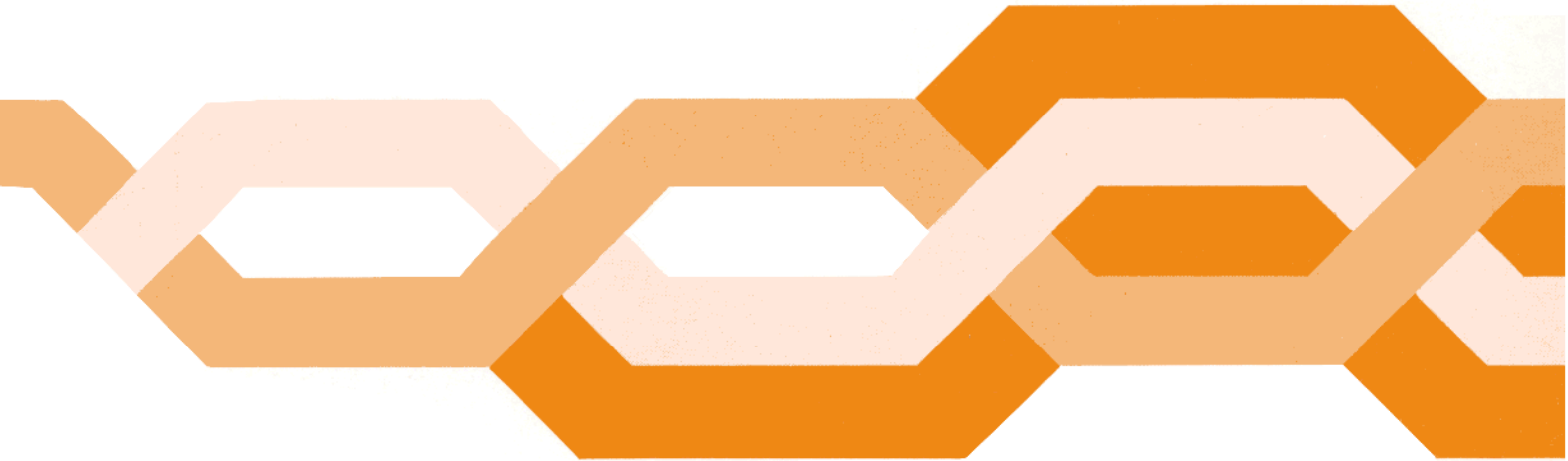
Maintenance News

19

Autumn
1981



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Published by BTHQ/NE/ES5.4.3 Room 1230,
207 Old Street
LONDON EC1V 9PS
01-739 3464 Ext. 7695

Maintenance News
ISSN 0143-6627

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Produced by Management Communications (BTHQ/PR3.1.5)

Editorial

We are grateful to Dick Walker of NWTB for compiling an index for *MN* which is published as a separate volume distributed with this issue. We hope to update the index every two years so readers may wish to keep their's up-to-date between issues.

Also included in this issue is the first of a series called *On Reflection . . .* in which some of the subjects covered 10 issues ago are reviewed. I hope readers will find the series interesting.

Ron Quinney – Editor

The BT Act 1981– and the future

by **Frank Lawson**

The Director, Residential and Customer Services, has been looking at the effect of Government policy on BT – especially on the maintenance side of our business.

The BT Act

The Act most of us have been talking about since the present Government was elected is now with us. What does it all mean in practical terms ?

The Act itself does not give much detail of the new competitive regime we now face. It simply sets up a loose-limbed framework in which the Government – through the Secretary of State for Industry – can work to implement its general policy of opening to competition parts of telecommunications in this country. Much of the new Act is very similar to the Post Office Act 1969 under which we have been operating for the past 12 years – but there are crucial differences. Some of these help BT's interests. For example, BT's powers have been substantially broadened to ensure beyond doubt that we can participate fully in the exciting new markets brought about by the convergence of computing and telecommunications – such as the 'electronic' office and 'electronic funds transfer'. Others do not benefit us in this way and have appreciable disadvantages.

Central to the Act are new powers given to the Secretary of State. These include

- wide-ranging powers of direction over BT
- powers to license competitive activities
- means to establish independent arrangements for setting standards – which must be met by attachments to the networks – and for certifying equipment to those standards.

These powers will enable the Government to liberalise both the supply of terminal equipment and the use – and even the provision – of networks. Many of the changes to be faced over the next few years will undoubtedly stay.

What are these likely to be ? Because much depends on Government policy rather than the Act itself, some of this is still unclear at the time of writing. Also, policy – unlike legislation – can be easily changed. So whatever the initial position, BT will be constantly 'on probation'. In competitive areas customers will choose for themselves – if *our* products, *our* services and *our* after-sales backup are not up to their expectations, they will look elsewhere. In monopoly areas our performance will be looked at closely by Government, by consumerists, and by customers. And if it is not considered satisfactory, the Government could well use its powers to enforce changes.

The new regime

The Government has made very clear its

intention to liberalise much of the market for terminal apparatus, and to ensure that where BT competes with other suppliers it does so fairly and is in a similar legal position – for example, having the same liability to customers for defective goods. On networks, initially the Government proposed that BT would retain the monopoly, but asked Professor Beesley to study certain aspects of possible competition in network areas. His report made very wide-ranging recommendations – not only that others should be able to use BT network capacity freely to provide services for third parties, whether or not these services included any 'added-value' (these are facilities not normally provided within BT's services) but also that competing networks provided by others should be permitted.

The Government has sought reactions from interested parties – and BT has vigorously opposed the more extreme recommendations made by Professor Beesley. The Government recently announced its decision to allow competitors to provide 'added value services'. Details of how this liberalisation will work still have to be arranged but in principle we can welcome it: new 'added value' services can bring more business for the network. The Government has not yet decided whether to implement more far-reaching liberalisation – including a system called Mercury, a separate network proposed by Cable and Wireless, Barclays and BP, to provide some trunk services. By the time you read this, the Government may have announced its further intentions, so we may be faced with other challenges and opportunities.

In the field of terminal apparatus, the outline of the new regime is reasonably clear, although many details still remain to be filled in. Subject to appropriate approval procedures, the supply, installation and maintenance of all types of attachments to the network are expected to be opened up to competition during the next two years – with two major and important exceptions. These are designed to protect the integrity of the network, to ensure that telephone users can always obtain adequate performance; and to simplify operation which might otherwise give rise to disputes about whether faults were due to the network or to private attachments connected to it. These exceptions are the so-called 'prime instrument' monopoly and 'multiple exchange line switching system maintenance' monopoly. It is very important that both of these are understood by staff.

The prime instrument monopoly

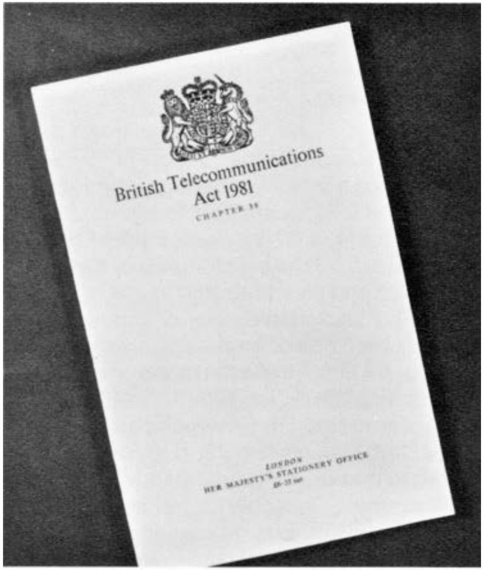
This will apply to all single direct exchange lines which provide voice communications either solely, or in addition to, non-voice facilities (but not to purely non-voice arrangements). It requires that at least one telephone instrument (or combined telephone/non-voice attachment) on each single direct exchange line shall be supplied and maintained by BT. The prime instrument monopoly also applies in the case of a multi-exchange line installation, accessed by a single telephone number (an auxiliary hunting group, for example) which does not provide switching facilities on the subscriber's premises. In this case either one instrument per line, or one instrument per group which can be connected (for example by plugs and sockets) to any line for test purposes, must be provided and maintained by BT.

Multiple exchange line switching systems maintenance monopoly

This will apply to all other multiple exchange line arrangements which provide voice communication facilities – ranging from the simplest key and lamp unit to the most complex PABX, with the exception of digital SPC PABXs. In all these cases the switching system and the extension wiring up to the sockets or block terminals serving the extension telephone instruments, must be maintained by BT. Like the prime instrument monopoly, this will not apply to purely non-voice arrangements, but will apply to mixed voice/non-voice systems.

Phasing, standards and approval

As already mentioned it is the Government's intention that the liberalisation of attachments to the network will be phased over a period of about two years. This time is needed to draw up standards for all the different types of attachments and for reciprocal trading arrangements with overseas competitors to be set up. So the programme will start with the basic types of attachment such as simple extension telephones, progress through increasingly complex devices such as HESs using existing technology, telex equipment, HESs using new technology, and finishing with the more complicated PABXs and ACDs (Automatic Call Distributors). There is also, of course, quite a range of types of equipment which are



already liberalised.

The standards, which may include conditions of use (extension telephone instrument only, for example), will be produced by BSI in consultation with interested parties including BT, and will need to be approved by the Secretary of State. It has been proposed that a further independent body (possibly the BEAB – the British Electro-technical Approvals Board) will be responsible for authentication of equipment to those standards. All equipment which has been passed will have to be so marked, including any relevant conditions of use, and any advertising will also have to include mention of such conditions. The guidelines to which BSI is working in producing the standards, include performance requirements and, where relevant, any requirements of international recommendations, as well as basic compatibility and safety requirements. This is to ensure that private apparatus

- will not interfere with network operation
- will not impose any danger of damage to the network or injury to BT staff working on it, and
- will perform satisfactorily.

Springboard for maintenance

With the exceptions of the prime instrument and multiple exchange line switching systems, the Government has proposed that all terminal maintenance work will, in due course, be open to competition. BT will compete vigorously for the maintenance of its own apparatus, and probably also of some types of privately supplied apparatus – if this appears commercially rewarding. Where there are worthwhile and profitable opportunities we shall try to seize them. We already have some experience of competitive maintenance – for example, modems over 2.4k bit/s – and we have been reasonably successful in maintaining installations in situations where our efficiency can be directly compared with the opposition. Indeed, we do have some massive advantages in the maintenance market. Our strong nationwide coverage, with highly trained engineering staff, is a powerful springboard. Our initial near-monopoly position should be a substantial competitive advantage – and many customers will be little inclined to change over to our competitors so long as we provide a satisfactory service.

But there is certainly no room for complacency. BT must provide

- a first class back-up service for its own products if it is to retain the maintenance of these in a competitive environment, and
- an outstanding service for the maintenance of competitors' products if it is to make substantial inroads into that market.

Moreover, our charges must be set at a competitive level, and our efficiency must be high enough to permit this and yet to ensure profitability. Nor is it only in the competitive areas that we must shine. Unless we provide a high standard of service in the maintenance monopoly areas of the prime instrument and switching systems such as PABXs, there will be strong pressures for further relaxation of these monopolies.

Changes

Changes are going to be necessary. For example, if overheads are included, the cost of sending an engineer out to a customer's premises is more than the cost of a basic telephone. We shall not be able to afford this when our competitors are providing instruments connected with plugs and sockets – very probably on a replacement/exchange maintenance basis. We are going to have to beat the competition at their own game. What we have to do to minimise loss of markets here is to look for different ways to serve customers' wishes. We must

- sell more telephones, particularly residential extensions, so as to increase the number to be maintained
- adopt new methods of working so as to retain the maximum proportion of the

maintenance market on existing types of apparatus

- seek new areas in which we can compete successfully and profitably for maintenance
- ensure that those people who want to pay for the convenience of engineering visits when their plug-and-socket telephone goes wrong receive the high quality of service they will expect, and
- above all, we must not sit back and rely on the remaining monopoly areas – that is a recipe for failure.

The outlook

Changes are coming and competition is here to stay – customers are going to have an increasing choice. The future is not going to be the well-trodden path to which we have all been accustomed. But telecommunication is a huge and rapidly expanding marketplace – there is plenty of room for competition and there's a stimulating and exciting time ahead. We have some outstanding products available – such as Herald and Monarch which are as good as anything of their type available anywhere. Others are coming soon. They are potential winners but must be given the after-sales support which customers will certainly expect. BT will compete vigorously wherever there are commercially worthwhile opportunities – but any business is only as good as its staff. Ours are second-to-none, so if we can rely on their wholehearted commitment to beating the competition, the future will be exciting and profitable.

Digital programme equipment

by **Kenneth Davies** Exeter Telephone Area. Included in BT's plan for the new digital network (*MN 15*) is the introduction of digital programme equipment. This article describes the first generation equipment made by GTE Telecommunications of Italy which forms a basic 2 Mbit/s Pulse Code Modulated (PCM) building block for the new network.

Later, a system developed jointly by the BBC and BT will supersede this equipment.

A complete terminal consists of one transmit and one receive multiplex on one rack, each having six sound channels of 40Hz to 15kHz bandwidth producing a combined digital output of 2.048 Mbit/s. Figure 1 shows the basic programme multiplex and the input and output signal levels.

Description

A slim rack known as N2, which is 2600mm high, 120mm wide and 225mm deep, houses all the equipment and is arranged as shown in Figure 2. Each sound channel is sampled every 31.25 micro-seconds producing a series of pulses known as a Pulse Amplitude Modulated (PAM) signal which is then converted into a 14-bit code corresponding to the amplitude of each signal sample. There are 16384 (2^{14}) signal values spread equally over the signal input range giving linear encoding.

The 14-bit code is then specially compressed according to a logarithmic law into 1024 (2^{10}) 'quantized' levels represented by a 10-bit code. Each of the 10-bit codes for the six channels is then combined and an additional 'frame alignment' bit and three 'parity' bits inserted (one for each pair of channels) making a total frame of 64 bits. This is illustrated in Figure 3.

The complete digital signal is then passed into a processing circuit which converts it into a High Density Bipolar (HDB3) signal – similar to that of standard 2.048 Mbit/s PCM systems – suitable for transmission by 2 Mbit/s line terminating equipment (LTE) or a 2–8 Mbit/s multiplex.

