the Greater London Council's Central Computer Service. The combined GLC/ILEA budget is £3 billion, and in 1983/84 the data processing budget was £13 million (excluding educational computing). There are 320 data processing staff, with 120 analyst-programmers.

The GLC is a major IBM user with an IBM 3081 and an IBM 3033 together with other advanced facilities. There are 1,000 mainframe terminals (mostly 3270s), 35 minicomputers, 650 microcomputers, 400 word processing screens, 100 handheld computers and 46 CAD workstations.

For management purposes, a GLC committee takes high-level financial decisions. Each department prepares an IT plan for its own committee, although each department has an IT steering group. A single committee controls IT — its strategy, budgets and priorities — via the central Computer Services Department (CSD). The CSD identifies a specific client for each project and that client leads the project team. All costs are recovered and there is an agreement with staff and unions on new technology.

In this session Ian Rickard reviewed local network developments at the GLC, particularly with regard to office automation and local area networks. He began by describing the physical environment at the GLC. County Hall is a very large building with one mile of corridors on each of the floors. Conversely, there are many other small offices around London. For networking purposes, when ILEA schools are considered, there are 3,000 locations.

In order to provide a rational basis for development, the GLC has defined a business communications strategy. This strategy emphasises the communications aspects of the equipment. The key requirements were for:

—Word processing.

—Communications (mail, mainframe access and database access).

—Personal computing (spreadsheets and diary).

The planned system will eventually be used by more than 2,000 people, and will require very large document storage facilities (10,000 megabytes of text is generated per annum, and must be retained for up to ten years). The GLC soon realised that it would have to accept responsibility for integrating the existing equipment with any new equipment to achieve a viable business communications system.

Today, the GLC has two types of operational system using LAN technology — a Xionics ring and a Xerox Ethernet system.

The Xionics system consists of four rings with 150 screens. Each ring has a master node providing duplicated processors for ring control and background task processing. The system provides facilities for filing, personal computing and mail for about 200 users. There are three main disadvantages with the Xionics system:

—The large wall space required by the intelligent sockets.

—The large holes in the walls required for six cables, (four signal and two power) to each intelligent socket.

—The limited printing facilities.

—The proprietary operating system that requires packages such as dBASE II to be converted before they can be run on it.

The single Xerox Ethernet cable has 40 screens of various types attached to it, together with two 80M byte file servers and two laser printers. It provides mainframe access, electronic mail, diary, filing, personal computing and document preparation facilities to the GLC's Scientific Branch.

A detailed cost-benefit analysis of the Ethernet has been completed as part of the DTI office automation pilot scheme. The system is cost justified if some allowance is made for intangibles such as quality and speed of response.

The most significant differences between the two networks are:

—LAN structure: Xionics uses a ring (with token passing) and Xerox a branched tree (with CSMA/CD). The GLC has no opinion yet as to which is best.

—The Xerox Star workstations provide very good graphics facilities.

—Printers: Xionics has only dot matrix and daisywheel printers; the GLC had to interface the 2700 printer to XiNet itself.

—The Xerox network has no processor server; there is nowhere to send a job when more power is needed. (DEC minicomputers could be attached to remedy this.)

These LAN-based office systems are in operational use and their users would not be without them. However, the GLC would not describe either as better than the other and has further LAN developments in hand. There is also substantial demand for PC-to-mainframe communications.

Commenting on the GLC's experience, Ian Rickard said that the following lessons had been learnt:

—A mixed supplier solution is inevitable if a broad range of facilities is required because no supplier can offer everything that is needed.

—There are few standards available to help users.

—Adequate LAN gateway facilities are only now emerging.

—Much of the emergent technology remains unproven.

—Suppliers do not respond as quickly as the GLC would like, especially if the required facility is not part of the main line of development.

The GLC systems need to be upgraded so that the three separate electronic mail systems can be integrated. (At present HOST, Xionics and Xerox are used, and are incompatible.)

The document storage systems, including ATMS, STAIRS, HOST, Xionics, Xerox, Displaywriter and Wang, must be integrated. The integrated system must be:

—Expandable to 100,000M bytes.

—Indexed, with enough processing power for quick searching.

—Able to look elsewhere if a document is not found initially.

—Compatible for document formatting.

—Compatible with external mail systems such as teletex.

—Able to use common commands throughout the system.

With especial reference to the local network, the GLC has concluded:

—It is too expensive to completely prewire a building as large as County Hall.

—It is not possible to predict the best LAN to install, but Ethernet seems to be developing in the right direction.

—It is not possible to predefine the best topography.

—Some cable will be redundant. You have to balance facilities against costs today, because there is insufficient information to make long-term choices.

—You cannot yet calculate the minimum cost network that will provide access to new wide-area facilities (Megastream, PSS, etc.).

—Today, four-wire telephone circuits can be the cheapest option by a factor of 10.

In conclusion, Ian Rickard said:

—Wait, if you can afford to, until the facilities and application that you want are available.

—Make your requirements, especially for the integration of systems, part of the supplier contract.

—Insist on international standards such as OSI to ensure a wide range of long-term options.

—Pilot the system before committing yourself.

—Insist that equipment be able to communicate at 3270 emulation and at a document level. When teletex standards/service are available, use them. Don't buy kit if this option is not available.

—Never trust the supplier — any supplier — until you can see the hardware and software working.

—See what your main supplier is doing.

THE PBX AND LAN COMMUNICATIONS SOLUTION

Kevin Moersch, *Ztel, Inc.*

Kevin P. Moersch is vice president of sales at Ztel, Inc. As such he directs all sales, marketing and support activities for domestic and international distribution channels for Ztel's state-of-the-art private network exchange (PNX).

Ztel, Inc., was founded in January 1981 to develop, manufacture and market an advanced business communications system called the Private Network Exchange (PNX) and associated peripheral equipment, software and services.

Mr Moersch prefaced his remarks by saying that, in his view, IBM does not have the same dominance in the US as it does in Europe. In particular, AT&T's aggressive push will cause IBM to adopt international standards, such as IEEE 802.5 for LANs.

The PNX is a local area network-based communications controller providing advanced private branch exchange (APBX) functionality and integrating voice, data and text communications. The PNX is compatible with the IEEE 802.5 standard for token-passing ring networks and with the IBM cabling system. A distributed architecture will allow the PNX to grow modularly from 150 to 50,000 lines and can provide non-blocking, virtually non-stop operation.

The company successfully concluded its alpha test at corporate headquarters, as well as the beta installation of an integrated voice/data PNX in June 1984. Full production manufacturing of the PNX began during the summer of 1984, with the first customer shipment taking place to the state of Utah in September 1984. At the end of 1984 the company had several systems installed in various applications and sites.

Earlier information processing systems for voice, data, text and image had developed separately and, as yet, there is no real integration between them. The PNX had been designed from the beginning with the functional requirements for integration in mind.

The architectural principles of the PNX were described. The system provides fourth-generation (APBX) functionality, data switching functionality and an integral LAN. It integrates voice with existing and future data and information systems. Each PNX system incorporates distributed processing and control, load sharing, and can be modularly expanded. (See Figures 1 to 7.)

