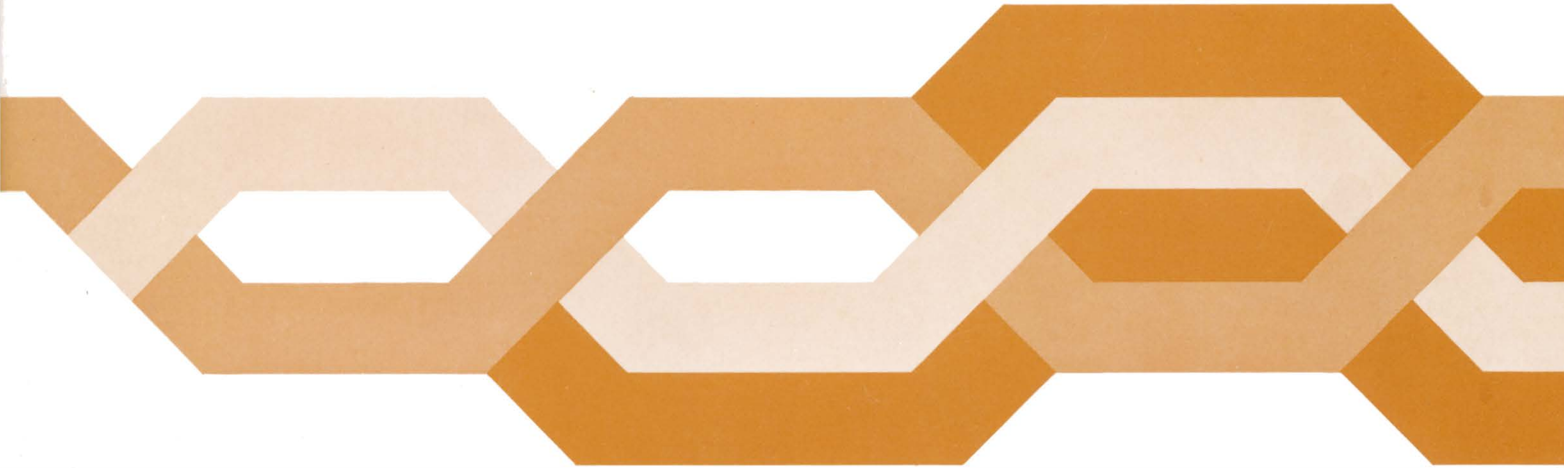
Maintenance News

10

Autumn
1976



Stop press

Handle meters carefully . . .

The problem of damaged ohmmeters 18A (see Stop Press in MN9) has been investigated further. A broken meter glass is the most common damage in ohmmeters returned for repair. So instead of the glass a transparent cover of high-impact plastics is now being fitted to all new and repaired instruments. This should considerably reduce the number sent for repair; but we emphasise again the need for careful handling. These are sensitive instruments for accurate measuring and need sensitive treatment.

Contents

Editorial

Apparently MN is regarded, "in the wilds of East Anglia, as worth its weight in grams against TIs by the pound" I am indebted to Mr Finedon of Ipswich for this bouquet, but have to treat it with some caution, as you will soon see. Mr Finedon went on to protest about my preserving editorial anonymity, when the names of contributors are nearly all published. In fact, my name was disclosed in the editorial written for MN3 in my absence. It could have been detected from the same issue that the regular editor and the E Div TI Adviser were the same person. In my time I must have dealt in TIs by the ton.

The aim of MN is to give background enlightenment twice a year, but TIs are wanted – well, some TIs are wanted – all the year round for doing jobs In MN authors know they are limited for space, and take care to concentrate on the main points. When they turn their hand to TIs they often try to cover everything on the subject, as in the days of EIs. It appears that some people in the field encourage them in this. So improvement in the presentation of information in TIs will be a continuing struggle for a long time yet.

The tonnage of TIs is undoubtedly excessive. Type 1 files seem to me to be the worst problem – the files meant to be used by travelling staff when they get to the site of work. In early 1973 I made a series of brief field visits to see some files for myself, and collected quite a few home truths. Now complaints from the field have had some effect. There is a new ruling that TIs to be distributed down to Type 1 files must contain only detail wanted on site. Before too long, I hope, Type 1 files will be working files only, as was originally intended.