Maintenance experience

The GTE digital programme equipment is the first to be installed in the BT network and has so far proved to be a reliable multiplex. Maintenance consists of card replacement in the event of a fault, repairs being done by Factories Division at Birmingham. The main problem has been that spare cards are supplied to one terminal-end only.

For those in need, a full technical report on the GTE multiplex is available from EMT 7, Exeter Area.
0803 23733

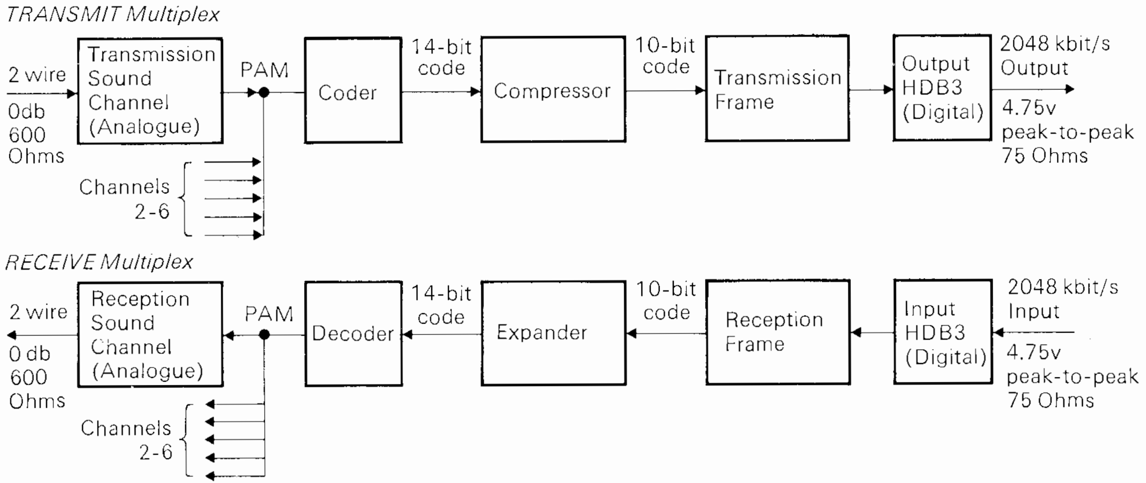
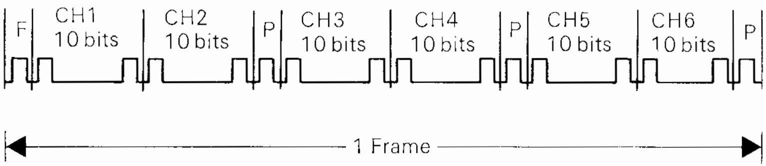


Figure 1 – Simplified block diagram of the GTE programme multiplex



F – 1 bit per frame according to the pattern X0011011 over 8 frames (superframe) to form frame alignment (synchronisation)
P – Parity bit, 1 bit per pair of channels

The gross digit rate equals the frame repetition rate (32kHz) multiplied by the number of bits per frame (64)
gross digit rate = 32000 × 64
= 2048 kbit/s

Figure 3 – Frame format for the six sound channel multiplex

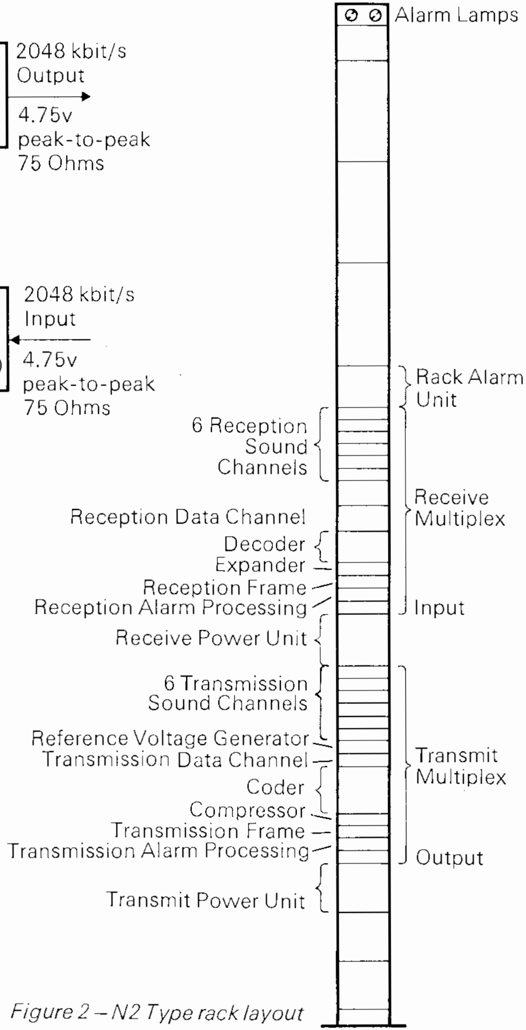


Figure 2 – N2 Type rack layout

London's maintenance approach to TXE4

by **Phil Darcy** BTLR/SM2.1.3

Just over two years ago Clerkenwell and Perivale – the first 'add-on' and replacement TXE4 units respectively – were brought into service in London. Since then 19 more units have been added and serve a total of 27 AFN codes and include a further 13 replacement exchanges, two being very high calling-rate units in central London. The early days of these new systems were not without numerous problems and we had our fair share of anxious days and nights tending to the new arrivals. Since then we have made good progress and gained much practical experience both in preparing for opening, and in the subsequent maintenance of new units.

Following TXK3 experiences, it was decided that early maintenance involvement was essential. So at most of the early sites, one or two of the Technical Officers who were to be eventually responsible for maintenance were attached to the Clerk of Works (COW) staff to gain TXE4 experience. This helped form a nucleus for the whole maintenance team, all of whom should ideally be on site when the unit is accepted for service from the contractor.

Check list

Apart from dealing with alarms and operating routiners there are many tasks and checks that need to be carried out by the maintenance team in preparing a unit for successful opening. To encourage staff to follow a disciplined approach – and cover all items of equipment – a check list has been devised which includes, for example, 'dormant' fault checks. Also included are items that are not tested sufficiently during commissioning, to ensure their successful operation in service. Until recently the Regional Service Division had arranged for and encouraged TOs in new units to have a short working-period in an operational TXE4 to broaden their training. But as nearly all Areas now have their own operational units, this aspect is being left to them to organise.

Liaison and site visits

It has proved beneficial at London sites for Regional and Area Works and Service Division staff to discuss maintenance involvement, and to arrange for this to be interleaved with the construction work, which is often considerable. Up to the BIS (brought into service) date the unit remains under COW control.

In the vital few months leading up to the opening of a new TXE4, site visits are made by the Regional service team. This is particularly important where sites are the first in an Area, or when the replacement units are large. The team's purpose is to guide and advise on problems and to see that the checks are progressing well. In common with most new systems a large number of modifications have been introduced, many of which overcome service-affecting problems, and it is essential to complete these before BIS date. To keep Areas informed, British Telecom London Region (BTLR) publish a list of modifications giving as much detail as possible on each and emphasising those needed to be completed pre-BIS. The list – which is frequently updated – is ever-growing as more sites become operational, highlighting problems by the A646 procedure or isolation reports.

Experiences

The main disappointment with TXE4s in operation has been their susceptibility to major service failures. The design objective was a mean-time-between-major-service-failures of 50 years, but in practice the achievement falls far short of this. The mean-time-between-failures is currently being measured on a three-monthly average and the national figure (although an improvement on last year) is only 11.3 months. Our experience in BTLR has been rather better, and currently our three-month average is 28.5 months. We feel that one of the major factors contributing to fewer major service failures in London is the tight control of modifications and our insistence on completion of the important items before BIS. Our worst experience was at a growth unit which had a large replacement extension integrated. Unfortunately the extension was carried out in advance of the extension manual being available and resulted in 10 service failures over an 18-month period. This does serve to highlight the care that will be necessary as extensions to 'live' units become more frequent if an improving trend is to be maintained. Restoration of service to any unit with a major service failure is of prime importance and BTLR have established a Regional escalation procedure to deal with actual or potentially serious service situations.

As soon as possible following the 'settling-down' period – which obviously varies depending on the size, complexity and calling rate – we advocate that the exchange adopts a system of normal maintenance. Although we have not yet formulated an overall maintenance procedure for TXE4s, we recommend the following basic principles pending further in-service experience:

- the unit should be kept alarm free, and the level of fault printout kept as low as possible,
- routiners should be run nightly and the resultant printout dealt with the following morning,
- routines should be carried out in accordance with the latest recommended periodicities unless local circumstances dictate otherwise.

Fault printouts

At small TXE4s – or even those of 10 000 exchange connections (ECs), where the calling rate is in the order of 0.05 Erlang per EC – it has been found that fault printout levels can be controlled, so that within six months of opening the busy-hour printout level is down to 30 lines an hour. Far greater problems are encountered in reducing the printout from the larger TXE4s in predominantly business communities, with a wide range of PABXs and average calling rates above 0.1 Erlang per EC. The reasons for the high level of fault printouts – and ways of reducing them – are still under review. On the routiners a well-tested Strowger technique has been considered for adaption. This is to provide the link and junction routiners with a 'busy step over' facility. Routiners are then run using this facility from Monday to Thursday nights and a complete test is carried out over the week-end.

Information interchange

With more and more operational sites, it is essential that up-to-date system information is passed to Area management and TXE4 sites. BTLR, in common with other Regions, uses a system of information notes for this purpose. The notes cover many aspects on the day-to-day running of the system as well as known service difficulties and possible expedient solutions, in advance of modifications, that will clear the problems. There is a frequent exchange of information notes between the Regions and BTHQ.

Improvements still to come

The quality of service from London's TXE4s is proving satisfactory for those units that have now reached the settled state. Unfortunately, TSO results are variable since they measure a unit's performance in the network, but some very promising results are being achieved in Areas that have MAC working to TXE4s, with measurement sequence 1 indicating 0.5 per cent failures. Another own-exchange performance indicator used in BTLR is the percentage of second attempt failures – as recorded on the 'fault meter' – compared with the total of the MCU 'effective calls' meters. The target figure of 0.5 per cent on a trouble-free unit seems readily achievable. But there is still considerable room for improvement in many of the units that are slow in reaching a settled-down state. Further improvements are also anticipated in the A51 results which are not always achieving the expected level for a new system.

We believe that potentially TXE4 is a system that will give improvements in measured performance as well as eliminating the general noise problems experienced with Strowger exchanges. Continued effort will be needed at Areas, Regions and BTHQ to resolve the remaining problems – and more may yet come to light. Further investigation is needed to find causes of high printout levels at some sites, and to introduce methods of reducing them. The routiners also have some shortcomings. While providing a regular check of the equipment they do not find all the faults that are potentially service-affecting. Some improvements in testing procedures are therefore needed, and these would certainly contribute to more efficient and satisfactory maintenance of the system.

01-587 7285

ROLM ACD system

A new digital automatic call distribution system by ROLM USA, marketed by Plessey, has recently been brought into service with a BTLR customer.

PD1.3.2

DATEC introduced

By **Roger Rothery** NE/T5.3.2

Many engineers may have heard the words 'DATEC' or 'DATEC organisation' mentioned recently by their colleagues working in the data field but will not be fully familiar with what this means.

DATEC, derived from Digital and Analogue Technical support, is a nationally co-ordinated organisation. Its aim is to improve the maintenance of all special services by providing more effective technical support for field staff when difficult faults occur. Although initially introduced for data services it is intended eventually to cover all special services.

Data services

The number of 'flag' cases and customer complaints being sent to BTHQ indicated in early 1978 that there was an urgent need to review our technical support procedures for the data services. At that time almost the whole of BTHQ data service group was continuously providing technical support to Regions and the available test equipment was then less than adequate. An urgent review of procedures and test equipment necessary to solve difficult field problems was undertaken. The projected increase in data services, and their rapidly-increasing complexity also served as a warning of a potentially difficult time ahead. So it was decided to introduce as rapidly as possible a well-equipped nationally recognised and effective technical support organisation. Thus DATEC was born.

The nucleus for DATEC already existed in every Region – the staff responsible for providing technical support for data services. Although not lacking in enthusiasm, these engineers were ill-equipped to deal effectively with many of the more difficult problems. The main advantage now is that technical support is nationally co-ordinated and aimed at enabling DATEC members to deal with difficult problems more effectively.

DATEC's main objectives are:

- to restore customer service as quickly as possible by providing advice or help to field maintenance staff when difficult problems occur
- to determine why field maintenance staff were unable to restore service, and where possible, to initiate measures enabling similar future problems are dealt with more effectively
- to find the causes of problems and initiate measures to find solutions to technical or organisational difficulties
- to develop the use of initiative to solve difficult diagnostic problems
- to recommend new test equipment requirements to improve available diagnostics
- to prepare brief reports on problems dealt with, and solutions found, for circulation nationally to all other DATEC members
- to operate in a co-ordinated manner with other DATEC members to solve problems where services experiencing difficulties cross Area or Regional boundaries
- to restore customer confidence by showing that British Telecom can provide adequate technical support for the services offered.

The DATEC organisation was launched in May 1980. Comprehensive diagnostic equipment was provided to all Regional Data Service Groups and a series of diagnostic seminars introduced at Horwood House.

The terms of reference for the DATEC organisation are detailed in *TI E8 B0014*. The aim of the DATEC diagnostic seminars is to bring the Regional technical support staff together at regular intervals so spreading the technical expertise necessary for solving data and special service communication problems, by:

- discussing technical problems experienced in particular Regions and their solutions
- demonstrating new diagnostic techniques or the use of new test equipment
- encouraging the spread of ideas and innovations adopted by individual Regions to solve problems
- enabling DATEC members to know each other personally so encouraging a co-ordinated approach to problem solving across Regional boundaries
- reviewing test equipment requirements so that DATEC staff are effectively equipped to deal with the most likely problems
- providing a feedback of information to BTHQ on matters affecting national policy, or where technical or diagnostic problems

need special attention.

New escalation procedures

DATEC's introduction raised questions on how and when a Datel field maintenance officer, meeting a difficult problem, should ask for advice or technical help. Normally, local procedures and the good sense of individuals concerned results in a timely request for technical assistance. But sometimes the request is delayed, or the need is not recognised, until a customer complains. Examination of complaints by data customers highlighted a need to review escalation procedures for special services. As a result we are arranging to introduce new escalation procedures giving clearer guidelines to field staff on when they should seek advice or help. Technical support from DATEC is an essential part of this new procedure.