Figure 1

PNX — 4th GENERATION PBX

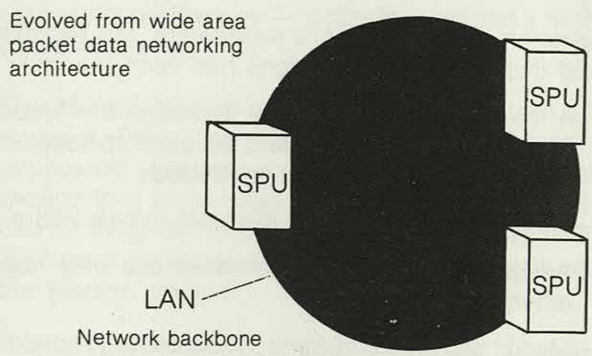


Figure 2

DISTRIBUTED SWITCHING

- SPUs can be located where required
  - — Co-located
  - — Physically distributed
- No central or main SPU

Figure 3

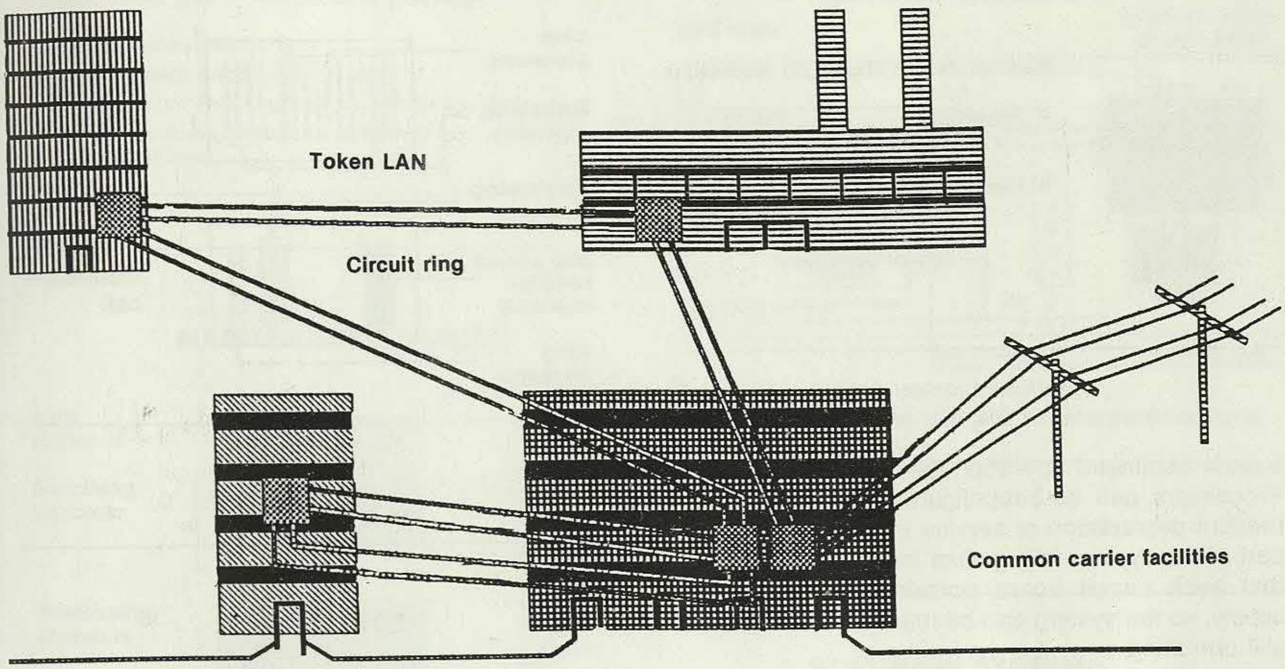
TOKEN PASSING LAN

- IEEE 802.5 token passing LAN
- Interswitch link for system control
- High speed data transmission
  - — 4 MBPS
  - — 16 MBPS
- Compatible with IBM announced LAN
- Future-safe

Figure 4

DISTRIBUTED SWITCHING

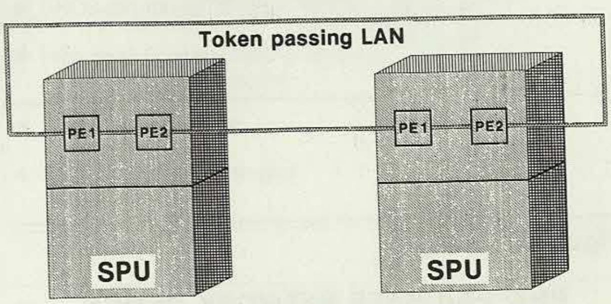
(▒ = SPU)



MULTI-SPU PNX SYSTEM

Figure 5

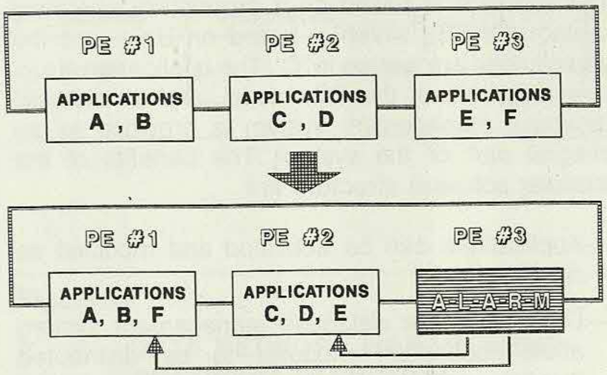
DISTRIBUTED CONTROL



All applications are processor independent. They can reside anywhere in the network.

Figure 6

LOAD SHARING



Active processors share the applications of a failed processor, with no loss of service.

The circuit-switched ring provides:

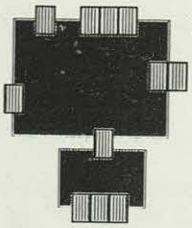
- —Digital voice.
- —Full duplex voice conversations.
- —Data up to 56k bit/s (asynchronous and synchronous).
- —The ability to add rings as needed to maintain non-blocking operation.

The main benefit of the distributed processing approach of the PNX is that the organisation needs only to install the capacity it requires, and can expand the system as required. Expansions can be made on-site.