Some field management have decided not to have files kept in unattended exchanges. Instead, they make arrangements for both the regular and the relief man to carry the Type 1 file for the load.

TI E1 A0002 about setting up maintenace files will be altered to recommend this practice wherever possible, since it is obviously desirable, even with slimmer files, to keep the filing load to a minimum.

To achieve slimmer files generally, there has to be an increase in mutual confidence between THQ and the field. On the one hand, TI authors must assume that files have been set up adequately. Much of the excess in Type 1 files, for instance, is due to the fact that authors have been reluctant to believe that their readers have adequate access to a Type 2 reference file.

On the other hand, field management seem often disinclined to believe that authors understand distribution needs. They should trust them to know, for instance, that some non-jointing work is inseparable from the faultsman-jointer's basic duty, and not lumber their faultsmen-jointers with all the TIs for non-jointing maintenance parties. Even worse, I have known many supervising officers, and their seniors, shown an altogether inordinate interest in other people's duty codes, scouring TIs like *E1 A0002* in other Divisions and calling up all the codes for subjects that interest them, presumably to be sure of missing nothing. This is a sure recipe for overweight files for themselves and their staff. If you are setting up or changing files, do not think about subjects, but about duties.

You will be willing to believe that TI authors, and even TI advisers, are human and fallible. The characteristic sin of THQ is to over-distribute information; but we do sometimes under-distribute. If you have set up your files correctly, and see a TI you think you or your staff should be getting, there is machinery for bringing the matter to attention and correcting distribution nationwide. Your local TI distribution centre knows, or should know, the procedure. If you are feeling particularly aggrieved, a call to the TI Adviser may help. You know my number now.
I hope I have been impartially critical of THQ and the field. It would be unrealistic to suppose that faults are all on one side. My thanks to Mr Finedon for the opportunity of letting off steam.

Dave Manning

Letters

Two auto exchange views

The ninth issue carried no letters from Technicians in the field, so MN has now proved to be a failure . . . We are in a state of economic crisis and yet we are inundated with useless house magazines like MN and . . .
Brentwood, Essex

MN is read with more interest, and generates more discussion, than any other official publication I know.
Stockton-on-Tees, Cleveland

The fact that no letters were published in MN9 does not mean that I did not receive any; but that I did not receive any with snappy enough back-answers for publication. For example it took me something like 300 words to reply to the following.

I submitted an A646 regarding an N diagram approximately 4½ years ago. A reply and thanks were received from THQ three years ago. The N diagram is yet to be amended.
G Rushworth, Shipley, West Yorks.

All correspondents get replies, but not all by any means are suitable for publication. Letters like Mr Rushworth's are useful whether or not they get published, because they express pithily what people in the field are feeling. It is the answers that the editor finds difficult to compress for publication!

N diagram requirements are to be thoroughly investigated, partly because Mr Rushworth and earlier correspondents said what they thought. You will appreciate that this is a very big job and that early results are unlikely.

Mr Rushworth's unfortunate experience with his A646 should not deter anybody from sending them in. As I wrote to him, we rely very considerably on this source of information. For instance, 'running TIs' like E5 A0101 are largely composed of items giving solutions to problems brought to light by A646s. I hope we will soon replace these TIs by several series of Bulletins which will get information back to the field more quickly.
Editor

Meter cycling

With the introduction of ISD it is now possible for subscribers to make calls to the rest of the world cheaply, but on some calls (to USA or Canada, for example) their meters step every 1.2 seconds. At this rate a telephone needs to be in use only 1 hour 31 minutes a day for five days a week for the meter to make a complete cycle of 99 999 units in a month. Again a datel call set up overnight by STD at 2.5 meter pulses a minute would cycle the meter in less than three months – the time between meter readings. It seems to me the PO stands to make thousands of pounds' loss of revenue from this cause on heavily used business lines.
Technical Officer (Anon) LTR/Centre Area