Guidelines

A maintenance officer is asked to escalate a problem for advice or assistance when :

- he recognises that work on the fault being dealt with will seriously delay the restoration of other circuits reported faulty and awaiting attention
- it is not possible to obtain co-operation from a remote point on a circuit
- he recognises that restoration of service to a customer who has opted to pay for 'out of hours' attention will not be possible by the end of the normal working day
- he recognises that, having completed all the normal diagnostic procedures, there is a difficult problem which he is unlikely to diagnose within three hours of starting
- he recognises that the problems need special test equipment which is not generally available
- problems exist in plant or equipment outside his direct control, for example, local line, main transmission network, or public switched telephone network
- a customer (or his agent) does not accept that the problem is not associated with plant or equipment

High quality service

DATEC—first introduced as a Regionally-based technical support organisation – naturally forms an important part of the new escalation procedures, but there is a growing need to provide improved support at Area level. This is particularly so in places like London with a high penetration of the more complex special services, so DATEC has now been extended to area level in BTLR.

We believe that introducing DATEC was an important step in the strategy to improve the standard of maintenance provided for 'special service' customers. When fully implemented it will enable British Telecom to provide a high quality maintenance service in the competitive environment following the changes in our monopoly.

Figures 1 and 2 show two items of test equipment used by DATEC members. The Data Line Analyser is used to measure transient data-affecting line impairments, and the Serial Data Analyser is used to monitor customers' data systems, or to simulate customers' terminals to diagnose 'protocol' problems.

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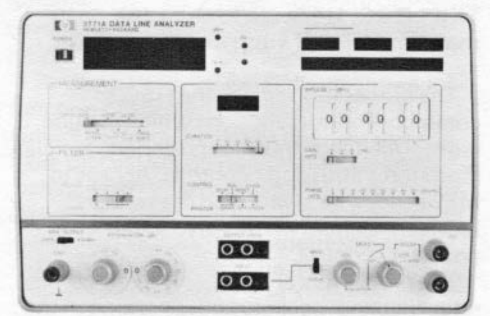

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The Headless Cross 'Mark One P'

by **Chris Betts** MTR/SM2.1

The first GEC Mk 1P processor-controlled TXK1 GSC at Redditch 'Headless Cross' has now completed two years' service. There are four processors controlling an eight-router, 3500 multiple extension to an existing TXK1 GSC. Here we look at the maintenance of such an installation.

The processors replace the GSC's common-control functions which include register/senders, translators/coders, auxiliary digit stores and router controls. Access to MF2 sender/receivers, and the sender/receivers themselves, are also under processor control.

The processors are connected in a security ring, enabling 'background' checking of the software. If a software corruption is detected, the processor corrects the error by 're-writing' the information obtained from the adjacent processors. The processors are also load sharing, such that if a serious fault occurs, a processor will relinquish control of its input equipment to the two adjacent processors. No degradation of traffic carrying capacity occurs under these conditions.

All man-machine communication with the processors is by teletype, and comprehensive service and alarm facilities are provided. Routing changes can be made by modifying the software rather than changing wiring. Software control also allows new facilities to be provided with the minimum number of wiring changes.

Statistical information compiled on software meters provides

- call attempts and failures on each register (SCC – signal conversion circuit) and MF2 sender/receivers
- first and second attempt 'effectives' and failures on terminating and junction calls on all router controls
- a record of abandoned calls, number of faults, print failures and MF2 second attempts on a processor basis
- group occupancy time meters per SCC type per router
- destination call count meters, international dialled route meters and alternative route meters.

These meters are read and recorded weekly and have pin-pointed trouble within the exchange such as a faulty relay in a junction marker.

As well as the normal equipment monitor printout, additional fault printout is given on the teletype under 38 different fault codes. There are eight switching fault codes, 15 SCC fault codes, eight MF2 fault codes and seven processor-based fault codes. Unlike the equipment monitor print, all call failures handled by the processors appear on the teletype printout and this can give an early indication of trouble within the switchblock. However, it is generally unrewarding to pursue individual fault prints.

Inbuilt self-testing of the SCCs and sender/receivers ensures that any of these peripherals involved in a fault printout are automatically routined and removed from service if faulty. The processors also run quality-of-service checks on SCCs, router controls, and sender/receivers enabling a faulty peripheral to be removed from service if it exceeds a pre-set quality-of-service threshold, determined by call attempts and call failure counts.

Software changes are achieved with the teletype using paper tape. For security, all software – program and data – is held on paper tape to enable partial or complete system re-load in the event of a fault developing in a store system.

The first two years' fault returns, for the 'new' and existing electromechanical equipment, show an improvement in fault rate by a factor of three for the 'new' when weighted like-for-like, in terms of broad equipment quantities and equivalents. This factor, allied with a 10 to 15 per cent reduction in floor space and installation costs are encouraging trends for all TXK1 GSCs, as future extensions to such units, in excess of one router, will use MK1P processors.

021-262 4276

Tester co-ordination working party—TCWP

by **Brian Pearce** ETB/S111

It all started at the Regional Directors' conference in 1970, when it was agreed that Purchasing and Supply Division – now Procurement Executive (PE) – should invite Regional representatives to consider their requirements for test equipment and maintenance aids, and the role that Factories Division could play in their procurement.

This meeting was held in June 1970 and discussed ways of improving the supply of testers. The main problem at that time was that some components could not be obtained quickly – often taking 24 months to deliver. In the interests of improving quality of service and saving maintenance manpower it was considered essential that test equipment should be provided on time. The possibility of 'designing out' difficult components was considered, but in many cases this would have meant completely re-designing existing items, creating many 'marks' of the same tester and giving rise to documentation problems. It was also decided to set up a standing committee, to be known as the Tester Co-ordination Working Party (TCWP), to examine the problems of test equipment supply and design. For the first meeting of the TCWP, Regions were asked to supply details of all types of test equipment ordered before January 1970 and still outstanding six months later.

The first TCWP meeting learnt that six urgently needed testers were outstanding and set themselves a recovery programme with the following terms of reference:

- ☐ To review the supply position of testers in general and, of those in short supply, to:
  - assess the possibility of using alternatives
  - consider the practicability of 'designing out' components causing delay
  - assess what excess cost could be justified to speed supply
- ☐ Assess priorities for individual testers
- ☐ Assess future needs of types and quantities of new testers
- ☐ Assess changes in the basis of provision resulting in changes of maintenance policy
- ☐ Consider the practicability of using Factories Division more extensively on a non-competitive basis for short-run items
- ☐ Ensure a degree of co-ordination on Regional developments so
  - keeping all Regions informed of development in-hand elsewhere
  - avoiding duplication of local development work.

At the following meeting in July 1970 a coin-and-fee-check relay-set portable routiner was introduced by LTR. This became Tester 219A and entered provincial service in 1974. Also because dials LT3 and LT4 were not available for the Tester TRT 135 (UAX outgoing relay set tester), it was decided that they should be delivered to the field without dials. Dials were provided locally and adjusted to give the required speed and ratio. Between July 1970 and February 1973 some of the items introduced and adopted were:

- Plug-in Send Uniselectors for Type 3 Controlling Registers
- A portable bank outlet tester, now known as Tester TRT 303
- Cleaners, Bank Automatic Nos 2 and 3
- Test Selector Areas at UAX13.

During this period, routining at night was being introduced, necessitating modification of routiner access control panels. TCWP monitored progress of this activity.

By June 1973, TCWP had fulfilled its main function of speeding supply of urgently required testers. So it was decided to allow more discussion on Regionally-designed testers. To this end a register of Regionally-designed equipment was introduced which is updated at TCWP's quarterly meetings. One of the first items to be discussed under this new arrangement was a Controlling Register Hunter Bank Outlet tester. This became Tester 241A but was subject to numerous delays and problems before its introduction into the field.

At that time there was some Regional disquiet about the future of Artificial Traffic Equipment, such as Testers TRT 32 and TRT 119, because Measurement and Analysis Routines were on the horizon. After much discussion it was decided that the TRT 32 and TRT 119 production would cease, that there would be a call sender exclusively for TXE2 exchanges, and another for general use as a back-up for MAC and service measurement in non-MAC exchanges.

Early in 1975 PE expressed concern about the accuracy of tester demand forecasts, and quoted instances where provision based on forecast had led to surpluses. As a result, a special meeting of all THQ tester provision groups examined the existing procedure and made recommendations aimed at improving forecasting accuracy. Testers were divided into three categories:

- those controlled by THQ Groups
- those not controlled, but for which it was considered a more accurate forecast could be obtained if provisioning was based on trend; for example, those testers which are subject to maintenance exchange procedure
- the remaining uncontrolled testers for which annual forecasts should be made by Regions and Areas, and agreed by THQ. Since 1975 all such testers have been provisioned in this way.

Metering

Problems associated with metering were beginning to appear during 1976 and various proposals such a Metering Variation Monitor, Tariff Pulse Machine Output Monitor, Automation of Routine Testing of customer meters and Meter Strapping Block Tester were discussed. This resulted in a decision that metering problems should be considered by a new THQ/Regional committee.

Modern systems

In 1975, the working party was asked to review testers for modern systems. At that time a variety of Matrix Testers had been produced by Regions and Areas to test the switchblock of TXE2 exchanges, and THQ were asked to evaluate these designs and approve, or recommend one for national use. A contract for 12 prototypes of the 'standard' version was placed early in 1979 and these were delivered to Regions during 1980. The test call sender for TXE2 exchanges – mentioned earlier – was also reviewed, but this item has not yet been introduced nationally although prototype versions have been made for testing purposes. Progress has been hampered by tone detection and tone level problems in some exchanges. Testers for Crossbar exchanges were also considered including a routiner for TXK1 Transmission Relay Groups (TRG), but it proved too costly to provide the necessary access. But two adapters to enable Testers 219A to be used in TXK1 and TXK3 exchanges, and a tester to access local TRGs and to steer calls to selected register and senders have been adopted for national use.

Because there has been little practical experience with TXE4 exchanges, only a few ideas have come from Regions and Areas. No doubt, when more are opened, TCWP activity will increase and deal with ideas and suggestions for test equipment thought to be desirable by the maintenance staff. Currently, TCWP monitors progress on tester manufacture resulting from earlier deliberations in THQ.

Recently TCWP have reviewed testers primarily used in Strowger exchanges with the objective of deleting items from the provisioning programme. As a result, it was recommended that 78 TRT testers, 11 AT testers and 11 other testers should no longer be provisioned either because sufficient stocks exist; they are obsolete; or have been superseded. Considerable savings will result if these recommendations are adopted.

Changing role

TCWP's story reflects the changing scenes and customs in the switching field over the past 10 years, which seem to have occurred in three distinct periods. In the early 1970s there was the tail-end of the growth of the late 1960s and the introduction of transit switching and international direct dialling. At this time there was excessive delay in the provision of testers for new exchanges, new facilities and new systems. TCWP played its part in reducing these delays and taking expedient measures to enable field staff to benefit from adequate testing facilities.

With these problems mostly resolved, TCWP was able to devote more time to evaluating test equipment designed in Regions and Areas. This very important aspect reflects the tester requirements as seen by maintenance staff. Duplication of effort is also reduced, but this can never be entirely overcome because two or more interested individuals recognise similar problems at the same time.

During the last two years there has been increased activity on testers for modern systems. The movement into the microprocessor era will mean that TCWP will be evaluating ideas on their use in the maintenance field. In future, System X will produce some testing or tester problems, despite all the precautions being taken and no doubt TCWP will be looking at these.

While TCWP has not been without its adversaries, neither has it always been successful in its deliberations. But the concensus of opinion, particularly among the Regional representatives, is that it provides a useful function and will continue to do so. There can be little doubt that in its early days TCWP expedited provision and delivery of urgently required testers. Now it provides a useful forum for Regions and BTHQ to discuss Regional tester design, BTHQ sponsored testers and other testing difficulties that arise.

0206-89588

Modified Monarch

First models of the Monarch 120 blind operator's attachment, which uses synthetic speech prompts, have proved highly successful and the Royal National Institute for the Blind have already ordered 20 for their members' use.

PD1.3.2

System X in Baynard House

by **Dave Menzies** BTLR/SM3.2.1

Baynard House in the City of London is so named because it looks out over the River Thames, from the site of the former Norman stronghold Baynard's Castle.

The building was formally opened by the Deputy Chairman, Peter Benton, on 5 July 1979, and is now an operational building under the care of BTLR City Area. It will house the National Telecom Museum as well as operational exchanges, DQ bureaux and many other facilities.

The first operational System X exchange unit was installed in Baynard House during May and June 1980 and brought into public service on 1 July 1980. Known as Baynard Digital Junction Switching Unit (DJSU), Baynard Tandem for short, it switches telephone calls between local exchanges in central London and local exchanges in south west London. (These calls were previously switched by a Strowger tandem unit in the South Kensington building.) This System X unit is the first step in a major modernisation programme to provide a fully integrated national digital network. As well as providing System X local exchange capacity, the new network will provide end-to-end digital transmission, including many additional local exchange connection facilities, an improved standard of service and reduced maintenance costs. A major extension of this first exchange is already under way at Baynard House and will be brought into service during 1982.

Much has already been written about System X, so this article looks at Baynard's performance during the first few months of service.

Good results

Since its opening Baynard Tandem has carried well over eight million calls. Various methods have been devised to measure the quality of service, using test call senders and measurement and analysis centres (MACs), all of which indicate a very good standard of service from the digital tandem. Perhaps the most interesting comparison has been of special MAC sequence two results – originating calls from calling exchange to objective exchange via tandem – and comparing Baynard Tandem with a typical TXS tandem. This clearly shows a reduction of 80 per cent in the call failure rate. These results are confirmed by the maintenance staff in local exchanges, who often complain of poor tandem service, but are impressed by their experiences of service using their System X tandem route.

This much improved standard of service is in part due to the high reliability of the digital switch. But another major benefit is that the System X exchange is constantly monitoring its incoming and outgoing circuits. Any interruption – for example, a momentary break in CB on a loop-


Baynard House

disconnect circuit – is reported to the exchange control terminal, and the offending circuit withdrawn from service. This junction guard feature is of considerable benefit in the London local exchange network, which is subject to much disturbance, but has little inbuilt guard facility.

