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ABSTRACT

In this paper I will look at some aspects of computer networks in the U.K. and compare these systems with those in Europe and the U.S.A. In general, I describe three types of network. Firstly, personal computer networks; secondly, local-area networks, and finally the nation-wide data services provided by the state telecommunications carrier British Telecom. I will emphasise the communications aspects of these systems rather than the micro aspects.

1) Introduction

A significant difference between the U.K. and the U.S.A. that emerges is that, although the U.K. has been at the forefront of data communications (indeed the term 'packet' was coined by D.W.

Davies of the British National Physical Laboratory in 1965), the personal computer fraternity have been much slower to latch on to the benefits of networking. There are reasons for this as outlined later. Networking has always been advanced in the academic community, however, but the philosophy has always been 'big-machine'. There are comprehensive links between all University computers and large central facilities such as the British Science Research Council's Interactive Computing facility at Manchester University. Local area networks are only just emerging as a viable medium distance solution to distributed computing, and the growth rate in this area is very fast. Finally, British Telecom provide comprehensive data communications facilities such as PRESTEL, the home information service, and PSS, the national packet switched system.

2) Personal Computer Networks

The British personal computer fraternity have lagged behind their U.S. counterparts in 'getting-into' computer networking. Indeed, as of November 1981, Personal Computer World (the largest selling U.K. personal computer magazine) listed only four networks, none of them operating full

time. There are, however, 'good' reasons for this (or bad depending on your point of view). Firstly, it has to be remembered that all telecommunications media are a state monopoly in Britain. This means that all communications facilities are either provided by British Telecom or licensed by them. This has advantages in that standards can be kept high, but is disadvantageous in that such a structure is inflexible. Personal computer users have suffered from this in several ways, but here is an example: it is not possible to buy a cheap 300 Baud direct-couple modem that has B.T. 'approval'. B.T. insists that any piece of equipment that is connected to a phone line must have an 'approved' certificate. (It should also be noted that this approval procedure is much more rigorous than the FCC; part 68 requirements). Manufacturers of equipments have in the past been so frustrated at the delay in obtaining approval, that they have dropped equipment projects rather than proceed with lengthy negotiations. So again, the personal computer user has suffered. There is, however, hope on the horizon. B.T. has announced far-reaching proposals for relaxing the laws relating to equipments for the telephone system. This will make the approval procedure much easier for the small manufacturer, and this in turn will benefit the personal computer users through lower prices. The inventiveness of the British personal computer user is not to be denied however! National telesoftware experiments are actively being pursued via the British PRESTEL information system described elsewhere in this paper. For interested parties willing to risk a transatlantic 'phone call, here are the networks operating:

Forum-80 Hull...Operator: Frederick Brown, tel 0482 856169. Facilities: electronic mail, software up/down loading, Forum-80 Users' Group, PET users' section, shopping list. Hours: 7 days/week, midnight-0800, Tues & Thurs 1900-2200, Sat & Sun 1300-2200.

Forum-80 London...Operator: Leon Jay, tel 01-286 6207. Facilities: electronic mail, program down-loading. Hours: Tues, Fri, Sat & Sun 1900-2300.

80-NET...Operators: Leon Heller & Brian Pain, National TRS-80 Users' Group, tel 0908 566660. Facilities: electronic

mail, software for downloading, newsletter, TRS-80 information. Hours: 7 days/week, 1900-2200.

CBBS London...Operator: Peter Goldman, tel 01-399 2136. Facilities: electronic mail, program downloading. Hours: Wed 0700-0930 & 1900-2200, Fri 1900-2200, Sun 1600-2200.

Forum-80 Holland...Operator: Nico Karssemeyer, tel 010 313 512 533. Facilities: electronic mail, program up/downloading, shopping list. Hours: Tues-Sat 1800-0700 nightly, continuous from 1800 Sat - 0700 Tues.

Be warned, however! The frequencies used for 300 Baud transmission on the Bell 103 type system are not the same as the British System, which is CCITT V-21 compatible. You should note, however, that with prior warning the operators will connect up a Bell type modem (not 'approved' on the British system) for you!

Those interested in fully approved operation should access a network that is connected to the British IPSS (International Packet Switching Service), described later.

### 3) Local-Area Networks (L.A.N.'s)

A local area network may be defined as a system for connecting independent computer systems that act as producers and consumers of information within a given organisation. Such systems are rapidly increasing in the U.K., particularly as the business community realises the cost benefits when compared with the 'old' philosophy of multi-user minicomputers. The reasons for these benefits are firstly the low cost of microcomputers and secondly the increasingly desirable cost objectives of moving information electronically by computer as opposed to by hand. Most of the British L.A.N.'s now in operation have been built at universities and are used to link a wide variety of different computer systems, typically microcomputers. As opposed to the U.S. fraternity who favour the Ethernet system, the preferred system in the U.K. is the Cambridge Ring.

The Cambridge Ring itself was born 6 years' ago from a proposal of Cambridge

computer pioneer, Prof. Maurice Wilkes. Essentially, the idea behind the system is to connect all the stations of a local network into a single-channel ring by means of serially connected shift registers contained in each station's interface. By synchronously clocking all these shift registers, typically at a data rate of 10 Mbit/s or more, a fixed-length bit train can be made to travel continuously around the ring, and the basis of the system's operation is the conceptual division of this continuous bit train into a fixed number of 'slots' each 38 bits long. When a station wishes to transmit over the network, it merely monitors the circulating bit stream until it detects an 'empty' slot, which it then replaces with a 'mini-packet' of information comprising an 8 bit destination address, an 8 bit source address, 16 bits of data and 6 control and parity bits. Each destination station simply monitors the bit stream until it detects a minipacket bearing its address.