The danger is well recognised and a computer program is now available to assist the Area telephone accounts group (TAG) in identifying subscribers whose meters are likely to cycle fully between standard quarterly readings. TAG arranges for the meters of suspected heavy users to be read say three weeks after a normal quarterly reading and for both sets of readings to be fed into the computer. The computer printout indicates which meters are calculated to advance by more than 60 per cent of their capacity over the quarter and whether they are four-digit or five-digit. From this TAG can arrange for interim meter readings to be taken, and decide which meters need changing for those of higher capacity in accordance with TI A6 A2151. Limited quantities of a six-digit meter should soon be available.
Editor

Introducing TXE4

by **George Huggins,** Sv 6.1.3

Over the past few years there has been a lot of talk about a new large electronic telephone exchange system, known as TXE4. Most maintenance officers have had snippets of information filtered down through official or staff association channels and via the perennial grapevine. But to a few, that is those intimately involved with the opening and maintenance of the first exchange, the last 12 months or so have been a very demanding, yet very rewarding time.

At 08.30 hrs on 28 February 1976 the first TXE4 was brought into public service in the Birmingham Area. It is a director exchange of approximately 3500 lines capacity, called Rectory, with the AFN code 021-378. This is the first of many such exchanges in the modernisation programme for both director and non-director applications.

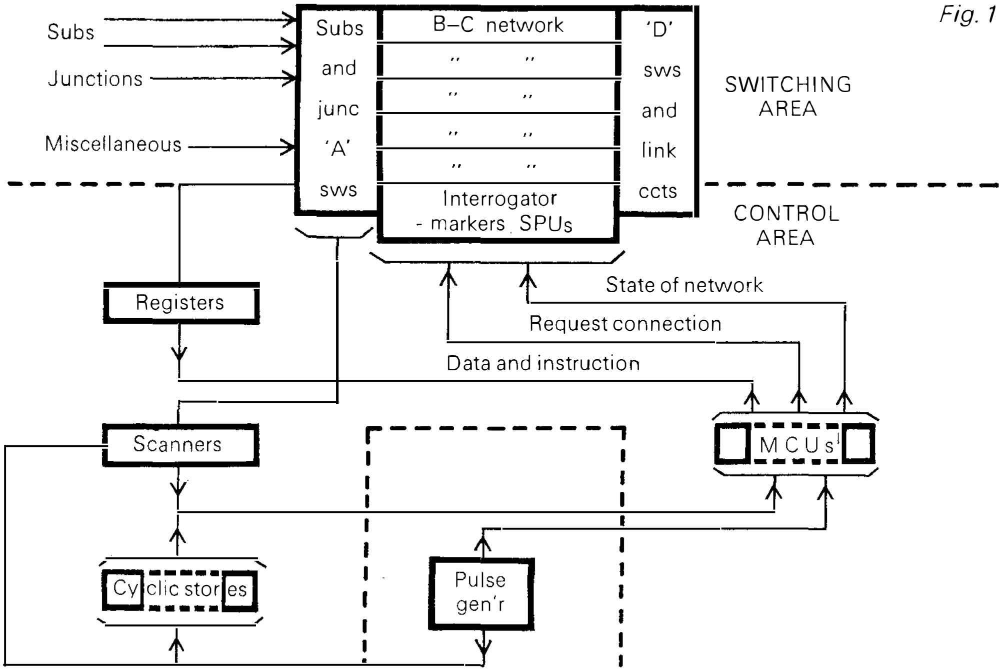


Fig. 1

TXE4 is a common control telephone switching system. It uses reed relay cross-point matrices for connection of speech pair, private and hold wires, and electronic programme control for call set-up and supervision. Each exchange is built up of a number of standard 'function building blocks' (FBBs) and both switching and control areas are sectionalised for service security : this provides a system which is simple in concept, versatile in application and basically fault tolerant. Exchanges can start with initial capacities around 2000 lines and can be extended up to 40,000 lines, or 5000 bothway erlangs, with calling rates from 0.02 to 0.35 erlangs per line.