The modular hardware architecture of the PNX features primary and redundant interface and control-cell elements, and a fail-safe network design incorporating a maintenance thread to virtually

Figure 7

GROW THE SYSTEM



Modular design allows for expansion:

- **Physically**
  - **— 250-50,000 ports**
- **Functionally**
  - **— SMDR**
  - **— Messaging**
  - **— Tenant services**

Figure 8

ELEMENTS

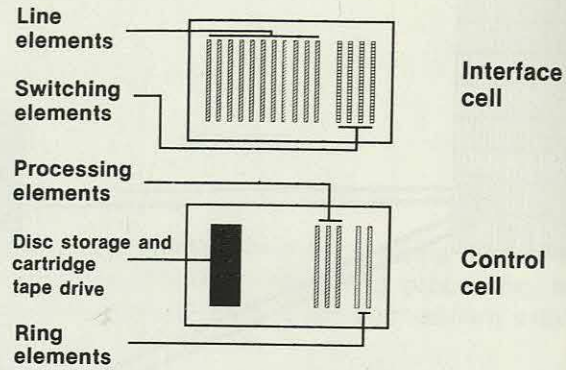


Figure 9

REDUNDANCY

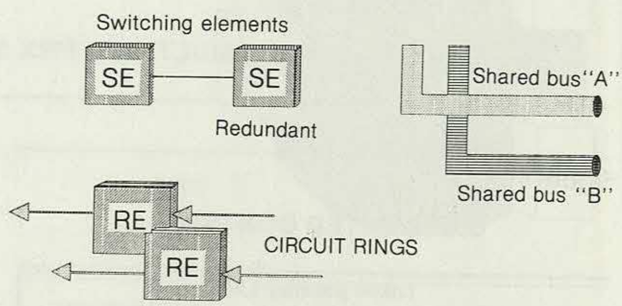
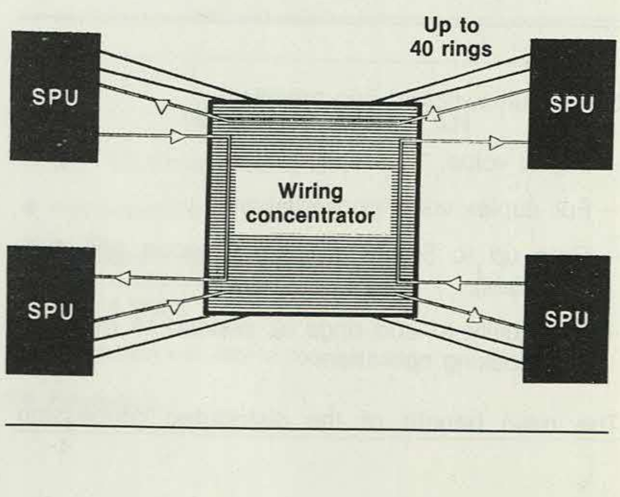


Figure 10

PNX: FAIL-SAFE NETWORK DESIGN



ensure continued operation (see Figures 8 to 12). Processors can be reconfigured automatically to prevent degradation of service in the event of one part of the system failing. One innovative feature is that each circuit board contains its own power supply, so the system can be maintained whilst it is still operating.

The PNX modular software architecture provides a detailed view of the software system structure and data network structure, and adheres to accepted standardisation (Figures 13 to 17). The open architecture of the PNX can allow other vendors' nodes to be included within the network.

The software is based on a proprietary operating system (DNOS), which is based on Unix, and the applications are written in 'C'. The application structure is based on the OSI model, and a relational database management system is provided as an integral part of the system. The benefits of the modular software structure are:

- —Applications can be activated and modified as needed.
- —DNOS and the database management system allow application modules to be distributed throughout the system.
- —The 'C' programming language allows end users (or third parties) to create customised software packages.

The PNX architecture also allows it to be used as a bridge between three standard LANs (e.g. between an 802.3 Ethernet LAN, the 802.5 LAN that is integral with the PNX, and an 802.4 LAN — General Motors 'MAP', for example).

The PNX provides solutions to structural and topographical requirements: non-distributed in a single

Figure 11

PNX: POWER SYSTEM FAIL-SAFE

- System uses *only* — 48VDC battery/charger
- On board power converters
  - — Hot board swapping (non-stop)
  - — Maximum PNX single point faulure line card
  - — No grounding problems as system size grows to 50,000 lines

Figure 12

MAINTENANCE THREAD

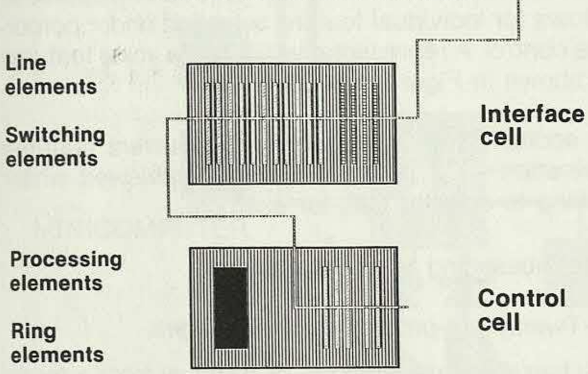


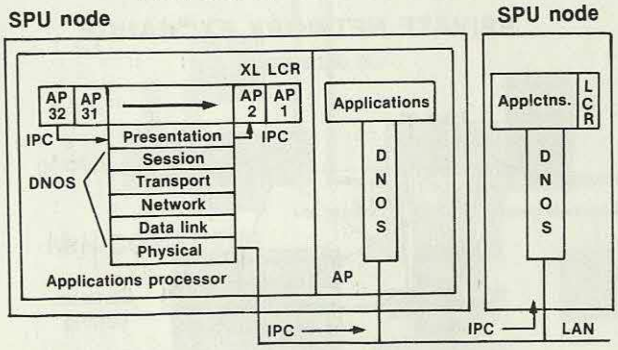
Figure 13

MODULAR SOFTWARE

- DNOS-distributed network operating system
- High level C programming language
  - — based on ISO model
- True relational DBMS
- Software option packages

Figure 14

PNX SOFTWARE ARCHITECTURE

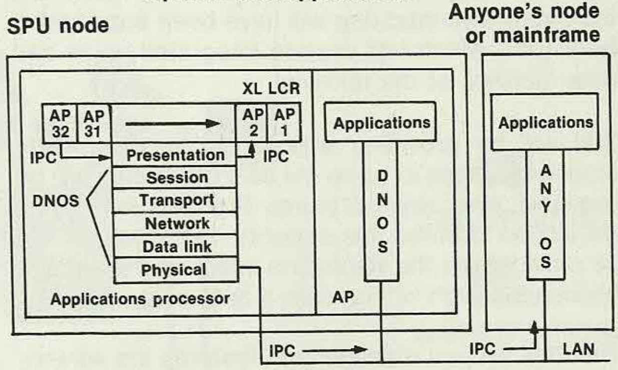


Inter process communications
All applications use IPC to intercommunicate

Figure 15

PNX SOFTWARE ARCHITECTURE

Open to new applications



Inter process communications
All applications use IPC to intercommunicate

Figure 16

SOFTWARE SYSTEM STRUCTURE

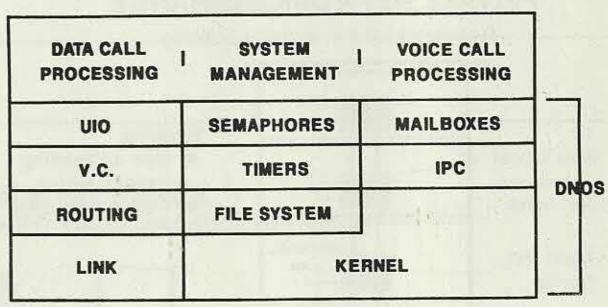
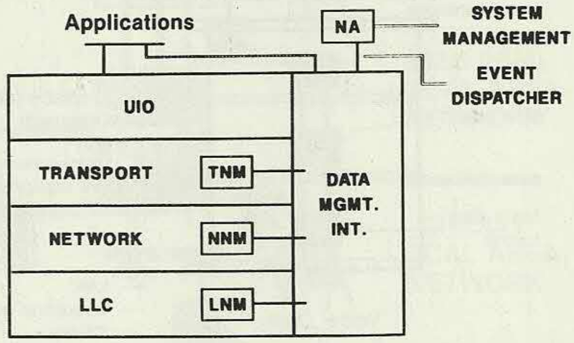


Figure 17

DATA NETWORK MANAGEMENT SOFTWARE STRUCTURE



building (Figure 18), distribution in a single building (Figure 19), and on a campus (Figure 20). Figures 21 to 27 show some typical configurations, and illustrate the likely evolution of the PNX. By late-1986, the circuit-switched ring will have been superseded by a LAN, which will provide integrated voice and data facilities at the terminal.