Interworks well

Some other facts may be of interest. Baynard Tandem inter-connects a network of TXS, TXK3 and TXE4 local exchanges, a good test of inter-working with existing switching systems. Also two-thirds of the interconnecting junction circuits use 30 channel PCM systems, the remainder being either loop-disconnect or DC2 signalling with conversion to PCM at the System X end. At present the busy hour traffic is about 100 Erlangs (3000 calls per hour). Additional routes are soon to be connected.

As there had been no previous opportunity to thoroughly test the System X design in service, and there was the likelihood that modifications would need to be made, facilities for fall-back to alternative routes were incorporated. It has been necessary to make use of this facility during three distinct periods – while commissioning in July, late August and early December. These events are attributed to weaknesses in the exchange processor which is an interim design, not using System X practice. These have now been resolved and a reliable continuity of service has since been established.

There is no doubt that conversion of the large electro-mechanical trunk and junction switching units in BTLR to System X will greatly improve the standard of telephone service. This coupled with the end-to-end digital transmission capability mentioned earlier will put British Telecom in a good position to meet the challenge of the 1980s.
01-587 7274

Britain's first digital public exchange

by **Duncan B McMillan** BT Scotland/S134

As mentioned in a previous article *(Small exchange replacement – the Scottish solution: MN17 Autumn 1980)*, about 660 of Scotland's exchanges have less than 600 lines. The UAX, which was developed in the 1930s, has traditionally served such communities. After 40 years of faithful service there is a need to replace these exchanges with a switching unit of modern design.

Currently System X does not cater for exchanges of this size, so it has been necessary to consider alternative methods of replacement. With an eye to future developments it was evident that a digital switching unit would best meet the modernisation plans.

A feasibility study considered various alternatives, capital cost and export potential. It was decided that adaptation of the BT developed Monarch 120 PABX was a practical proposition. A trial model was built which entered service at Glenkindie in the Aberdeen and North of Scotland Area in July 1979.

Monarch 120 development

Figure 1 shows the development changes necessary to enable the Monarch 120 to meet the requirements of a public exchange.

□ *Security*

The mains powered Monarch 120 was designed for installation in offices. The mean-time-between-failure (mtbf) was considered to be about 3.5 years, excluding mains failures. Clearly, for public exchange working this had to be improved.

To permit the use of our standard 50v power supplies and to reduce the dependence on public electricity supplies, DC-DC converters were introduced to derive the necessary supply voltages. Further supply security is achieved by the installation of a standby engine with 30 days' fuel reserve.

System security is improved by providing a second control shelf on the basis of worker and 'hot standby'.

By providing secure power supplies and duplicating the control shelf an estimated mtbf of approximately 100 years has been achieved.

□ *Call charging*

It was necessary to introduce some form of call charging. To minimise development time it was decided to use a system of periodic metering on electromechanical meters. Meter driving hardware was developed to interface between the processor and the meters, and metering pulses are software controlled. →

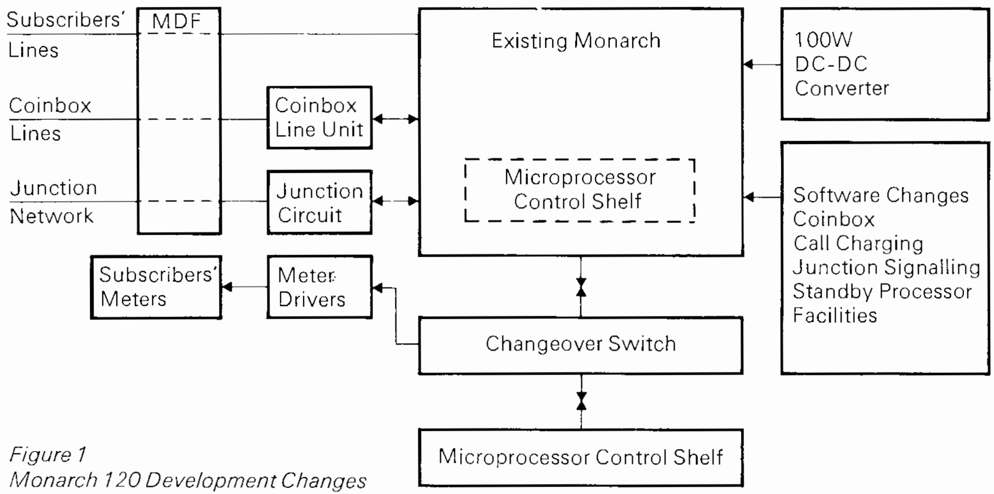


Figure 1
Monarch 120 Development Changes

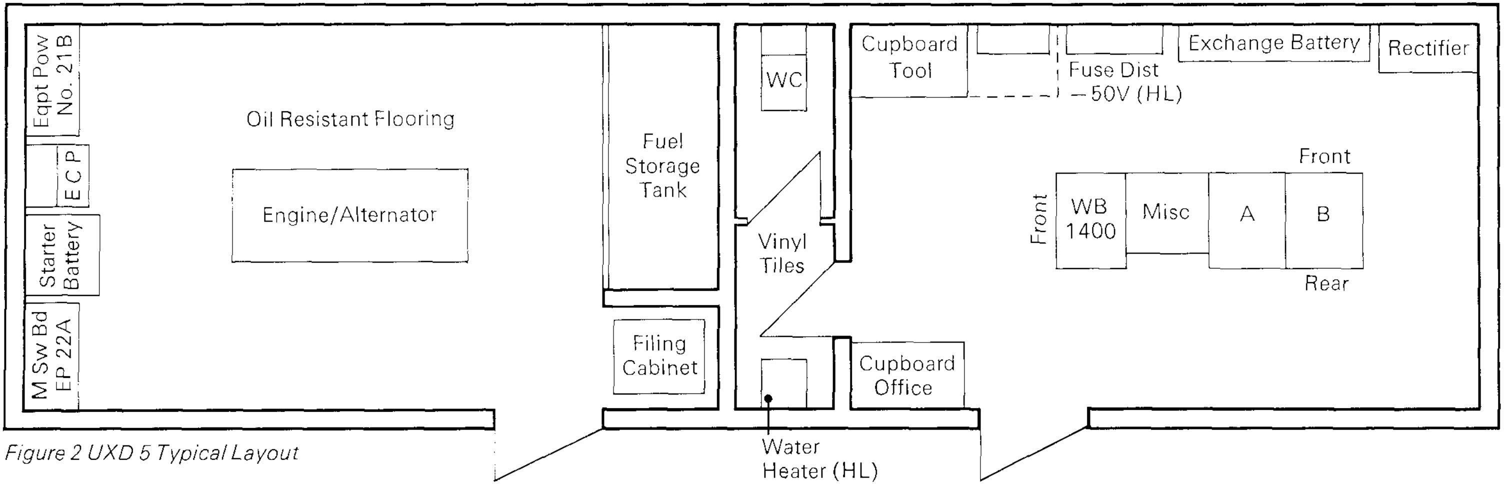


Figure 2 UXD 5 Typical Layout

□ *Junction signalling*

A loop-disconnect junction card was developed for Glenkindie using TXE2 line signalling elements and controlled by the exchange software.

The falling cost of microprocessors has since allowed the development of 'intelligent' junction cards for loop-disconnect, SSDC2, SSAC8 and E&M signalling.

□ *Coin and fee check facilities*

A new CCB card has been developed which, under the control of the processor, will provide the necessary C & FC facilities.

Installation

Glenkindie UXD5 is installed in a standard A-class building which previously held a UAX12. Being a trial model, it was decided to retain the UAX12 as a fall-back, so at present, the two units occupy the exchange building.

Alterations to the standard building to include a standby engine and toilet facilities, in addition to the UXD5, have resulted in the layout shown in Figure 2.

To facilitate proper turn-round, the building work was carried out in stages. First, the length of the building was extended to 10 metres. The existing UAX then moved into the extended area to clear the cable entry. The former UAX site was then refurbished and antistatic flooring laid. Installation of the UXD5 then began and, after changeover, the UAX equipment recovered. At this stage the remaining building adaptations were completed to provide room for toilet facilities and the engine. During this period, and before the standby engine was installed, the exchange was dependent on the new, low capacity, exchange battery for standby power. Thus, special arrangements had to be made in the event of a power failure.

In-service experience

Because it is part of a feasibility study, the Glenkindie experiment has been dealt with by BTHQ London and Martlesham staff directly. The Regional Service Group has had very little involvement. Any serious problems were dealt with by telephoning Martlesham and using a logic analyser to diagnose the trouble. If necessary, a site visit was made.

In practice the hardware has been as reliable as anticipated. The only problem being zener diodes in the line cards suffering lightning damage. The rating of the zeners has since been changed and there has, so far, been no recurrence of that particular problem.

As expected, there were many software faults which have been corrected by Martlesham staff.

Line interface unit

The UXD5 is effectively a 4-wire switched exchange, each subscriber's line being allocated a 2-wire to 4-wire hybrid termination. This, in turn, imposes new transmission problems in the local network because the subscriber's line must closely match the hybrid balance if an adequate trans-hybrid loss is to be achieved.

In practice a compromise is met by using one of three different types of line interface unit:

- Lines under 4dB – standard card with attenuator strap in.
- Lines between 4 and 10dB – standard card with attenuator strap out.
- Lines over 10dB with cable gauges 0.32–0.5 – long line card A.
- Lines over 10dB with cable gauges 0.63–0.9 – long line card B.

This means that the planners must look at the local network – and in some cases, the customer's installation – closer than ever before. System X will also require this attention to detail.

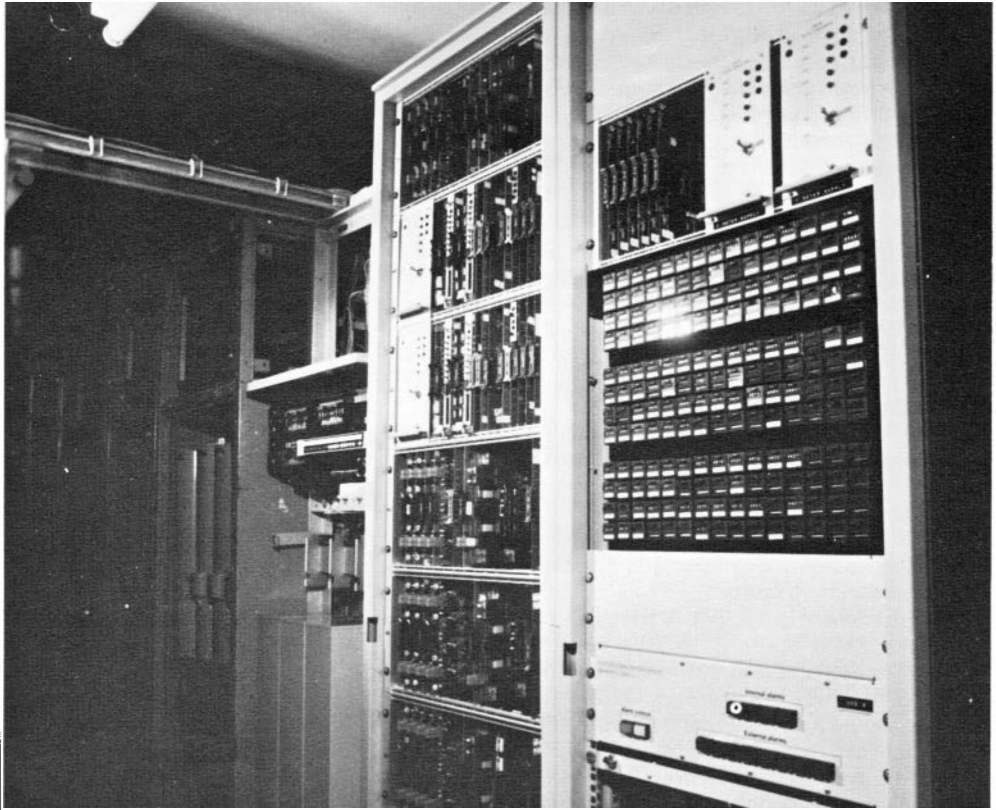
Looking ahead

The lessons learned from the prototype installation at Glenkindie have helped the development of further models. Factories Division have built evaluation models which are currently being installed and a production order has been placed with a manufacturer for installation in 1982.

Scotland will have a total of 51 UXD5s installed by the end of 1982 and thereafter it is hoped to install approximately 80 a year. For organisational reasons the early installations have been grouped geographically and it is hoped to arrange the maintenance organisation for UXD5s to fit in with that for System X.

031-222 2695

The Glenkindie UXD 5



Microphone inset 21A

by **Myles Hansen** ME/PD1.1.2

The Microphone Inset 21A (MI 21) is being introduced as a linear (non-carbon) replacement for the Transmitter Inset 16 (TI 16). The MI 21 looks very much like the TI 16 but internally it is quite different, comprising an electro-acoustic transducer together with a semiconductor amplifier mounted on a printed circuit board. A number of differing transducer and amplifier technologies are possible. The photograph shows the internal construction of an 'electret' microphone with integrated circuit amplifier developed at Martlesham Research Laboratories. An electret can be likened to a capacitor, the value of which varies according to the diaphragm movement.

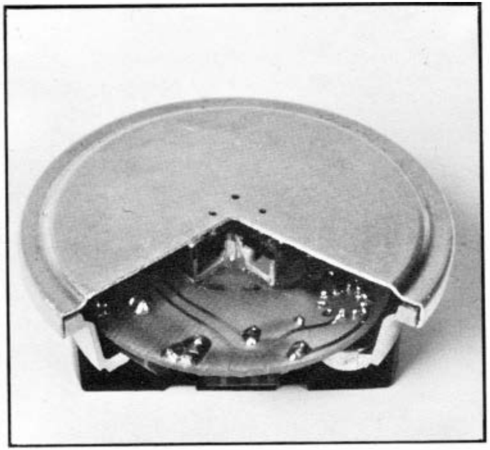
Some 100 000 MI 21s employing various forms of transducer technology – moving coil, piezo-electric film and electret – are currently being field trialled. Early results from the trial confirm the expectation that the MI 21, compared with the carbon transmitter, will exhibit:

- a significantly lower failure rate
- a reduced incidence of reported noise and other intermittent faults
- an improvement in subjective speech quality.