The system comprises two main functional areas of equipment ; the switching area and the control area – the whole being kept in synchronism by a pulse generator, which is triplicated for system security. Over 95 per-cent of circuitry and components is mounted on plug-in-units (PIUs) which have gold-plated edge connectors for connection to the rack wiring. This practice helps system diagnosis and repair, and future changes of, or modifications to, PIUs. Inter-rack cabling is also 'plug-in'. These cables are manufactured in set lengths and sizes which ensures easy and quick installation and commissioning.

The exchange switching area is a network built up of a number of separate identical 'units' (of which a maximum of 30 can be provided) and each unit can handle a fixed amount of bothway traffic. Subscribers' lines, junctions, peripheral and miscellaneous circuits are connected to the outlets (O/Ls) of A switches, the inlets (I/Ls) of which are connected to a two-stage permanently interconnected B-C switch network. Two separate groups of A switches are provided, one for subscribers and the other for junctions and other circuits; each group is connected to its own B switches. Both subscribers' and junction B switches combine at the C switch stage, the other side of which is connected either directly, or via a link circuit, to a D switch and from there back to a C switch. D switches thus provide the inter-connection between units.

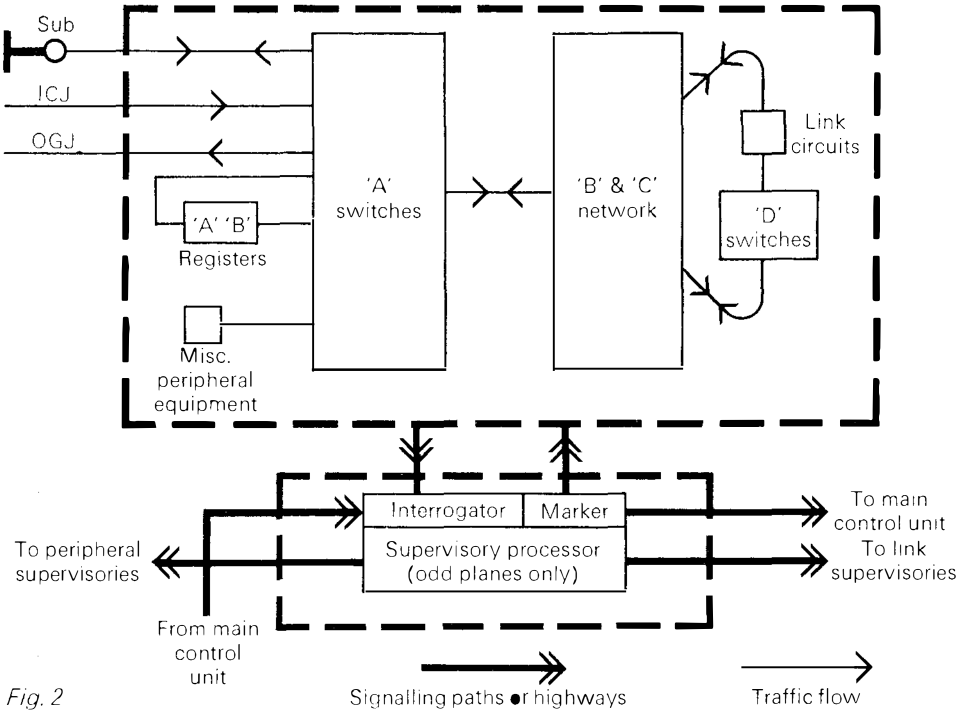


Fig. 2

A Switch

The subscribers' A switch is made up of a number of identical matrices, each of which has four O/Ls connected to subscribers' lines and six (or eight) I/Ls to B switch O/Ls – one in each 'plane', see *Fig. 2*. These individual matrices are provided in 'sets of ten', serving 40 subscribers' lines and providing access to 60 (or 80) paths to B switch O/Ls. The number of 'sets of ten' I/Ls commoned to the B switch O/Ls can vary from one to ten, depending upon the traffic to be carried. Thus the A switch is built up in multiples of 40 and one B switch can serve from 40 to 400 subscribers' lines.