Ztel will be providing support for desk-top data communications at up to 4M bit/s (2.5M bit/s will be available over twisted pairs). Products are being developed to utilise this capacity. 3270 support will be provided via the voice/data integrated telephone handsets, which will contain a data plug.

The PNX system management features are screen-based and include:

—Interactive menu-driven database administration for moves, additions and changes.

—Extensive reporting facilities for usage and accounting.

—System maintenance, including online error detection.

—Concurrent access to administration functions.

The operator's console is also screen-based, and includes an integrated online directory and message centre.

The Ztel digital handsets are programmable and can provide more than 50 features. Three models are available, with 28, 12 or 4 feature buttons. Any one of the available features can be assigned, under user control, to each of the buttons. The user profile in the system management database determines the user-feature authorisation. This flexible approach allows for individual feature selection under corporate control. A representative list of the voice features is shown in Figures 28 and 29.

In addition, the PNX provides concurrent features operation — a new call can be previewed whilst talking to another call, for example.

The messaging features include:

—Twenty pre-programmed messages.

—User message creation or retrieval from a terminal or handset.

—Message prompts provide name and extension.

—Handset message lamp displays urgent and normal status.

A representative list of PNX data features is shown in Figures 30 and 31.

Ztel will not be providing its own workstations but will integrate other vendor's products into the PNX (initially the IBM PC and Apple's Macintosh).

Figure 18

PRIVATE NETWORK EXCHANGE

Non-distributed in a single building

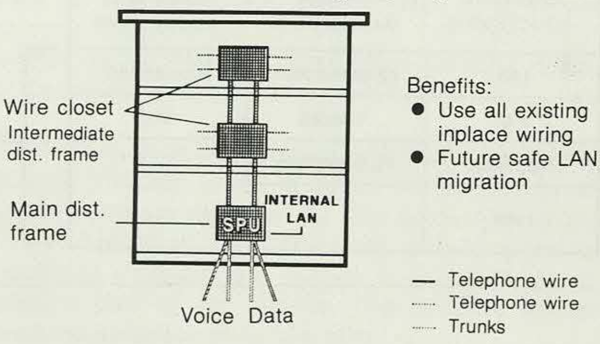


Figure 19

PRIVATE NETWORK EXCHANGE

Distributed in a single building

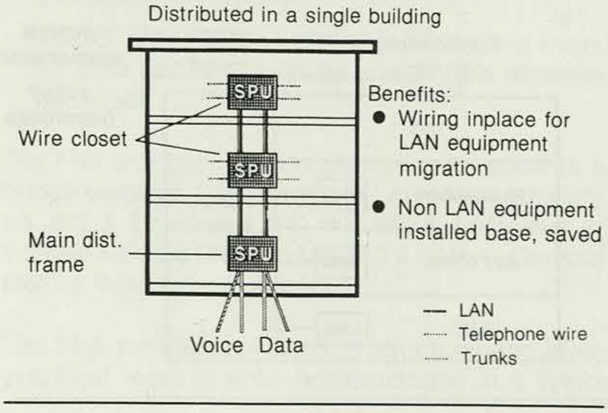
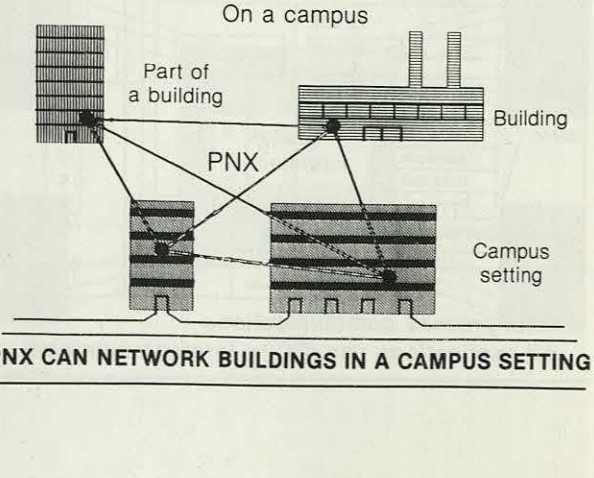