The MI 21 costs about three times as much as the TI 16, but this extra cost should be outweighed by the maintenance savings. It is therefore essential that the MI 21 is not regarded as a cheap, throwaway, item and it should be replaced only when positively identified as being faulty.

A contract has recently been placed for 2.4 million electret MI 21s, with the aim of achieving an annual procurement of about three million. No further contracts for the TI 16 will be placed, but there is nevertheless a sizeable stock of these which will need to be used up. Therefore over the next 18 months or so, maintenance demand will have to be met with a mixture of MI 21 and TI 16. How best to employ this mix must, to a large extent, be a matter of local judgement. But as a general principle, greater benefit to BT will be achieved by fitting MI 21 in high-usage business installations.

01-432 2712



Jump(er) to it

by **Roy Tanswell** NE/ES9.3.3

The procedure to be followed by jumpering staff is detailed in *TI C4 C3001*. One vital requirement, when a line is connected for service, is to pass a test call over the line to ensure that all connections are in order and that the meter works.

Metering failures are brought to notice by means of a Metering Performance Statistic and we are concerned that a number of cases of 'No Metering' prove to be on new lines. These faults can remain undetected for up to three months until the meters are photographed for billing purposes.

Customers might be delighted with free calls but we must collect the revenue due for the service we give. So remember – it's the meter that counts!

01-432 1344

Ambassador

The Ambassador telephone was launched nationally in November 1981: initially some ¼ million instruments are being purchased. Installation and maintenance information is published in *TI S10 S0007*. Issue 1 deals with the early production models and Issue 2 (due out early 1982) will cover the updated, fully developed, instrument.

PD1.1.1

Cable ships keep 'Alert'

by **Andy Chalmers** *Chief Cable Officer, CS Alert, IN6, Marine Division*

Ever since the first telegraph cable was laid across the English Channel in 1850 by the steam tug *Goliath*, specialist ships have evolved for laying and maintaining submarine cables. In the early days the ships were owned by the cable manufacturers or operating companies but, on occasions, others were chartered and converted for the special operations. Perhaps the most famous of these was Isambard Kingdom Brunel's *Great Eastern*, built at Millwall on the Thames, the largest passenger ship to that date, but which could not be made to pay. Her first attempt to lay a cable across the Atlantic in 1865 failed when the cable broke. But at her second attempt in 1866, she was successful and then went on to recover the lost end from the 1865 expedition and complete the lay to Newfoundland – a tremendous achievement in deep water especially when it is remembered that the ship made the grappling drive under sail alone.

The GPO, as we were then known, first became a shipowner in 1870 when the Telegraph Act nationalised all the private companies, one of which had owned *Monarch* (*1*). Unfortunately she broke down on her first expedition and was relegated to a coal hulk. For the next 13 years ships were chartered until *Monarch* (*2*) was launched in 1883. In 1890 another company was taken over and their ship renamed *Alert* (*1*). These two names have been perpetuated and perhaps this is a good point to introduce a brief history of each ship.

Monarch (1)	1870-1870	Relegated to coal hulk after one expedition.
Monarch (2)	1883-1915	Sunk by mine or torpedo off Folkestone.
Alert (1)	1890-1915	
Monarch (3)	1916-1945	Shelled by an American destroyer in 1944 while laying the second cable to Normandy after D-Day, with the loss of the captain, most of the deck officers and a number of the crew; repaired but eventually sunk by a mine off Southwold with the loss of three lives.
Alert (2)	1918-1945	Torpedoed and lost with all hands off Margate.
Ariel	1939-1977	Two of a class of six ships, the other four at first owned by the Admiralty.
Iris (1)	1940-1976	
Alert (3)	1945-1960	Ex-German ship *Norderney* taken over as war reparations.
Monarch (4)	1946-1970	Of 8000 tons, the largest ship ever owned by the Post Office; she laid many thousands of miles of telegraph and telephone cables; bought by Cable and Wireless Ltd in 1970 and renamed *Sentinel*, eventually scrapped in 1978.
Alert (4)	1961-Still in Service	6413 Tons
Monarch (5)	1976-Still in Service	3874 Tons } Sister ships
Iris (2)	1977-Still in Service	3874 Tons }

As can be seen, cable ships remain in service a very long time and during their life-time undergo many modifications to cope with the continuously changing technology until eventually they cannot be modified any further. For instance *Monarch* (*4*) had vast space for stowing cable, but limited space for repeater stowage – so when repeater spacing came down to six miles, the repeater area would be full whereas the cable tanks only half full. Similarly, the cable machinery of *Ariel* and *Iris* (*1*) could not cope with modern large cables so economics had to be considered. The ships were too small to work in wind and sea conditions of more than 20 knots, which meant that in winter they could only work, on average, one day a week. Their replacements, *Monarch* (*5*) and *Iris* (*2*) are the most sophisticated cable ships afloat today, and presented a tremendous challenge to the crews who had to adapt from operating simple steam-powered machinery to complicated diesel, hydraulic, electronic and pneumatic equipment. These ships – which were designed to work in wind and sea conditions in excess of 30 knots and remain stable – have a very high standard of accommodation for the crew.

Alert (*4*) was built primarily as a North Atlantic repair ship classified at Lloyds to work in ice and capable of medium-length cable lays. To date she has laid 8242 miles of cable including submerged repeaters. She spent much of her first 12 years patrolling the Newfoundland Banks guarding the first transatlantic telephone cables (TAT I and II and CANTAT I) from the large numbers of fishing vessels working there, a duty shared with two other ships annually. Nowadays *Alert* is on station at Southampton as one of the four ships always on standby under the Atlantic Cable Maintenance Agreement – where all those who have a share in any cable pay to keep the ship in readiness. *Alert* has to look after the north-eastern part of the North Atlantic and the other ships on station under the agreement are:

Ship	Owners	Station	Area
Mercury	Cable & Wireless Ltd	Vigo, Spain	South-east part of North Atlantic and part of Mediterranean.
John Cabot	Teleglobe, Canada	St Johns, Newfoundland	Ice breaker/cable ship North-west part of the North Atlantic.
Long Lines	American Telegraph & Telephone Co	Bermuda/ Newington, USA	South-west part of the North Atlantic, the West Indies and northern South America.

Monarch and *Iris* are also based at the Southampton Central Marine Depot and are primarily on standby for repairs to cables in UK waters. They are also used for laying the shore ends of new systems where the water is too shallow for the main laying ships.

All three ships also make route surveys for new systems. Before the ship sails, a detailed 'desk study' is done in the office and the best possible route chosen. The ship then goes along the route taking depth soundings and making up a profile of the sea-bed so that the amount of slack cable required to fill irregularities can be calculated. At the same time, sea-bottom temperatures are taken for transmission purposes, and a path each side of the route is looked at with acoustic sonar to ascertain whether there are any wrecks or other obstructions on the bottom. The sonar also indicates the type of bottom (sand, mud, rocks, and so on). This information, together with actual samples of the bottom taken with a grab, cores taken with a long tube forced into the sea-bed, and another sonar device which can measure the thickness of the surface layers, are used to determine whether the cable can be buried on the sea-bed or not.

Most cable damage is caused by fishing gear or ships' anchors, so with the high cost of repairs and lost revenue when a high capacity cable is out of service, increasing emphasis is nowadays placed on burying cables whenever possible. There are two ways of doing this, either when the cable is first laid by feeding it through a plough towed by the ship (as yet no BT ship is equipped to do this) or by using the cable ship as 'mother' ship with an unmanned submersible following the cable digging a trench under it with water jets for the cable to fall into. *Alert* and *Monarch* are at present being equipped to handle two different types of submersible.

Coaxial-type submarine cable systems have now almost reached their limit of development with 5000 circuit capacity and repeater spacing down to 2.5 miles. Fibre optic cables will offer advantages to the ships as the cables will be lighter and smaller with regenerators at much greater spacing. But jointing on board and handling under tension will pose other problems.

New grapnel

A development in recent years has been the 'cut and hold' grapnel designed by the BT's Martlesham laboratories. This complex equipment was needed because economics had forced a change in the way deep water systems were installed. In the old days cable was usually laid slack enough for the bight to be lifted to the surface in deep water, or a cutting grapnel would be used which would eventually cut through the cable as the bight was being lifted and the weight on the blade increased. Also special repair cable was used which had less attenuation than the original and the extra length which was inserted during the repair would not affect the system performance. Now, the 'cut and hold' grapnel is towed behind the ship on a length of rope usually about twice the depth of water and emits acoustic pulses at a set rate which are received on the ship. When the cable enters the grapnel it is wound onto a drum, the acoustic rate changes, and the ship stops pulling. The grapnel then cuts the cable away on one side, the acoustic pulse rate changes again, and the grapnel with the other end of the cable are recovered by the ship. As an example, if the depth of water is 2.5 miles and the repeater spacing 2.5 miles, an extra five miles of cable and two repeaters would have to be inserted. Usually such repairs replace faulty repeaters in deep water where it is very rare for the cable to be damaged. In shallow water actual cable faults, usually caused by fishing gear, ships' anchors, erosion on rocky bottoms or corrosion are more common.

Repair sequence

When a fault does occur around the UK coast on a repeatered cable system, the probable sequence of events is:

- cable failure alarms alert repeater stations who inform IN5, IN5 inform IN3 who arrange alternative traffic routing
- repeater station staff carry out initial tests and localise the fault between two repeaters
- IN5 inform IN6, the standby ship is alerted and its sailing time set, usually within 24 hours. Ship checks that sufficient stock cable and spare repeaters, if necessary, are on board
- repeater stations carry out further tests to pinpoint fault location and advise the ship via IN5. The location will also give information on the nature of the fault which may be either a complete break or a shunt fault where the centre conductor has been exposed. If the latter, the ship has to accept the repeater station's fault location; but if a break, the ship will use an electrode location technique
- ship advises the repeater station of the time she expects to start work and will ask for a 'tone' to be applied to the cable, and for the repeater stations at each end of the system be staffed
- repeater station sends the ship a 'power safety' message to confirm that power is off the system and that it is safe for the ship to cut into the cable
- when the ship arrives in the approximate area of the fault, electrodes are streamed and search starts for the tone. When the tone is received over the electrodes, the ship will zig-zag along the cable until the tone is lost, thus knowing she has passed the fault. By making several more passes it is possible to pinpoint the fault to within 0.1 mile. Normally, the repeater station fault location is quite accurate but, for various unexplained reasons, it has been known to be up to seven miles out.
- ship then asks the repeater station to remove the tone and leave both ends of the cable disconnected and free.
- ship then grapples for the cable on one side of the break. When the cable is on board it is cut and tested, the stray end – the piece between the ship and fault – is picked up and the good end – the end between ship and repeater station – is sealed and lowered to the bottom and 'buoyed off.' The repeater station is informed and staff may test to the sealed end
- ship then grapples for the other side, joints on the good end to stock cable which is laid across to the buoy and a final joint and splice made
- when the final joint is in the water, the ship sends 'power safety' message to the

repeater station who then power up and test the system. If the results are satisfactory, the repeater station releases the ship.

Good co-operation between the ship and the repeater station is essential throughout. It is very easy for the ship to forget that there are people in the repeater station whose normal routine has been broken and who may not know when they are next going to eat and who are wondering what the ship is up to when they hear nothing for hours. Typical of the things which may delay the ship are : bad weather ; the cable has been buried and cannot be found with the grapnel ; joints taking a long time and sometimes have to be cut out and done again. If everything goes wrong at once, the repeater station will probably occasionally, but unintentionally, be forgotten !

A final word

A word about cable ship life. *Iris* and *Monarch* carry a crew of about 65 each and *Alert* has 90. Although deck officers cannot join the service until they have a Masters Certificate at an age of about 28, there are some men aboard who have been in the ships for 40 years.

It is a job you either love or hate, with the biggest drawback being uncertainty of movements from day to day. Without doubt, though, there is a good deal of job satisfaction when a fault is quickly located and repaired, allowing international services to be restored with the minimum delay.

0703-782900

STC Crossbar spares

by **Denis Hill** NE/ES9.2.1

Since the introduction of STC Crossbar systems some 12 years ago, replacement parts have presented a problem in some cases. It was – and still is – BTHQ policy to have a minimum stock in exchanges, the bulk being held in piece parts depot (PPD) or main stores depots.

In Strowger systems a history of replacement parts has been built up over a long time whereas in Crossbar the replacements required had to be estimated with no previous reliability information.

Bearing in mind Crossbar was a proprietary system, the spares had to be obtained through STC. Eventually a pattern for the replacements would have emerged and re-stocking would have been automatic. Unfortunately with the curtailment of Crossbar exchange orders, supplies became increasingly difficult to obtain, with high minimum purchase prices being imposed on each order. In addition the delivery time was increasing, partly due to the needs to obtain orders at an economic price.

Tremendous response

Recently we arranged with Factories Division at Fordrough Lane, Birmingham, to receive and inspect any stores that TXK 3/4 exchanges had surplus to their requirements.

The exchanges were then asked to review their spares holdings – which included recovered items from works specifications and equipment left on site by contractors.

The response has been tremendous. Work on the items returned has started and equipment that can be re-issued will be stamped and put on the shelves of PPD. It is difficult to assess the financial savings of this scheme but, bearing in mind the delay in supply and non-availability of some of the items, the exercise has been well worthwhile.

01-432 1394

Regent launched

Regent, BT's newest rental range PABX, was launched in ETB and NWTB recently. With a maximum capacity of 134 extensions this all-electronic SPC PABX uses solid-state analogue crosspoint switching and is contained in an attractive cabinet suitable for modern offices.

ETB/S1.3.3

A two-line error

Readers may wish to note that in typesetting Ray Carter's article *Datel's new modem 27A* in *MN18*, two lines were unfortunately omitted – unwittingly changing the operating technique of the *Datel 1200* Duplex Service !

The last two lines of the centre column on page 3 (just above the photograph) should have read . . . " – the calling modem transmitting a carrier of 1200Hz and the answering modem transmitting a carrier of 2400Hz."

– Editor.

Digital transmission—line systems

by **George Clark** NE/T5.1.4
In the last issue of *MN* we looked at the basic PCM system. Here we look at line systems. But first a recap . . .