An important advantage of the Ring system is its in-built transmission-acknowledge system. Once a minipacket has been inserted onto the network, it travels round the ring to the destination station, where appropriate control bits are set to indicate whether it has been accepted. Once the minipacket has arrived back at its source, it is cleared to form an 'empty' slot, which cannot, however, be immediately re-used by the same station but has to be passed on, so preventing any one station from 'hogging' the network. If a transmitting station finds that its minipacket has not been accepted by a 'busy' destination, it then 'holds back' for a randomly determined interval before transmitting again.

Developments of the Ring concept include the S.R.C.'s project UNIVERSE which will interconnect a large number of rings via satellite.

#### 4) National Data Services

British Telecom provide a wide range of data services. These include Datel, PSS, and PRESTEL.

##### Datel

Datel services are the standard data comms. facilities of B.T. The range of services

goes from 300 bits/sec asynchronous 2-wire Duplex to 16,000 bits/sec via the 4-wire Adaptively Equalised Plessey Modem. It is necessary to rent a modem from B.T. to obtain service.

#### 4b) PRESTEL

PRESTEL is the U.K. Teletext System. The system is expanding every day and now has about 20,000 subscribers. In general, subscribers can buy an approved PRESTEL adapter which is a simple keypad with integral modem. Colour display is output to an ordinary domestic T.V. receiver. Users can access up to 150,000 pages of information, from the stock exchange to the latest teleshopping information. PRESTEL is also being used by personal computer users for telesoftware, and in general provides several other significant closed user groups. The medical profession use PRESTEL extensively for the latest professional news. By interfacing a personal computer to the system a user can not only network via the system, but become an information provider.

#### 4c P.S.S.

P.S.S. is the national packet switching service. P.S.S. is provided by a network of 'packet' exchanges (PSEs). This means that instead of adopting the technique used for telephone calls, where one transmission path is constantly maintained between 2 parties for the duration of the call, on P.S.S. the 'message' is broken into discrete quantities which are wrapped separately in control information, and sent through the network as distinct entities called packets. The packets normally all take the same route, and they will be delivered in the correct order at the destination, the control information will be discarded leaving the message in its original form.

The advantage of this method is that packets from various sources may be interleaved as they travel through the network, so the traffic load can be carried with maximum efficiency.

The end user sees nothing of this technique. At demonstrations of packet switching the question is often asked 'where are the packets?' The answer is that the user will never see the packet 'wrappings' because they are added and

removed either by the P.S.S. exchange or by the software in his own terminal. He simply inputs his 'message' or receives his 'answer'. In many cases the output he does see will appear to flow in an uninterrupted stream.

A set of instructions is required to break a 'message' into blocks, wrap it with routing and control information and send it through the network. Such instructions are known as 'protocols'. The set of instructions which govern the functioning of P.S.S. is a 3-level protocol.

Level 1 governs the physical and electrical connection, or interface, to the network. Level 2 governs the procedures which set up and maintain a secure link between the customer's equipment and the exchange, and provides error control. Level 3 specifies the way in which the data is to be wrapped to form packets, and provides the rules for establishing calls and controlling the flow of data. This 3-level protocol reflects an international recommendation known as CCITT recommendation X25.

It is important to bear in mind the distinction between the 2 kinds of customer equipment, packet terminals and character terminals, because they entail different modes of working and different facilities.

Packet terminals are connected to the nearest P.S.S. exchange by a Dataline. This comprises a modem (ie transmission device), a dedicated line, a modem in the exchange and a port (ie point of connection to the exchange). There is no telephone and no need to make any kind of telephone call.

Character Terminals cannot work directly to the network, because they cannot make packets, ie cannot comply with the P.S.S. protocol. Therefore they are connected to a Packet Assembler/Disassembler, known as a PAD, which is located within each P.S.S. exchange.

Character terminals may be connected to the PAD either by a Dataline, or by dial-up using a Datel service and the Public Switched Telephone Network (PSTN).

Customers who have no direct connection to

P.S.S., but dial in over the telephone network, all share common access to the PAD.

#### 4d) Euronet DIANE

DIANE stands for Direct Information Access Network for Europe. It is the on-line information retrieval service available via the EURONET telecommunications network.

The EURONET network is the product of CEC and member PTT co-operation, EURONET DIANE service is the outcome of CEC co-operation with major European on-line host computer operators and information providers.

Its aim is to bring to the European on-line user the best of European services in the fields of scientific, technical and socio-economic information.

Some 30 host operators offering about 200 databases have undertaken with the Commission to offer their services on a commercial basis via EURONET DIANE. The subjects covered range from agriculture to zoology.

EURONET DIANE also brings added benefits to the on-line user through the development of common services under sponsorship by the Commission:

- Common Command Set
- enquiry and referral services
- multi-lingual aids
- central user forum

Moreover, users benefit from the impetus so given to the development and improvement of on-line services in Europe.

#### 5) Conclusions

The paper has given a 'flavour' of the facilities for networking in the U.K. Developments are obviously on-going, and more details of telesoftware, PRESTEL networking, and international networking via packet systems will be presented at the Faire.