Figure 20

PRIVATE NETWORK EXCHANGE

On a campus



PNX CAN NETWORK BUILDINGS IN A CAMPUS SETTING

Figure 21

PRIVATE NETWORK EXCHANGE

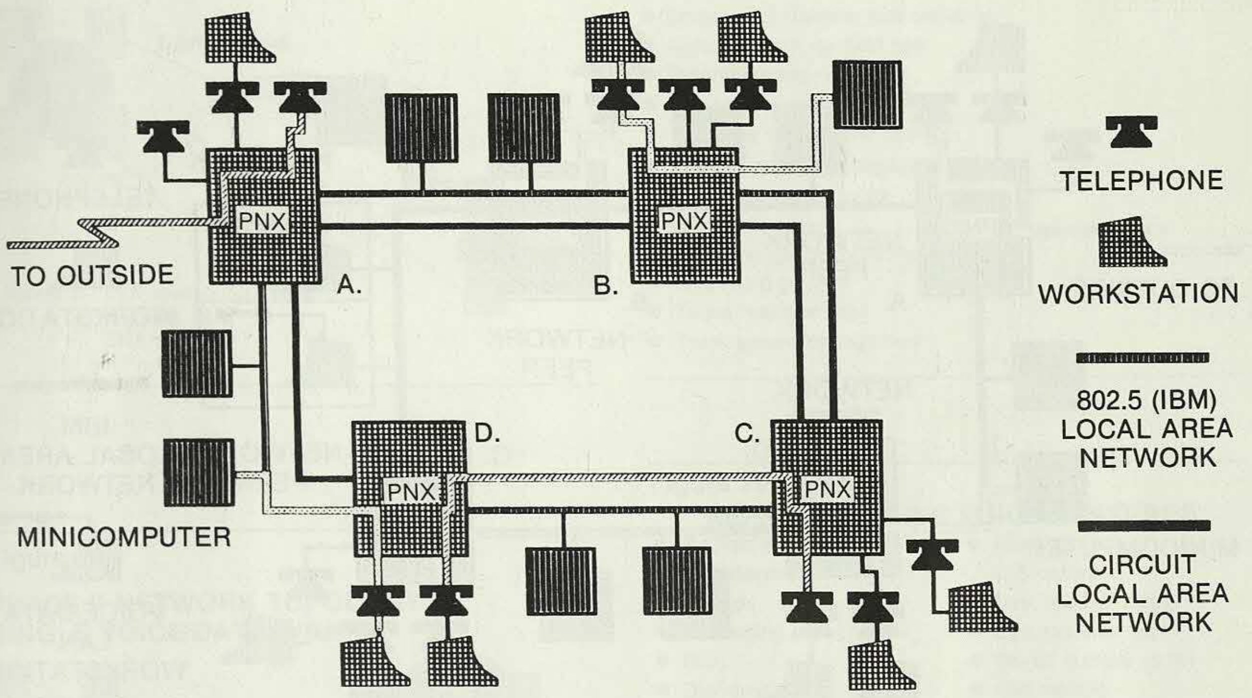


Figure 22

PRIVATE NETWORK EXCHANGE
MIGRATION TO LAN ATTACHED DATA WORKSTATIONS

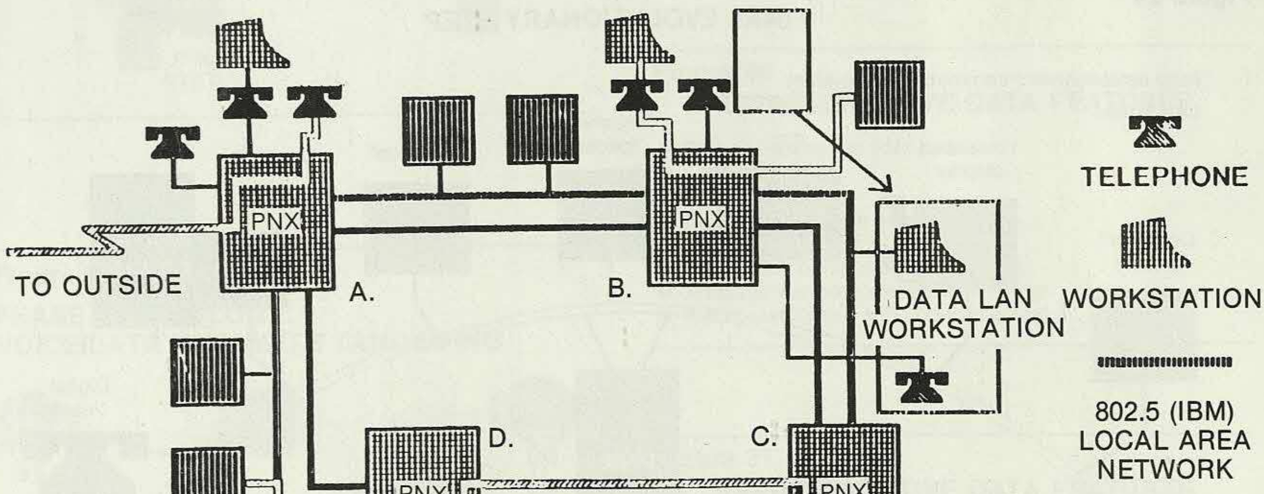


Figure 23

PNX — MIGRATION TO LAN ATTACHED VOICE/DATA WORKSTATIONS (FUTURE)