Junction A switches, besides providing terminations for incoming and outgoing junctions, also carry terminations for peripheral equipments such as registers and C&FC relay sets. They are similar to subscribers' A switches in layout but have a lower concentration. Some of the peripheral equipments have two terminations since they require an 'in' and 'out' connection for call set-up and/or control.

B-C Switch network

The B and C switching stages of a Unit are also divided into six or eight identical sub-units. These are known as 'planes' and whether six or eight are provided is dictated by the traffic loading of the exchange. The standard B-C network comprises a two-stage fully interconnected array for each sub-unit consisting of 18 B switch matrices (each with ten O/Ls and eight I/Ls) and eight C switch matrices (each with 18 O/Ls and 12 I/Ls) A particular feature of this network is that for any chosen C switch I/L there is only one path from that I/L to a chosen B switch O/L.

D switch
The C switch I/Ls on even numbered planes are connected directly to the D switch whereas the C switch I/Ls on odd numbered planes are connected to the D switch via link circuits. Thus the D switch provides the connection between the chosen A-B-C paths of the odd and even planes. There are 96 D switches for every even plane – the actual matrix size depending upon the number of units being served.

Link circuits
Two types of links are used, 'bridge' and 'through'. Bridge links provide the transmission bridge and supervisory facilities on own exchange and incoming calls, and through links are used when a metallic path is required and/or the supervision is provided in an outgoing relay set. 96 link circuits are provided for each odd plane sub-unit and the proportion of bridge to through links can be varied between 64:32 and 32:64 according to traffic requirements.

The control area comprises three major separate areas of equipment plus the pulse generator (PG).

Cyclic store (C/S)
This operates with scanners, synchronised by pulses from the PG, to provide information on every circuit terminated on the A switch O/Ls. This information is generated at regular intervals, the frequency depending on the type of circuit, subscribers' line terminations every 156ms, registers, outgoing junctions and peripheral equipments every 36ms and incoming junctions every 12ms. The C/S is a library holding all the information relating to A switch terminations; it consists of a series of threaded ferrite rings. The threadings are pulsed sequentially and the rings give an output when pulsed. In the case of a subscribers' line the information held consists of the directory number, equipment number, and class of service. The C/S also stores routing and translation information, and is used to search for a free junction on a particular outgoing route.

Scanners
The scanners examine the state of each termination at the same time intervals as the C/S and, as each termination is scanned, its state of line (SOL) is passed over data highways to all the main control units (MCUs). For subscribers a SOL store is provided which retains in its memory the state at the previous scan; on each scan, the new SOL information is compared with that stored to determine a change in state, eg to 'calling' from 'free'. Scanners are mounted on C/S racks. A C/S comprises a number of racks made up into sets, each set having four different types of rack, A, B, C and D. Three sets comprise one 'Tri-set'. The maximum size of a C/S is seven Tri-sets, that is 84 individual racks. Each rack caters for 480 subscribers' lines 84 incoming and 126 outgoing junctions (or peripheral circuits).

MCUs and registers
MCUs are the electronic brains of the exchange and control all the steps necessary in setting-up calls through the switching network. They also control the operation of most of the other items of equipment making up the control area of the exchange. MCUs are allocated by a 'pre-allotter'. This pre-selects one MCU from all available MCUs which have free registers available for the next call that arrives. MCUs are used intermittently for short periods during setting-up of calls and the total active time is, on average, only about 200ms per call. Up to 20 MCUs are provided according to traffic demand rate, but there is always a minimum provision of three for service security reasons. One part of the MCU is really a purpose designed computer which issues instructions for setting up the call. These instructions, which together form a programme', take the form of wires threaded through a ferrite ring transformer memory. This is easily alterable for programme facility changes and is known as a miniature threaded wire store (MTWS) MCUs also

contain working ferrite core stores for temporary storage of received information on individual calls, for example the dialled digits.

Registers in TXE4 are used on all originating and incoming calls. They have no storage or translation facilities and merely repeat dialled digits into the MCU working store and subsequently send loop disconnect pulses to line (the routing digits and repeated numerical digits), as directed by the MCU. Registers are one category of the peripheral equipments referred to earlier that have both their 'A' and 'B' sides terminated on junction A switch O/Ls of the switching network.