The essential elements of an integrated Digital Network (IDN) are stored program control (SPC), digital switching units and digital transmission links. While the ultimate objective will be to transmit all classes of signals in digital form from their source to the terminal receiving point three stages in converting to digital transmission will be experienced.

Stage one. Providing circuits between space switched exchanges to achieve greater economies in the transmission area. Equipping pair type cables with 30 channel PCM equipment, for example.

Stage two. Providing an integrated network of digital switched exchanges and interconnecting digital paths. These two aspects will overlap in time.

Stage three. Providing a 100 per cent digital connection path from customer to customer as digital equipment slowly penetrates the network as a whole.

Line systems

□ ***For pair type cables***

Higher capacity systems than the basic 2 Mbit/s system already mentioned (*MN 18*) can be routed over pair-type cables. For example, an 8 Mbit/s system is available for equipping 24 pair 1.27 mm cables originally used for 12 and 24 circuit FDM carrier systems. Up to twenty 8 Mbit/s can be provided on two cables to provide a total of 2400 telephone circuits. The repeater spacing is 3 km and power is transmitted from power feeding stations over phantom circuits derived from two pairs.

□ ***For coaxial cables***

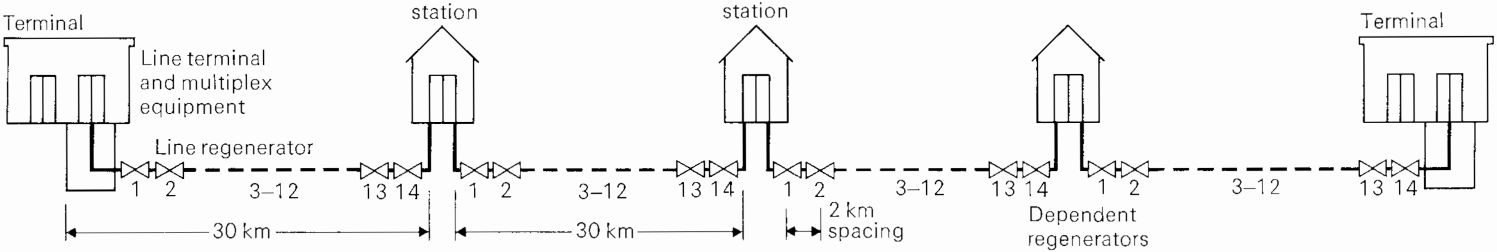
An important feature of systems operating on coaxial pairs is that the repeater spacing and power feeding arrangements should be compatible with that for FDM systems and that digital and analogue systems can operate within the same cable sheath.

The 140 Mbit/s system can operate on 1.2/4.4 mm or 2.6/9.5 mm coaxial pairs and comprises line terminals, intermediate power feeding repeaters and buried dependent repeaters.

The line terminal comprises equipment to provide line termination, power feeding, system supervision and speaker circuit, and interfaces with a 140 Mbit/s coded mark inversion (CMI) signal, as standardised by the CCITT.

In the transmit direction, the terminal equipment accepts the incoming 140 Mbit/s CMI signal and converts it to a ternary signal of about 93 MBaud for transmission to line; in the receive direction, the inverse process takes place.

Repeater spacings for 140 Mbit/s on 1.2/4.4 coaxial cable



The line terminal feeds power to the dependent repeaters over the inner conductor of the two coaxial pairs. The number of repeaters that can be fed and therefore the power feed spacing depends on the voltage and current used ; for example, on 1.2/4.4 mm cable, a 250-0-250 V, 50mA supply gives a power feed spacing of 30km whereas a 500-0-500V, 100mA supply gives 100km spacing. Still larger spacing can be achieved when 2.6/9.5mm cable is used.

Dependent regenerative repeaters are housed in underground boxes at intervals along the route and each unit comprises two separate unidirectional repeaters, one for each direction of transmission. The regenerator re-times and regenerates the incoming 93 MBaud ternary signal and transmits it to the next section.

The maximum spacing between repeaters is 2.1km on 1.2/4.4mm coaxial cable, which is equivalent to a loss of some 79.4dB at 46.4MHz. The nominal regenerator spacing used is 2km ; for shorter section lengths, line-building-out networks are used in the repeaters. When used with 2.6/9.5 mm coaxial cable, the maximum repeater spacing is about 4.7km and the nominal spacing 4.5km.

Intermediate power feeding repeaters, situated in buildings, are required at intervals along the route. These have very similar transmission equipment to the dependent repeaters, together with power feeding units for supplying dependent repeaters in either or both geographical directions.

01-432 1328

Digital transmission—multiplexing and coding

by **George Clarke** NE/T5.1.4

Primary multiplex

The primary multiplex equipment has already been referred to as a sub-system of the *Basic PCM System* (*MN18*). The multiplex equipment generates 32 time slots each of 64kbit/s to form a 2Mbit/s digital stream. When used exclusively for telephony, 30 time slots are used to provide the 30 speech channels, each sampled at 8kHz encoded in accordance with CCITT A-law companding characteristic to obtain 8 bit words for each sample. The signalling conditions associated with the 30 speech channels are multiplexed into one 64kbit/s stream, which occupies time slot 16. The remaining time slot (time slot 0) is used for frame alignment and remote supervision information.

Time slot access facilities can be provided to enable non-telephony services to be multiplexed together with telephony signals to form a composite 2 Mbit/s stream. By substituting a data card for a speech card, up to six 64kbit/s data circuits can be provided together with 24 telephone circuits within the 2 Mbit/s stream. Alternatively, two 15kHz channels for two monophonic or one stereophonic sound programme can be combined with 18 telephone channels in the 2 Mbit/s stream.

To permit the 2 Mbit/s primary multiplex equipment to interwork with the many signalling systems encountered with various switching systems, a comprehensive range of signalling units has been produced.

2 to 8 Mbit/s multiplex equipment

The 2 to 8 Mbit/s multiplex equipment combines four HDB3 coded 2 Mbit/s streams to form a single 8 Mbit/s stream, also encoded in HDB3 format ; in the receive direction, the equipment performs the inverse function.

The incoming 2 Mbit/s streams are first converted to binary unipolar form. Other justification digits are added, to allow for *plesiochronous input signals, and the digits from each input tributary are interleaved. The combined 8 Mbit/s output stream is then converted to the standard HDB3 format.

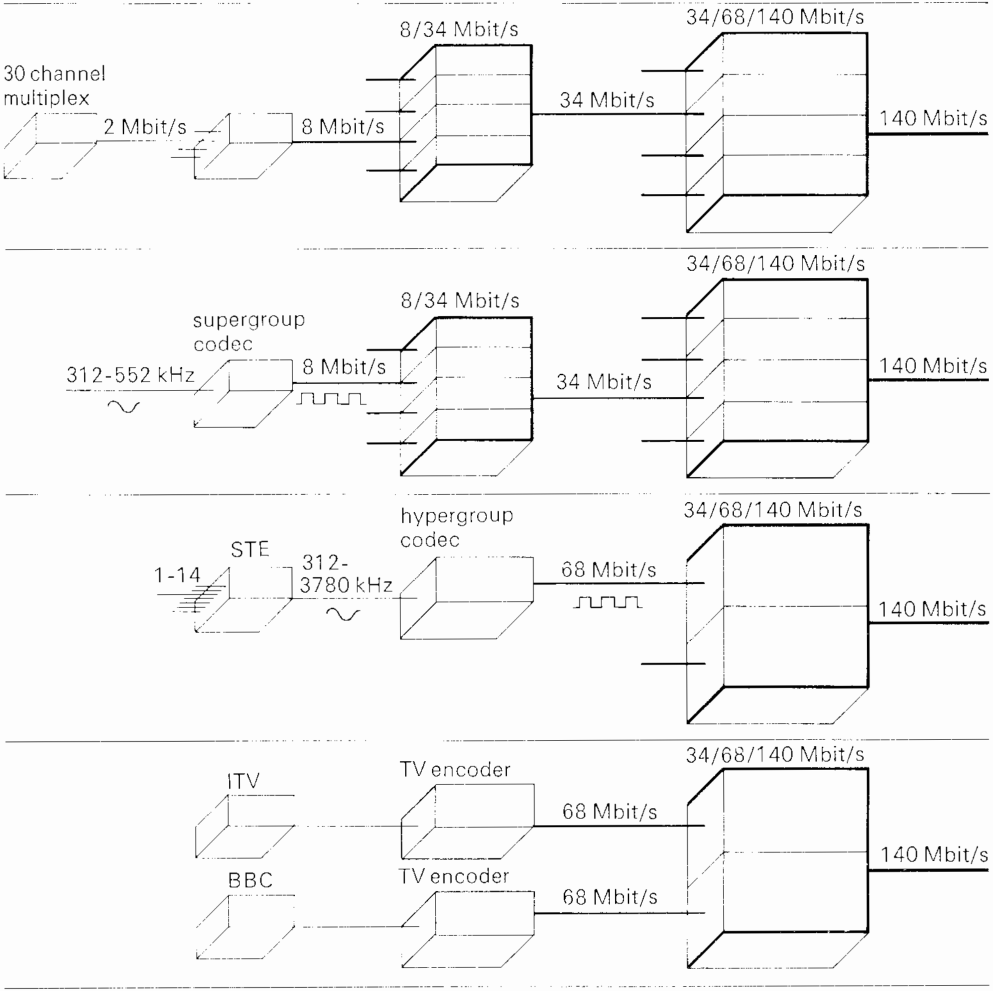
8 to 34 Mbit/s multiplex equipment

The 8 to 34 Mbit/s multiplex equipment combines four plesiochronous HDB3 coded 8 Mbit/s input streams, using justification and digit interleaving processes. By these means, a combined 34 Mbit/s HDB3 digital stream is produced at the output. In the receive direction, the inverse process is performed.

34 to 140 Mbit/s multiplex equipment

By using the appropriate input tributary

*Plesiochronous signals are nearly in time with the bit rate.



cards, the 34 to 140 Mbit/s multiplex equipment can accept the following combinations of plesiochronous input signals:

- four 34 Mbit/s streams encoded in HDB3
- two HDB3 coded 34 Mbit/s streams and one coded mark inversion (CMI) 68 Mbit/s stream
- two CMI 68 Mbit/s streams.

The equipment uses justification and digit interleaving techniques to combine these inputs and form a 140 Mbit/s output stream, encoded in CMI. In the receive direction, the equipment performs the inverse functions.

Coding

☐ *Supergroup coding equipment*

This provides for the encoding of a basic 60 circuit FDM supergroup assembly of 312-552kHz for transmission as a HDB3 signal within a 8448 kbit/s digital stream, and for the complementary function of decoding of the incoming digital signals and their reconstruction to the basic supergroup at the distant terminal. Thus 60 analogue circuits occupy the capacity equivalent to 120 digital circuits giving a 50 per cent utilisation of the digital capacity.

☐ *Hypergroup coding equipment*

This provides for the encoding of a nominal 4 MHz hypergroup for transmission within a 68 Mbit/s digital stream. Two such encoded hypergroups can be accommodated within a 140 Mbit/s digital line system. The present BT proposals are to provide for a 14 supergroup assembly, supergroups 2-15 in the frequency spectrum 312-3780kHz, with a capacity for 840 circuits and a capability for extension to a 15 supergroup assembly, supergroups 2-16 in frequency spectrum 312-4028kHz. In each case the analogue signal will be connected to a 68 736 kbit/s digital signal in CMI form at the system output.

□ ***Video coding equipment***
This equipment design caters for the encoding of 625-line colour television signals occupying a frequency spectrum of 5.5 MHz into a CMI encoded 68 736 kbit/s digital signal for connection to the 68 Mbit/s input port of the standard 34-140 Mbit/s digital multiplex.
01-432 1328

Harmony LST
The Harmony Loudspeaking unit (Amplifier and Loudspeaker 12A) is now available nationally to supersede the Doric (Amplifier and Loudspeaker 11A).

PD1.1.2

Digital transmission–radio systems

by **Bob Moore** NE/T5.2.1
Microwave radio relay links provide the major proportion of transmission capacity. An important feature of a digital radio system in an evolving digital network is its capability to use existing towers and buildings. In practice this means that dual band antennas may have to be fitted to avoid tower strengthening and that the system has to perform satisfactorily over existing hop lengths.

11 GHz digital radio relay system
British Industry has developed a radio relay system to operate in the 10.7 to 11.7 GHz frequency band. Six bothway bearers are provided, each capable of carrying a 140 Mbit/s signal. Automatic protection switching can be incorporated on the basis of one protection channel for up to five working channels.

The terminal transmitter accepts the CCITT recommended standard 140 Mbit/s coded mark inversion (CMI) interface signal and processes it to modulate directly the RF carrier, using quadrature phase-shift keyed (QPSK) modulation. This modulated carrier is amplified by a travelling wave amplifier (TWA) to a level of 10W. Filters and circulators are used to multiplex a number of RF bearers on a common aerial feeder.

At the terminal receiver, the incoming RF signals are separated by the RF multiplex equipment. Each signal is down converted to an intermediate frequency (IF) of 140 MHz, and filtered and amplified to a constant level. The digital signal is then demodulated by a coherent demodulator, regenerated and processed to provide the standard CMI 140 Mbit/s output signal.

At regenerative repeater stations, the output of the regenerator is fed directly to the RF modulator of the following transmitter.

Space diversity is provided by two aerials the outputs of which are fed to the RF combiner which continuously maintains the phase relationship of the signals from the main and diversity antennae such that they add at the receiver input.

The quality of the transmission is continuously checked in each receiver by pair-monitoring, additional digits being inserted at the terminal transmitter. At the terminal receiver, the information derived from the monitor determines the basis on which main channels are diverted via the standby channel. Service-band information is carried independently from the main digital stream before frequency modulation of the RF carrier.

Other digital radio relay systems
The radio systems described above are only examples of digital radio systems in production or under development at this time. Development work is at present

proceeding on radio systems for other frequency bands in order to meet the future demand for digital capacity. For example, British Telecom is carrying out active work on the problems of placing digital radio systems in the existing 4 GHz and 6 GHz bands.