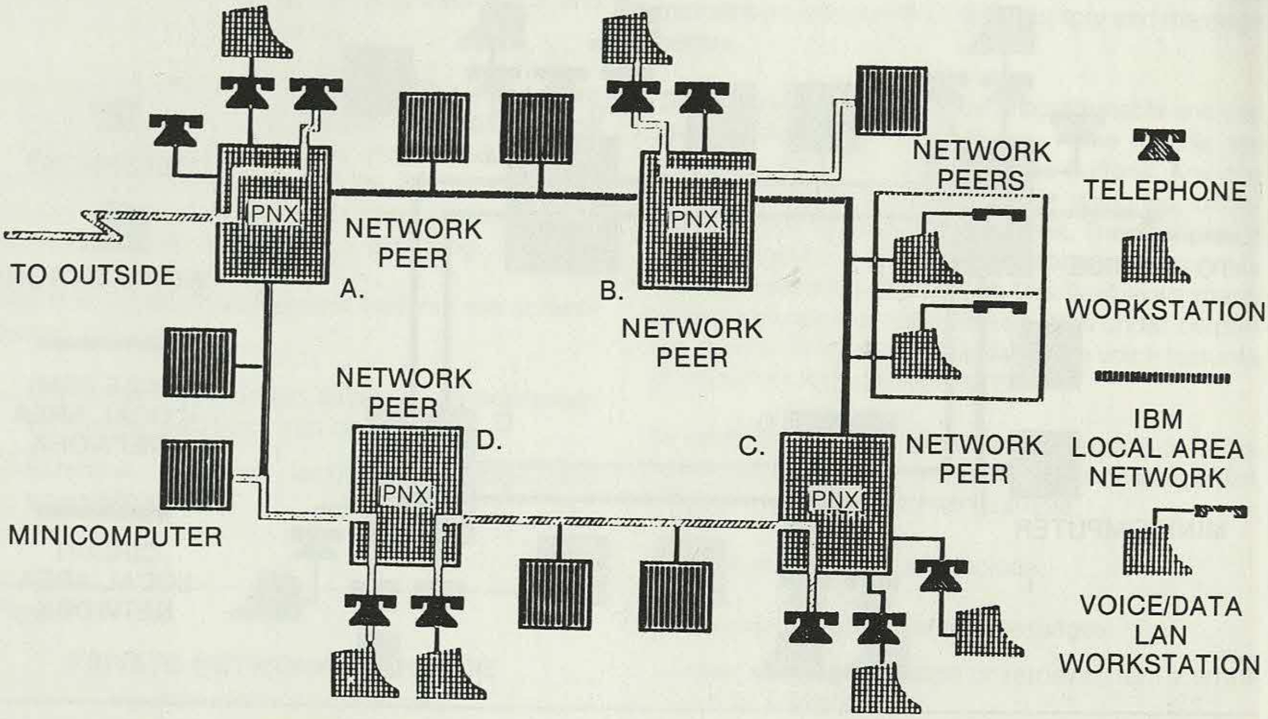


Figure 24

FINAL EVOLUTIONARY STEP

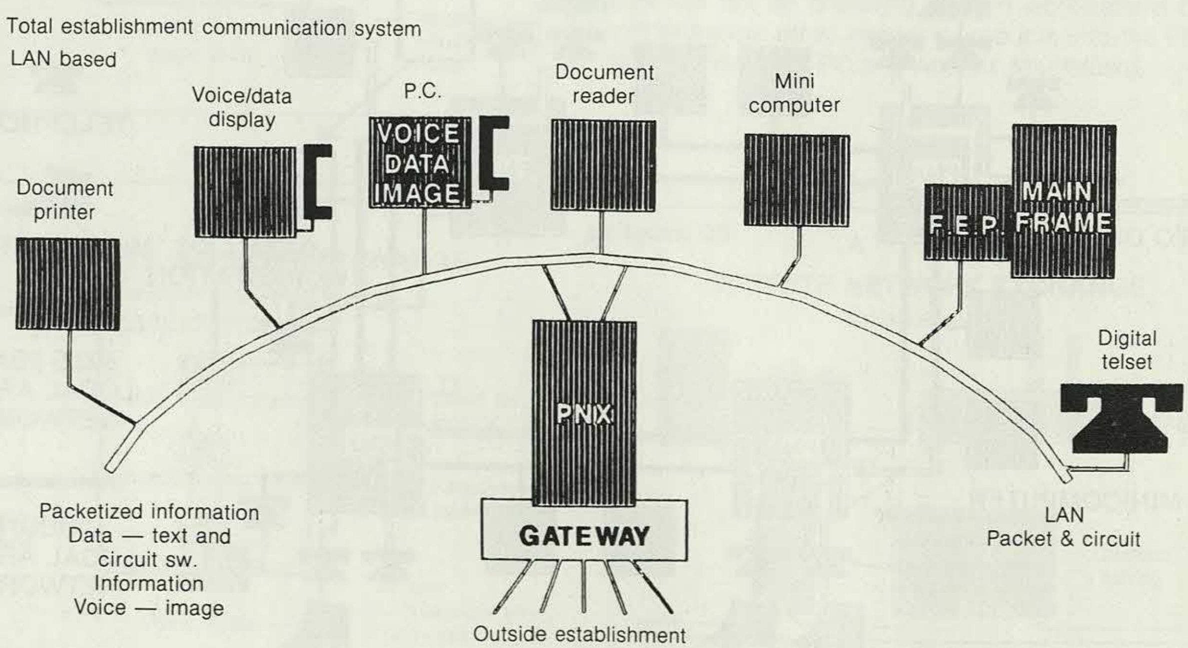
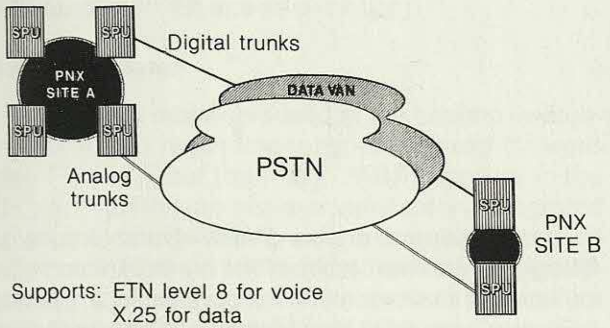


Figure 25

PHASE I NETWORK TOPOLOGY: SEPARATE VOICE/DATA WAN



Supports: ETN level 8 for voice
X.25 for data
SNA for data

Figure 26

PHASE II NETWORK TOPOLOGY: SINGLE VOICE/DATA WAN

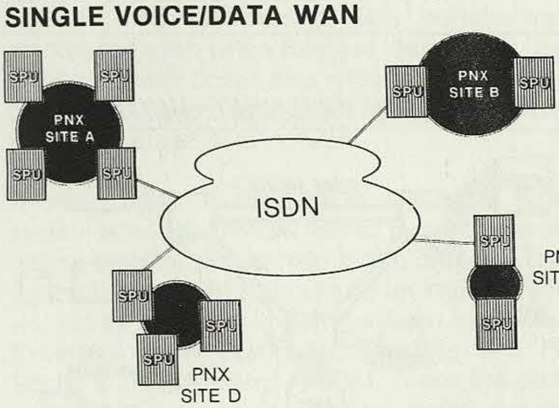


Figure 27

PHASE III TOPOLOGY: VOICE/DATA WAN WITH TANDEMING

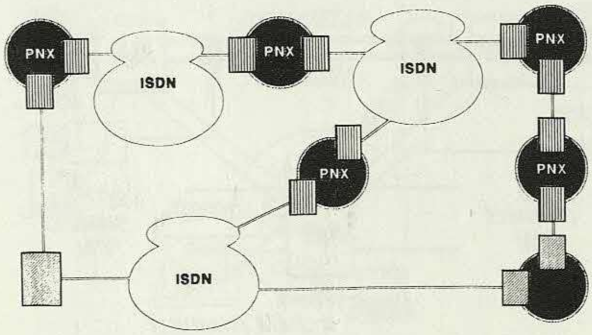


Figure 28 REPRESENTATIVE VOICE FEATURES

- I-hold
- I-use
- Station call transfer and camp on
- Auto ringback on held call
- Discriminating ringing
- Dial input verification display
- Incoming call source display
- Time of day, date display
- Attendant digital clock
- On-line directory
- Incoming call identification
- Line management
- Telset management
- Trunk group management

Figure 29

REPRESENTATIVE VOICE FEATURES

- On hold dialing
- LCD display
- Preview
- Messaging
- Flip
- Dial over voice
- Speed dialing
  — 3 varieties
- Least cost networking
- Call forwarding
  — 9 varieties

- Hunting
  — 8 varieties
- Last number redial
- Last number redial
- Saved number redial
- Call waiting
  — 7 varieties
- Prime line selection
- Automatic line selection
- Ringing line preference

Figure 30

REPRESENTATIVE DATA FEATURES

- External access to PNX features
- Class of service
- Resource sharing
- Equivalent to voice operations
- Data call by telset or keyboard
- Hunting on computer ports
- Message centre access via terminals
- Automated speed and code detection

Figure 31

REPRESENTATIVE DATA FEATURES

- Universal Sync/Async data interface devices up to 56 KBPS
- IBM compatible LAN (4 MBPS-16 MBPS)
- Modem pooling
- SMDR processing/accounting
- Protocol conversion (ISO level 1)
- Terminal user interface — TUI
- Automatic speed and code detection

SESSION 12 WIDE-AREA INTEGRATION

Edward Vulliamy, *Butler Cox & Partners Limited*

Edward Vulliamy is a Senior Consultant with Butler Cox, specialising in telecommunications strategy planning. He said that over the last ten years there had been a lot of talk but not much action in the area of voice/data integration. However, with the emergence of digital technology as a dominating factor in telecommunications, this situation is beginning to change.

In a digital bit-stream some bits would be data, some text, possibly some could be image; but the majority are likely to be digitised voice. This bit-stream could be transmitted or stored in various media: on a Megastream circuit, or passing through a digital circuit switch, or on disc storage as a 'compound electronic document'. Thus voice/data integration needs to be considered at three distinct levels: transmission, switching and applications.

Transmission level

Today, practical and cost-effective voice/data integration is occuring mainly at the transmission level. Organisations are renting digital bandwidth from British Telecom, or Mercury, and sharing it between their private voice and data networks. At present a Megastream circuit is good value for money and, even if rental costs were to be raised significantly, an organisation with enough voice and data traffic to justify 2.048M bit/s 'pipes' can exploit the digital bandwidth to good effect.

At present, there are two main options for sharing a Megastream circuit. Significantly both come from the data communications industry, which has identified a market niche neglected by the PABX suppliers.

The first option is to use high-bandwidth digital multiplexers that are capable of handling several 2.048M bit/s aggregate links and have a wide range of circuit boards for individual voice and data channels. Typical suppliers are Infotron, Timeplex and Case, and Figure 1 shows a representative configuration.