Interrogators, markers and supervisory processing units (SPUs)

Interrogator-markers are used to determine the free paths available in the switching network. When a path is required the MCU 'asks' the interrogator to identify all free paths. The MCU selects the most appropriate route and the correct type of link circuit for the call and instructs the particular markers of the chosen path to close the matrix crosspoints.

SPUs are provided on odd planes only and are associated with markers, through which they obtain their information and instructions, to supervise and control the operation of bridge links, outgoing junctions and certain peripheral equipments. The SPU carries out all functions of call control and metering; by concentrating these functions into this piece of common equipment, which associates itself with the individual circuits for 24 micro-secs every 156ms, the individual circuits are simplified and reduced in size and complexity.

Pulse generator (PG)

This is common to the whole exchange and because of its fundamental importance to the whole operation of the exchange is triplicated for security. The three pulse generators operate independently but in synchronism with each other and the exchange will function if one equipment, and only one, is out of order or synchronism The PG produces and distributes all the various pulse periodicities to the appropriate parts of the exchange for the inter-related individual functions and various items of control equipment used for setting-up a call.

Maintenance

The exchange has built-in self-checking circuits which detect failures in major items of equipment and initiate an alarm and/or a line of print on a teleprinter. Both prompt and deferred alarms are provided. In certain cases faulty equipment is automatically busied out; faults within the switching network also give a printout, and a second attempt is made to set up the call. In addition to the visual print-out a perforated tape is also produced and is sent to a computer centre for analysis of the switching network failures.

Automatic routiners, provided with the exchange equipment, are peripheral equipments accessed via the switching network and are controlled by special programmes in MTWSs of the first three MCUs. They can be arranged to switch on automatically and their 'display' is a line of print on a teleprinter. In addition to the routiners each exchange is being provided with 17 different types of tester/test-set, ranging from a simple device for detecting when all O/Ls of a switch are free or busy, to complex testers for the markers and SPUs. Two types of oscilloscope will be available for checking signals and data on highways and for localising faulty PIUs.

Besides the System Handbook and TIs that are being issued for TXE4, there is a 'Diagnostic Manual' which will give guidance to maintenance officers in the diagnosis of alarms and system failures, and procedures for carrying out special checks: this manual will be updated as experience is gained on maintenance of the system.

The PO is investing huge sums of money in modernisation using the TXE4 system and we must all play our part in making it a success.

Sv6.1.3 (01-432 1404)

International subscriber dialling

by **Roy Tanswell,** Sv6.5.6

International subscriber dialling (ISD) from this country began in 1963 with London subscribers able to dial Paris; the service was then extended to provincial director areas. Cardiff was the first non-director GSC to have ISD. in November 1972. By the end of 1976 some 120 centres generating 0.25 erlangs or more of ISD traffic will have the service, to more than 30 countries. The whole country should have ISD by 1980.

World numbering plan

Just as a national numbering plan is needed for STD, so is a world numbering plan for ISD. The table shows the nine numbering zones into which the world is divided, and typical country dialling codes within those zones. The zone number is always the first digit of a subscriber's international number and the first digit of his country code. North America and the USSR have single digit country codes 1 and 7. These two zones have integrated numbering plans, so that individual countries within them do not have to be identified by dialling codes.

World numbering zone	*Allocated area*	*Typical country codes*
1	North America	Integrated numbering plan
2	Africa	Ethiopia – 251
3	Europe	Luxembourg – 352
4	Europe	Germany – 49
5	Central and South America	Venezuela – 58
6	South West Pacific	Australia – 61
7	USSR	Integrated numbering plan
8	South East Asia	Japan – 81
9	Middle East and India	India – 91
0	Spare	

A subscriber's international number is built up of his country code followed by his trunk code and his local number. Typical UK subscribers' international numbers are shown in the table. It will be seen that the trunk code is the STD code less the STD prefix 0.