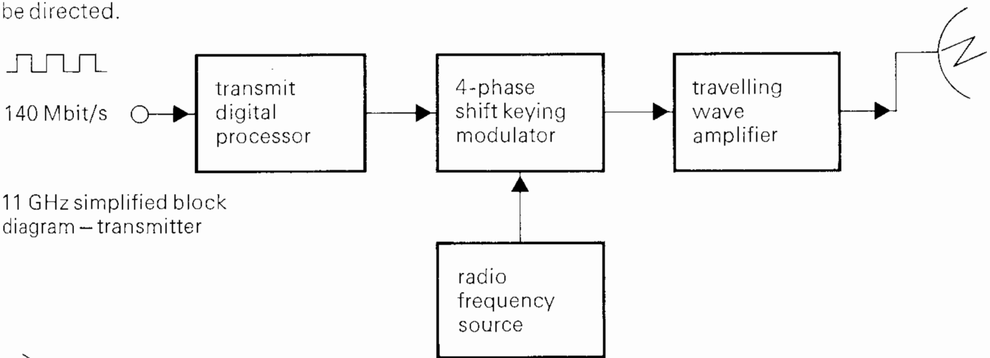
Maintenance

The supervisory system indicates the nature and location of any fault which occurs, displaying the information at a remote control point from where maintenance can be directed.

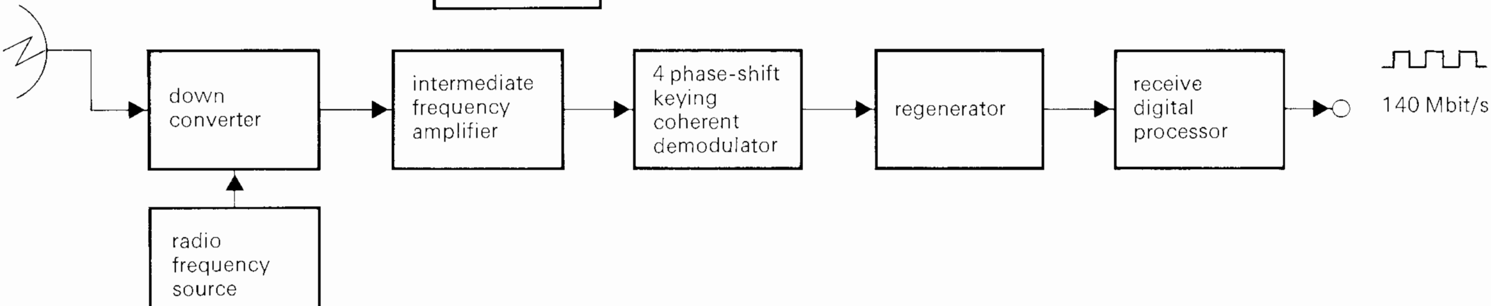
In most instances the fault can be located to a single printed circuit board which can be quickly replaced with a serviceable spare. The faulty board will be sent to a repair centre for detailed faulting and replacement of the faulty component.

Because of the system's in-built performance monitoring circuitry, routine maintenance, presently performed on the existing analogue microwave network, is expected to be minimal and done without interruption to traffic.

01-432 1338



11 GHz simplified block diagram – transmitter



11 GHz simplified block diagram – receiver

ABC in East Anglia

by **Dave Gooding** ETB/S1.1.3.5

British Telecom's ABC alarms service was introduced about 2½ years ago in the areas served by the Norfolk and Suffolk police and fire authorities. This fairly new service overcomes many of the problems of established alarm services. For instance, ABC does not depend on auto-diallers to transmit signals, customers do not need costly private circuits and emergency authorities do not need to provide room for terminating circuits. Here we look at the basic principles of the ABC system, how the network is configured, maintenance facilities, problems experienced and the way ahead.

ABC principles

The system uses a normal telephone circuit, with the customer's alarm signalling equipment connected through a filter to the telephone line. The alarm receiving equipment is also connected through a filter to the exchange equipment as shown in Figure 1. The alarm system operates whether the telephone on the circuit is free or not.

A Local Processor in the receiving equipment supplies the alarm information to the Central Processor and then to the Display Points.

☐ *Customer equipment unit*

This consists of a carrier-frequency generator and transmitter housed either with, or separate from, the call point mechanism. This mechanism – and, hence the alarm – is activated by pressing the front panel which locks. It can only be manually reset. The equipment is normally powered from the local processor but a nickel cadmium rechargeable battery is provided to supply power while the telephone is in use. On the fire call point mechanism, facilities exist for the user to receive an acknowledgement signal from the local processor on receipt of the alarm.

☐ *The local processor (LP)*

An initial installation consists of one 62-type rack containing receiver units for 112 customers and two common equipment shelves holding the scanning and transmission equipment. The LP can be extended to serve up to 448 customers. The LP scans and monitors each customer's line, forwarding the alarms and faults to the central processor over dedicated circuits using time division and frequency division multiplexing techniques. The LP also powers the customer's transmitter unit, supplies trickle-charge current for the battery in the customer's equipment and also self-checks all of its data, control and address highways during a highway test sequence. Any faults found are forwarded to the central processor and will be printed on the maintenance display unit.

☐ *The central processor (CP)*

The CP provides the focal point of the system. It has a handling capacity of 30 associated local processors and can supply information of alarm states to 15 terminal display points, with the facility to re-route alarm messages to a nominated AMC should a failure occur on an authority's terminal. Its main function is to scan highways and identify call signals from the LPs or display points, and route messages to the predetermined terminal display point identified by the address code from the LP. It returns control information to the LP which originated the call, and carries out numerous self-checks during the scanning sequence.

☐ *Terminal display units (TDU)*

Pairs of microprocessor-based display units are located at each of the authorities' premises and at the CP. Printed information gives coded details of customer, LP, type of alarm, message number, time of alarm and time the alarm was acknowledged. There are two main categories: 'A' alarm indicating that fire or police assistance is required and an 'L' alarm indicating a line fault. The 'L' alarm causes a printout on both the CP and the police display units, the latter to cover malicious damage incidents.

Network arrangement

As mentioned, the customer's equipment is connected to the LP over normal telephone circuits. Connection of an LP to its associated CP and the CP to the terminal display points, is over dedicated circuits which are duplicated for security and, where possible, over different routings. The two circuits work in a main/standby mode with an automatic changeover should a fault occur.

Maintenance
No faults or alarms are brought directly to the attention of either the customers or the LP maintenance staff, but detected faults and 'L' alarms are printed on the display unit associated with the CP. A TDU reference book allows maintenance staff to identify the nature of the printout information and to deal with it. Faulting is mainly restricted to unit substitution and, at present, each processor is provided with 100 per cent spares. Repair of faulty units is done at Colchester Area Repair Centre (ARC) where a modified, full ABC alarm system has been installed to allow faulting and 'soak' testing techniques to be used.

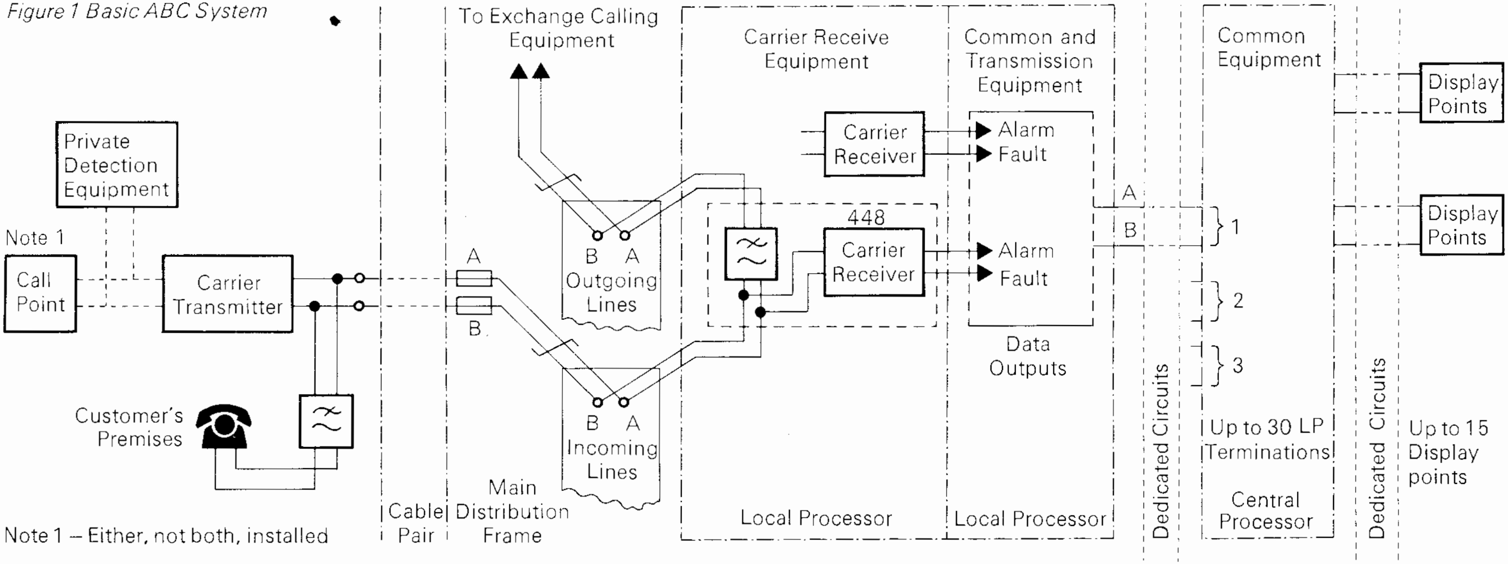
Problems
Some problems have been experienced with ABC due to the sensitivity of the CP terminating equipment. Short breaks in FDM or PCM systems carrying the inter-connecting circuits cause alarms to be generated. This does not cause loss of security since any break exceeding 280 milliseconds will cause immediate changeover to the standby circuit. A fault printout is generated if the break exceeds 20 seconds.

However, there is a danger of ABC losing credibility with the police if it generates too many 'L' alarms due to faults on BT line plant. At present about 60 per cent of these 'L' alarms are caused by our own staff disconnecting the line plant, apparently unaware of the presence of the sensitive alarm system.

Manpower expenditure on the system is at present rather high since maintenance and installation procedures require, in many cases, simultaneous attendance at the customer's premises, local processor and the central processor. Investigations into reducing manhour expenditure are in hand.

Equipment performance during the first two years of service has been good. Exceptions are the terminal display units and the local processor carrier and receiver card. These items will need some modification to

Figure 1 Basic ABC System



improve their performance.

Line characteristics have also posed some problems. The system was designed to work within the 10dB, 1600Hz local line limit, so a full check is made on any suspect line before a firm acceptance for connection to ABC is given.

The way ahead

To date system growth has been slow, and some changes are desirable if ABC is to expand and become profitable. When combined with the principles of System X, other ideas which may provide a key for ABC's future success are:

- reduction in carrier frequencies to improve line length – so capturing the valuable rural market
- design of an 'intelligent' terminal to replace the relatively poor TDUs
- rationalise the location of local processors and use the more flexible out-of-area shelf (OOAS).

The last – which is being introduced – will make it possible to extend 12 customers' LP terminations over a junction to a remote exchange, such as a small unit exchange (UAX).

We are looking forward to the next few years of involvement with ABC, and feel that if the manhour expenditure can be reduced by revising procedures then BT will be able to compete with outside alarm companies – many of which use ABC as a transmission medium for proprietary alarm installations within East Anglia.

0206 89645

Herald: a new electronic call-connect system

by **Bob Killick** BS3.4.2

The Herald call-connect system has recently been introduced in several Areas, and by the end of the year will have become available nationally.

Microprocessor controlled

Herald is a single-microprocessor controlled key-system intended for business customers requiring installations varying in size from typically two exchange lines and four extensions, to 10 exchange lines and 36 extensions. The modular construction of the central equipment allows the system size to be varied within these limits. The system uses a stored-program-controlled (SPC) space switch using custom-designed large scale integrated (LSI) circuits and is capable of being individually configured to meet customer requirements. An attractive feature of the system is the Herald telephone, which is available in two sizes (Standard (HS), Deluxe (HL)) and various colour combinations of brown, grey and orange. These telephones have additional buttons enabling the user to access individual exchange lines and the wide range of inbuilt user facilities. Standard loop-disconnect telephones can be used but these have access to fewer facilities.

Basic system facilities

The following facilities are part of the basic system program and are available to all users of HL or HS telephones. Only those marked with an asterisk are available to loop-disconnect telephones.

- Selective access to exchange lines, PBX extensions, and private circuits for making and receiving calls
- Keypad dialling
- * Level 9 access to exchange lines or PBX extensions
- * Level 7 access to private circuits
- * Hold, for enquiry
- * Call transfer
- Direct calling to other extensions via programmed push-buttons
- Line status indicators (light emitting diodes)
- Tone calling
- Tone sounder volume control
- Recall, when system is subsidiary of PBX
- Repeat last number dialled
- Different ringing cadences for external and internal calls
- * Selective call barring

Additional optional facilities

Each Herald HL or HS telephone can be individually programmed with any combination of the following facilities:

- Repertory calling (numbers up to 16 digits)
- Customer-programmed diversion of calls to another extension

- Monitor
- Internal conference
- Busy
- Sounder on/off
- Lamps on/off
- Intrusion
- Direct voice calling on internal calls
- Headset in addition to handset
- On-hook calling on outgoing calls

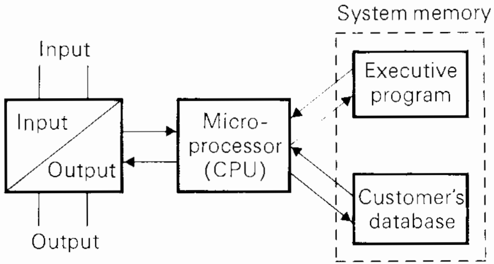
Central equipment

Depending upon system size, the central equipment consists of either a single control module or a control module mounted above an extension module. The control module, which is no bigger than a medium-sized suitcase, houses the processor, extension memory, and tone units with their associated DC/DC power unit, along with up to five line-interface units. Power for the shelf is derived from a mains driven AC/DC power unit. Each line interface position is allocated four ports and therefore the control shelf has a maximum capacity of 20 ports. Extensions require one port (that is, four extensions per interface unit) whereas exchange lines and private circuits require two ports (that is, two exchange lines per interface unit). Therefore a single control shelf can be configured for say a 4+12 system. For larger systems an extension shelf is added which is also powered by an AC/DC power unit and provides up to 10 additional interface positions (40 ports) making 60 ports maximum. This will allow a maximum system size of typically 12+36.