The second option uses a technique called 'drop-and-insert' multiplexing (see Figure 2). It is relatively inexpensive and allows the 2.048M bit/s digital trunk to be terminated on the PABX. Data circuits at 64k bit/s are extracted from the bit-stream and sub-multiplexed if necessary. The only supplier at present is Eurotel, whose D/I Mux is marketed both by British Telecom and Racal-Milgo.

The first option is better when there is a reasonably high percentage of data (or image or video, or whatever) compared with voice in the total bit-stream and also when comprehensive network management is needed. The second option is more suitable when there are relatively few data channels.

Figure 1

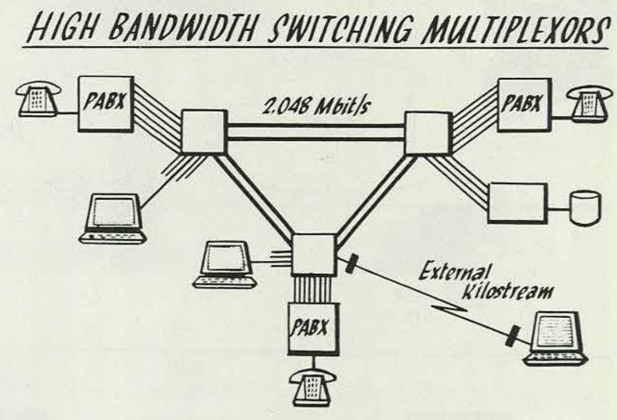
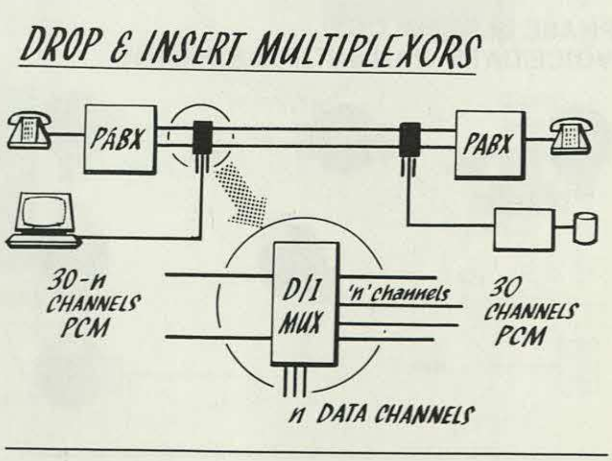


Figure 2



The main benefit from sharing a Megastream circuit is that circuit costs (especially for data) are reduced. And, if cost is of paramount importance, voice can be digitised at 32k bit/s or even lower. It is also possible to provide Kilostream equivalents with automatic full-speed back-up.

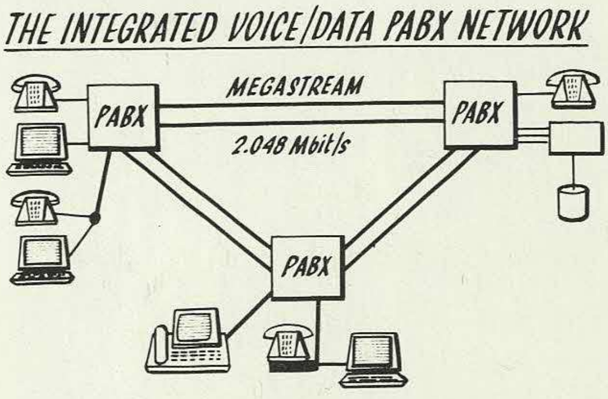
Switching level

The picture is more confused at the second (switching) level. The requirement appears straightforward (see Figure 3), but the major PABX suppliers in the UK seem unlikely to achieve satisfactory integrated voice and data switching via a wide-area digital network until 1986 or 1987. Even then many organisations may continue to choose either a separate purpose-built data switch from Infotron, Case, Gandalf, Micom, etc., or adopt an interconnected LAN approach rather than rely on their network of SLXs, IDXs, MD 110s or SX-2000s for data. SNA and equivalent networks will continue to need dedicated point-to-point data circuits.

The two main reasons for not having integrated switching are limited functionality and high cost. The telephony suppliers do not fully understand the complex and fast-moving data communications market and even when they get things right the cost of the interface boxes plus a share of the switch will often provide an uneconomic solution compared with a separate data network.

Another reason is the lack of a suitable signalling system although DPNSS (digital private network signalling system) should help in this respect. The next generation of PABXs should be an improvement but will not be available in network form for some time. Examples from European suppliers are Philips' Sopho S and Siemens' HICOM. These are designed with ISDN (integrated services digital network) in mind and provide 144k bit/s at the workstation (64k bit/s for voice, 64k bit/s for data and 16k bit/s for signalling).

Figure 3



Looking further ahead to the 1990s, a major question will be whether British Telecom's ISDN will cope with all of an organisation's wide-area networking needs (see Figure 4). The public service will be judged on function, quality, connectivity, reliability and cost.

Application level

At the application level, an important consideration is the techniques used for digital encoding of voice, and hence the storage required (see Figure 5).

Mr Vulliamy then identified three applications trends in the functional integration of voice and data in the wide area:

—Voice output via the telephone.

—Voice input via the telephone.

—Unified text and voice messaging.

A good example of voice output is provided by the DECtalk text-to-speech product. A US bank has installed six DECtalks as output devices. Corporate customers telephone in early each morning and are provided with a spoken statement of their daily cash

Figure 4

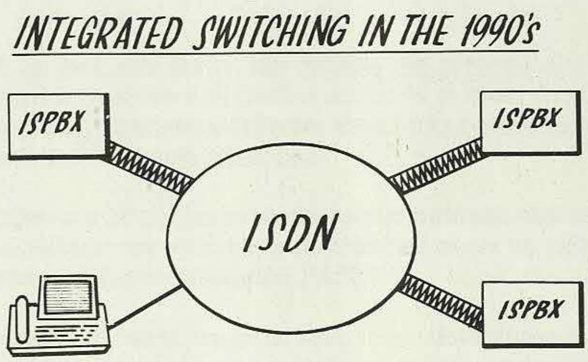
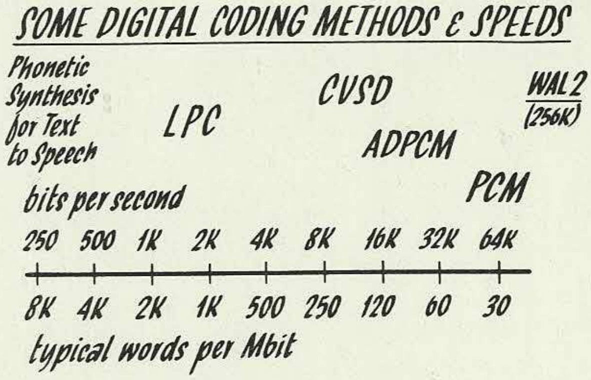


Figure 5



position, which is output direct from the bank's computer system. This is a big improvement on the old system where customers often had to call several times before they got through. In addition, the bank's staff disliked so much early morning activity.