	Country code	*Trunk code*	*Local exchange no*
UK ND Area (Leicester)	44	533	XXXXXX
UK Director (London)	44	1	234–XXXX
UK Director (Liverpool)	44	51	345–XXXX

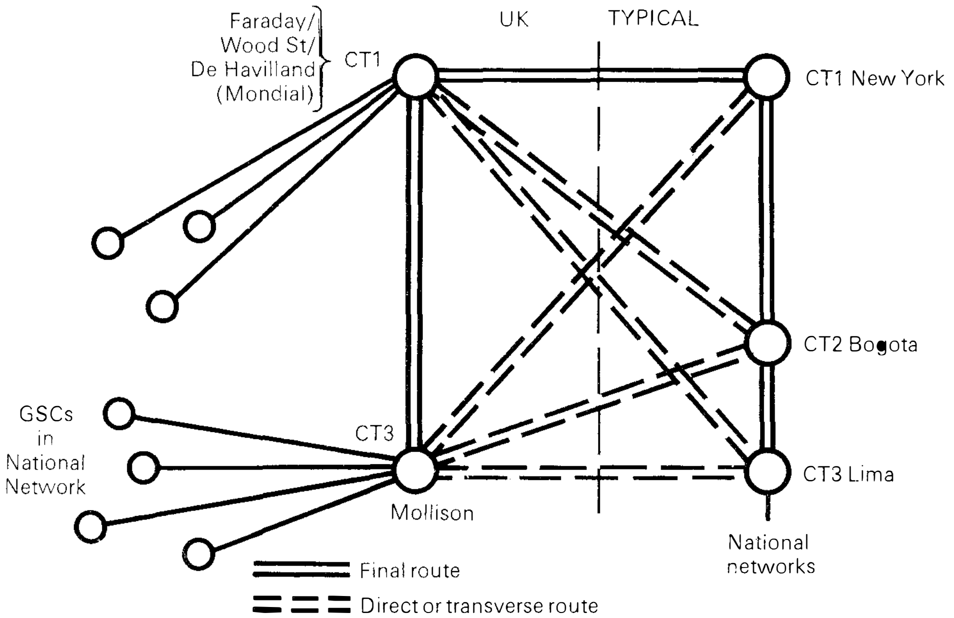
In the same way that in making a STD call the wanted subscribers' national number must be preceded by the STD prefix 0, so in making an ISD call the wanted subscriber's international number has to be preceded by an ISD prefix. A UK subscriber wanting any of the numbers in the following table would first have to dial the UK international (ISD) prefix 010.

	Country code	*Trunk code*	*Local exchange no*
Germany (Frankfurt)	49	611	XXXXX
France (Paris)	33	1	234–XXXX
Belgium (Brussels)	32	2	234–XXX
USA (New York)	1	212	234–XXXX

Thus the world numbering plan gives every telephone subscriber in the world a unique international number, having a maximum of 15 digits; and he is reached by first dialling an international prefix.

World routing plan

For routing calls between any two telephone stations in the world with adequate quality of transmission and overall economy, a world routing plan has been evolved. The world has been divided into a number of major zones, not necessarily the same as the numbering zones, each with an international transit centre designated CT1. At present the CT1 centres are London, Moscow, New York, Tokyo, Singapore and Sydney. The amount of telephone traffic does not justify CT1 centres for Africa and India. The diagram shows that CT1 centres are inter-connected and are also connected to subsidiary international transit centres CT2 within their zones. These normally serve large countries and also interconnect international circuits from smaller countries, each having a CT3 centre handling international calls only from and to its own country. Thus Germany, France and Italy have CT2 centres, Belgium and Ireland CT3s only.



Interconnection of CT1, CT2 and CT3 centres depends on traffic patterns and economic planning. Final routes, as shown by full lines in the diagram, are those ultimately necessary to meet transmission requirements.

Each national centre will be connected to an international switching centre (ISC) in its own country to route calls into the international network. An ISC is often called a Gateway.