Stored program control

As already mentioned the Herald system uses SPC which means that it depends on the orderly use of a program of operations controlled by a microprocessor. Part of the Herald memory contains all the information required to perform this function which is referred to as 'The Executive Program'.

Another part of the memory contains information relating to the individual customer's system which is called 'The Customer's Database'. This is the part of memory which has to be configured and entered by BT staff according to the requirements of the customer.



Simplified Microprocessor CPU System

It is the combination of these two parts of the memory (or stored program) in conjunction with associated software – which enables the Herald system to be so flexible.

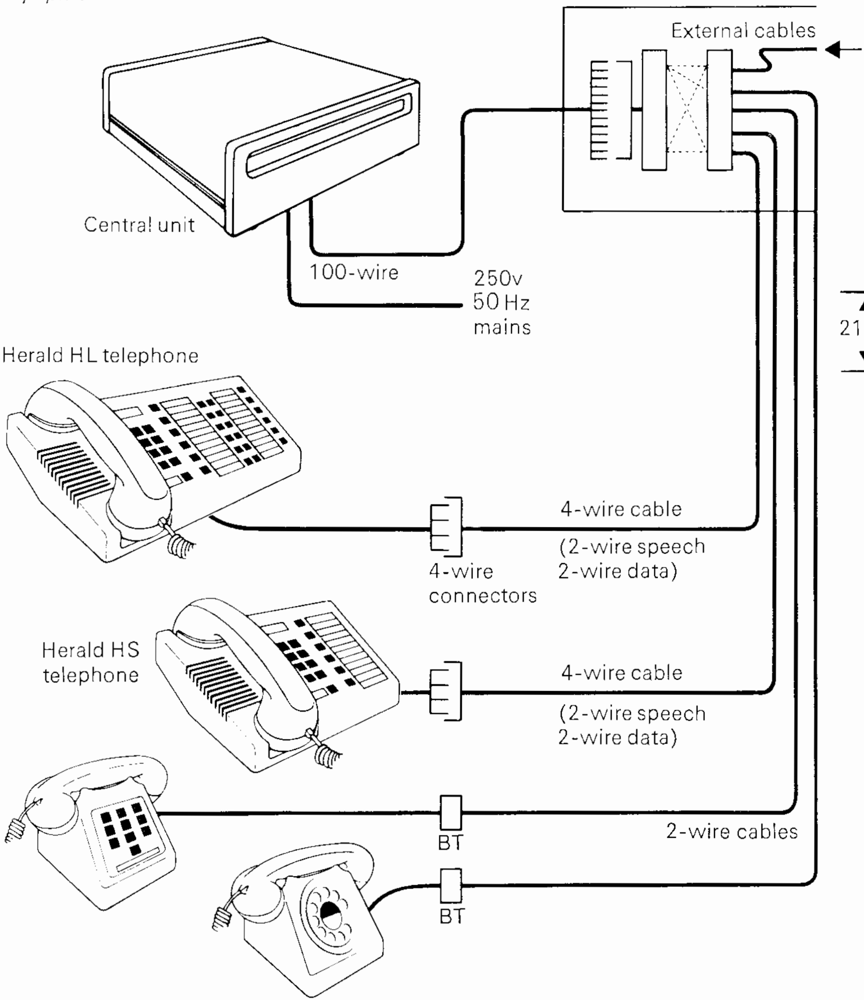
Modern installation methods

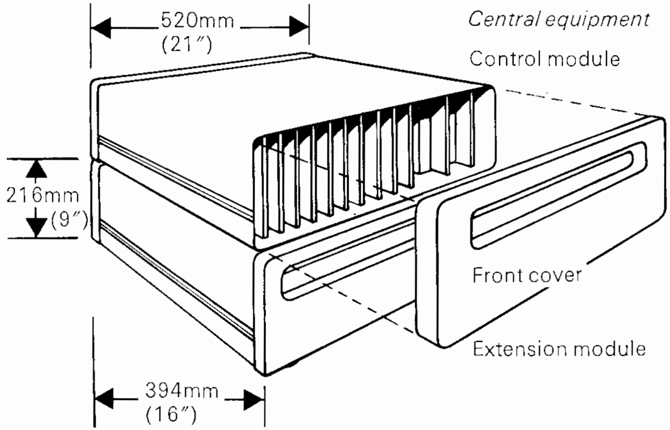
Herald is installed using up-to-date methods and practices. The box connection (Box Conn 101A or 102A) uses insulation displacement techniques which rely on the insulation of a wire being displaced as it is forced between a 'V' shaped pronged tag to establish mechanical and electrical contact. This is achieved by using a special tool (Inserters Wire No 2A) which forces the wire into the connector, at the same time trimming it to the correct length. All Herald equipment is connected using plug and socket arrangements which enable the customer's premises to be wired while all equipment for that particular installation is being assembled and tested at a Herald assembly centre. However, before the equipment can be tested the customer's database must be configured and entered by Customer Works Group (CWG) staff. A computer program (Herald Software Support System) in conjunction with a microcomputer, is used to configure this data to the customer's exact requirements. In addition the program produces a printout of the installation giving such information as the facilities provided at each extension, details of exchange lines and private circuits, box connection jumpering schedule, and other details particular to the installation. Before being transported to site for installation, the system is fully tested to ensure all equipment is functioning and that the customer's database contains the correct information. This enables the time spent at a customer's premises to be kept to a minimum.

Maintenance

The Herald's central equipment is designed for installation in an office and, to achieve speedy repair without undue disturbance to the customer, efficient faulting techniques are required. The complex technology used, and the high density of the components, does not make the system suitable for on-site repair. No routine maintenance is required

Equipment interconnection





Layouts (as seen facing the unit)

Control module	IF5	IF4	IF3	IF2	Line IF1	Tone generator	Processor	Memory	Power DC-DC converter	Mains to 50v DC Power Unit	
Extension module	IF15	IF14	IF13	IF12	IF11	IF10	IF9	IF8	IF7	IF6	Mains to 50v Power Unit

Herald HS

and there are no inbuilt maintenance and diagnostic tests. So maintenance is corrective only – relying on a simple logical process to identify the faulty unit and replace it.

Although each Herald installation is individually designed to a particular customer's requirement it is possible to provide spares kits for most maintenance situations, taking into account that Technicians IIA deal with the telephones, interface units, and cabling in-between; with Technical Officers dealing with the common control elements of the system.

A little on-site maintenance is also carried out on Herald telephones. On-site repair can involve changing the handset, cords, loudspeaker amplifier or headset jack, while for all other faults the complete telephone is changed.

Because of the individuality of each system, on-site documentation particular to a customer's system is of great importance to maintenance staff. The printout produced by the Herald Software Support System computer program, giving all customer details, is associated with the box connection and left on-site for maintenance use.

Repair of faulty Herald equipment is being carried out at Area Repair Centres (ARC). Due to the complex circuitry, computerised testers are used to identify faulty components on processor and memory units while other Apparatus Slide-in Units (ASU's) and terminals have special testers to aid fault identification and location.

Reprogramming

If the customer's database becomes corrupt, or the processor fails, it may be necessary to either re-program the existing processor and memory, or program new units and to substitute these. The customer's database information is stored by CWG(P) on floppy discs (five-inch magnetic discs). Three copies of the disc are made when the system is configured, one being for maintenance use. This disc, in conjunction with the microcomputer, is used to program the replacement units at a Herald assembly centre.

A new portable modem called TEAM (Telephone Equipment And Modem) – known as Test Access Unit 8A – will be available shortly, and will allow the customer's database to be re-programmed on site over the PSTN direct from the CWG(P).

Training

Herald training courses are available at six Regional training schools for supervisors and field staff. Courses available are

- E2.0.170 For Technicians. A four-day course dealing with basic system operation and simple faulting, for both installation and maintenance staff.
- E2.0.171 For data-entry TOs. Eight-day course dealing with all aspects of data entry; for installation staff only.
- E2.0.172 For TOs. Seven-day course dealing with in-depth system knowledge, re-programming and advanced faulting for installation and maintenance staff.
- E2.1.173 For supervising officers. Two-day course on general system appreciation.

Future developments

The Herald call-connect system has been designed using the latest technology to provide an up-to-date telephone system for installation in the modern office. However, technology and customer requirements continue to change and therefore development of Herald will continue. This will require changes in both system hardware and software to ensure we continue to provide customers with an efficient modern system into the future.

01-432 1383

On reflection...

This is the first in a series of short articles in which authors (or their successors) look back and report on their original contributions to *MN*. We begin with some articles which appeared in *MN9 (Spring 1976)*.

CSS1 (Cordless switchboard system 1)

Kishor Tanna, ES9.3.1, explains that there has been no further improvement on the CSS1 since 1976; and ACRE will not be the 'bolt-on goodie' as suggested in *MN 9*. This is because the CSS1 switchboard needs extensive stripping down to accommodate ACRE – giving it a different appearance. ACRE is nearly fully developed and field trials are due to start at eight exchanges – four with cordless switchboards and four with sleeve-control – during 1982. At present, Eastbourne is being used as a 'test bed'.

SSAC 9 (M)

The miniaturised SSAC 9 (Signalling system, alternating current 9-miniaturised), has been successful, explains Phil Hunter, ES9.3.3. Although to date 118 000 units have been installed nationally, demand beyond this year is difficult to predict because the penetration of digital systems is unknown. The SSAC 9 (M) had a few early problems, but these were overcome and the signalling system has been generally reliable.

New teleprinter for telex

Derek Turner, BS6.2, reports that over 13 000 teleprinters 23B have been installed nationally. The 23B's fault rate has proved to be lower than mechanical machines with similar facilities and field staff are coping well with its new technology and the new form of fault finding required. For the future, Derek explains that more advanced electronic machines are due – starting with teleprinter 73A. This machine was introduced in September this year in the BTL City and West Areas under the title – The Puma Telex Terminal. Some of its principal new facilities are:

- automatic calling with machine unattended
- internal directory of some 25 telex numbers, user-inserted and accessed by a two-character code
- electronic message storage of 8000 or 16 000 characters
- editing facilities enabling a word, line or entire sentence to be inserted, deleted or altered for message preparation.

The new machine is of modular construction, consisting of nine printed wiring boards, a 7 × 5 dot matrix print head, keyboard and power supply. Fault location is simplified by an in-built fault diagnostic program. Training and familiarisation is being aided by a video film, and a machine will be made available to staff before its introduction into a particular Region.

Breaking the moisture barrier

Eric Harcourt, T5.1.2, reports that test equipment for locating breaks in moisture barriers should now be available in all Areas.

An oscillator 163 supplies the 3Hz signal which is applied between the moisture barrier and earth at the end of the cable. This signal is detected along the cable route using a tester 236. The equipment – and its method of use – is detailed in *TI E3 F1017*. Advice on the local availability of this equipment can be obtained from your Areas' External Plant Maintenance Centre (EPMC).

PMBX 11

Since its introduction in the mid-1970s, PMBX 11 has suffered from a number of installation and maintenance problems. Bob Killick, BS3.4.2, explains that the main problem is the excessive time needed to install a system. Currently, 'insulation displacement techniques' are being considered in an attempt to improve matters.

Maintenance difficulties are mainly customer mis-operation due to anomalies in the operating instructions. Other problems have arisen with relay interaction on the exchange line unit (see Customer Equipment Newsflash 1056B) and cord connect fuses blowing on key restoration (Customer Equipment Newsflash 1055).

With the introduction of several new call-connect systems using microprocessors for system control, the demand for PMBX 11 is diminishing, so although problems may exist in the field, the main effort of design groups is being concentrated on the new product range.

TOLD

Mike Fursedon, T5.3.2, reports that since the Telecoms On-Line Data (TOLD) system was introduced some 2000 visual display units (VDUs) have been installed – mainly in Areas – for such work as payroll and accounting. These VDUs are very heavily used daily. What is remarkable is that some VDUs are still fully operational after seven years' use – a great credit to our maintenance organisation. Off-site repair at Area Repair Centres has also gone very smoothly.

... there will be more reflections in the next issue.

Did you know? About 110 000 new telephone poles are supplied to Areas each year – 30 000 coming from Scotland. On average a pole lasts forty years.
Hollow poles – made from glass re-inforced plastic or steel – have been introduced. They allow wiring to be done at ground level – a great safety feature.

A Christmas story

Last year, the Head of Product Development PD1, 'Ces' Hillen, wishing to promote the season of goodwill, sent a BT Christmas card to a Halifax, Nova Scotia, company. Shortly afterwards, Ces received a letter from an engineering supervisor with Maritime Telegraph and Telephone who happened to notice the card. Apart from it being a very attractive and striking photograph, the writer was more interested in a vehicle gracing the snowbound scene depicting an overhead linesman up a pole. Apparently the north-of-Canada company had been looking for just such a vehicle and were seeking further information.

The 'most-interesting' vehicle turned out to be a Swedish-made Sno-trac. BT have a number of these VW engined, caterpiller-tracked vehicles for use mainly in the remoter parts of the UK – principally Scotland, where they are indispensible in winter.

Ces was able to supply Nova Scotia (New Scotland) with details of Sno-tracs used by BT –

made by Westermaskiner,
Morgongava,
Sweden.

Volkswagen engine – air-cooled, 34hp at 3600rpm
– fuel consumption 5 litres per hour
– tank capacity 40 litres
– speed in 4th gear 20km/hr.

length 12ft
width 6ft 3in
height at back 3ft 7in
height at front (cab) 6ft
ground clearance 1ft
load capacity 1100lb
weight 2500lb.

... it's interesting what others see in Christmas cards!

Maintenance News aims to provide a medium for two-way communication – that is, between Headquarters and the field. If you want to write about anything you may have seen in *Maintenance News*, or indeed, about any maintenance topic, send your letter to : The Editor, Maintenance News, Room 1230, 207 Old Street, London EC1V 9PS.
Say what you like, but the Editor may tone comments down if he decides to publish.
Do please give your full address.

If you have a contribution to offer to *Maintenance News* other than a letter to the editor, please forward it through normal channels to the *Maintenance News* agent for your Region or Telecommunications Board. The list is shown below. The Editor cannot publish anything to do with current awards suggestions.

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PR011 (12/1981)

Printed by Camgate Litho Ltd 68 Willow Walk London SE1