Voice input (i.e. voice recognition) is more difficult to achieve than voice output. Nevertheless, there are small-vocabulary, speaker-dependent systems available now at a reasonable price. An insurance company in the US uses Votan equipment to allow its fire assessors to call in from the scene of a fire and file their reports using a specific and well-defined vocabulary. Using the old manual system, reports took, on average, 28 days to be produced.

Experience shows that most people find it tiresome to have to use both a text and voice mailbox. AT&T has anticipated this problem and recently announced the unified messaging service, although the first phase will merely allow text-to-speech conversion and message-waiting indication in both directions. IBM is also integrating its ADS product with DISOSS/PS and with PROFS. And Northern Telecom has a unified messaging product called Meridian.

Mr Vulliamy summarised his talk by saying that although the potential is there for voice-data integration at all levels, in 1985 integration is usually sensible only at the transmission level.

CONFERENCE CONCLUSION

Roger Camrass, *Butler Cox & Partners Limited*

From what we have heard over the last two days, we must conclude that we are entering a period of intense change in the telecommunications area. As a consequence, heavy demands are being made on telecommunications managers by the user community. For example, users at the operating and systems levels would like to evolve from:

—Cost-based networks supporting telephone and telex to a service-based approach offering a wide range of facilities.

—Fragmented, applications-based data networks to large, interconnected 'open' systems supporting a wider choice of equipment.

—Single-service local networks to multi-service 'integrated' networks supporting multifunction workstations.

However, the current commercial, organisational and technological environment is likely to impede progress towards these long-term goals. For example:

—By and large, commercial management is not ready to abandon cost-based criteria for evaluating new networks.

—Integration or interlinking of computer networks can only be achieved by adopting proprietary architectures such as SNA, or implementing piecemeal solutions.

—Local communication needs can only be met by several different networks (e.g. PABX and local area networks).

Nevertheless, we have heard that solutions to the current problems are just around the corner:

—OSI promotes open networking.

—Fourth generation PABXs promote a single local network, especially in combination with the IBM cabling scheme.

As managers and professionals involved in meeting user needs, you must surely ask:

—"To what extent do we disregard the long-term objectives in favour of doing today's job with proven tools such as SNA and multiple local area networks?"

If, as was said during the debate, the purpose is to provide creative and flexible solutions to meet short and long-term requirements, then I must leave you with the following question.

"Can you afford not to be distracted from short-term expedients by long-term possibilities such as OSI and the fourth-generation PABX?"

At the very least, we must keep these developments under review and we must learn quickly wherever practical experience has been obtained. This is very much what we have been trying to do over the last two days.

LIST OF DELEGATES

AGB	Martin Ray
ALLIED-LYONS	Frank Clay John White
BP INTERNATIONAL	Michael Alexander Robert McCluskey
BP OIL	Barbara Dickens
BRITISH NUCLEAR FUELS	Frank Boydell Peter Howell Hugh Sturman
BROOKE BOND GROUP	Geoff Codd
BROOKE BOND OXO	Peter Barton Des Lee
BURTON GROUP	Neville Hoyle
CADBURY SCHWEPPES	David Eastwood
CCTA	William McKinley
COURTAULDS	David Tyler
DALGETY	John Nixon John Powell Matthew Thackeray
DATEC	Michael Debenham Mike Prentice
DEPARTMENT OF TRADE AND INDUSTRY	Adrian Grilli
DHSS	John Hart Gill Jordan
EASTERN GAS	Guy Thompson
ELECTRICITY COUNCIL	Alfred Crowder Brian Swindells Donald Taylor David Watkin
ENGLISH CLAYS LOVERING POCHIN	Mike Keat Peter Rose
HEWLETT-PACKARD	David Lyon

HORIZON HOLIDAYS	Richard Hodgson Neil Mullett
ICI	Ken Edwards
ICL	Keith Harvey Sue Oliver
IMPERIAL BREWING AND LEISURE	Malcolm Henwood Roy Spence Roy Tomlinson
ISTEL	Clive Tristram
LONDON BOROUGH OF CROYDON	Don Ainge
MERCHANT INVESTORS ASSURANCE	Roger Gascoyne
MIDLAND BANK	Giles Brennand
MONSANTO EUROPE	Eric Marlow
NORTH EASTERN GAS	Paul Reynard
NORTHERN GAS	Anthony Johnston John Rayner
PILKINGTON BROTHERS	Mike Hyldon
PROVINCIAL INSURANCE	John Crane Chris Knowles David Newton Colin Wilson
PRUDENTIAL ASSURANCE	William Halton
RECKITT AND COLMAN	Geoff Gregory
RHM COMPUTING	Philip Bull Stewart Gething John Playfer
ROWNTREE MACKINTOSH	Rob Dyer Philip Hewitt Stan Hogg Ron Pontefract
SHELL UK	Philippe Verroest
SOUTHERN GAS	Michael Evans
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SURREY COUNTY COUNCIL	Gurmel Bansal Fred Partington
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ARGUS PRINTING SOUTH AFRICA	Daan Olivier

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Butler Cox & Partners

Butler Cox is an independent management consultancy and research organisation, specialising in the application of information technology within commerce, government and industry. The company offers a wide range of services both to suppliers and users of this technology. The Butler Cox Foundation is a service operated by Butler Cox on behalf of subscribing members.

Objectives of the Foundation

The Butler Cox Foundation sets out to study on behalf of subscribing members the opportunities and possible threats arising from developments in the field of information systems.

New developments in technology offer exciting opportunities — and also pose certain threats — for all organisations, whether in industry, commerce or government. New types of systems, combining computers, telecommunications and automated office equipment, are becoming not only possible, but also economically feasible.

As a result, any manager who is responsible for introducing new systems is confronted with the crucial question of how best to fit these elements together in ways that are effective, practical and economic.

While the equipment is becoming cheaper, the reverse is true of people — and this applies both to the people who design systems and those who make use of them. At the same time, human considerations become even more important as people's attitudes towards their working environment change.

These developments raise new questions for the manager of the information systems function as he seeks to determine and achieve the best economic mix from this technology.

Membership of the Foundation

The majority of organisations participating in the Butler Cox Foundation are large organisations seeking to exploit to the full the most recent developments in information systems technology. An important minority of the membership is formed by suppliers of the technology. The membership is international with participants from the United Kingdom, France, Sweden, Switzerland, Belgium, Denmark, the Netherlands, Italy, South Africa, the United States and elsewhere.

The Foundation Research Programme

The research programme is planned jointly by Butler Cox and by the member organisations. Each year Butler Cox draws up a short-list of topics that reflects the Foundation's view of the important issues in information systems technology and its application. Member organisations rank the topics according to their own requirements and as a result of this process members' preferences are determined.

Before each research project starts there is a further opportunity for members to influence the direction of the research. A detailed description of the project defining its scope and the issues to be addressed is sent to all members for comment.

The Report Series

The Foundation publishes six reports each year. The reports are intended to be read primarily by senior and middle managers who are concerned with the planning of information systems. They are, however, written in a style that makes them suitable to be read both by line managers and functional managers. The reports concentrate on defining key management issues and on offering advice and guidance on how and when to address those issues.

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