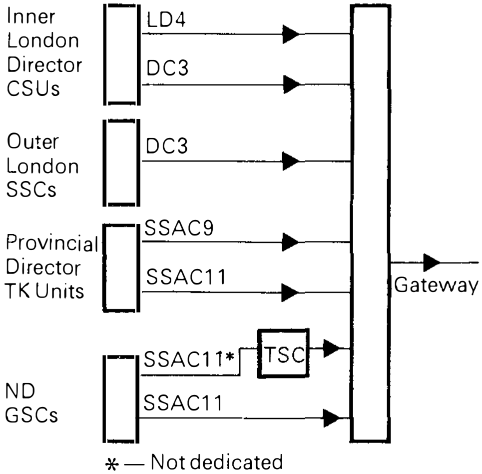
UK gateways

Originally Faraday and Wood Street ISCs switched all UK international operator and subscriber traffic, acting as separate CT3s but functioning jointly as a CT1 for international transit traffic. In future only one CT1 is to be in service at a time. With the opening of Mollison (CT3) and De Havilland (CT1/CT3), Faraday and Wood St will be left to switch CT3 traffic only. After Mondial (CT1/CT3) opens in 1978, De Havilland will be CT3 only. A further CT3 unit called Thames, in the Mondial building, is expected to come into service in late 1977 or early 1978, switching the majority of international traffic from the London Director Area (LDA) and incoming traffic to the whole UK. De Havilland and Wood St will switch the remainder of LDA traffic. The obsolescent Faraday ISC will close in the early 1980s.

Signalling to the gateways

The diagram shows the signalling systems used from the GSCs in the national network to the gateways. In LD4 and SSAC9 digits are sent at 10 pps. In SSDC3 and SSAC11 there is fast signalling of digits in SSMF2 form.

SSMF2/SSAC11 has to be used from non-director GSCs to meet end-to-end international transmission requirements. Where traffic warrants it, a direct route will be provided to the gateway; otherwise the transit network via a transit switching centre (TSC) will be used.



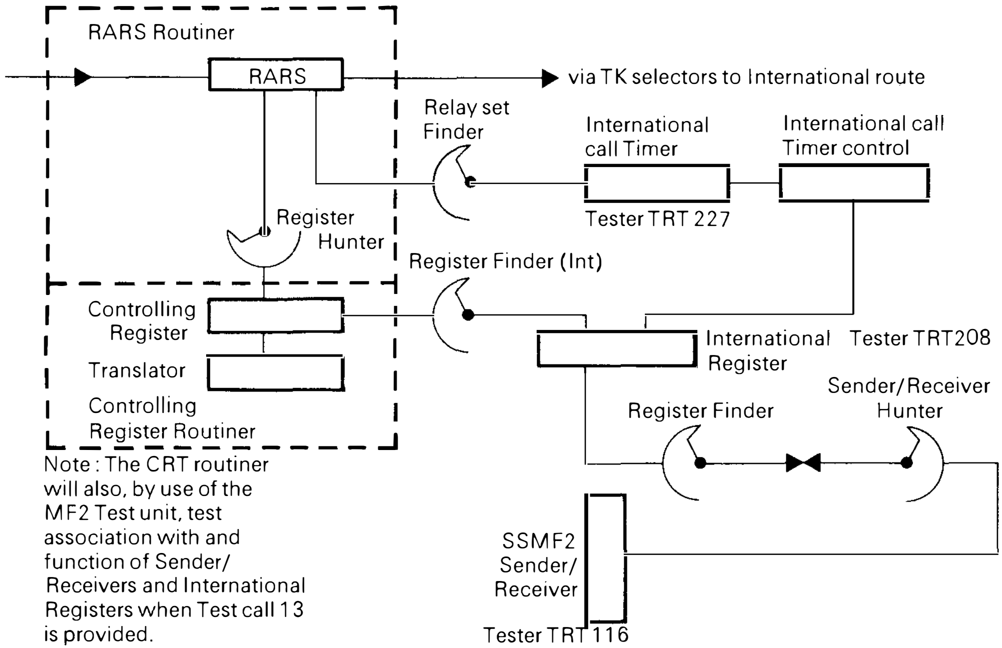
Switching ISD calls at a ND GSC

The diagram shows schematically the equipment brought into use on ISD calls at a non-director GSC. A call to Paris would require 010-33-1-XXX-XXXX to be dialled, 010 being the ISD prefix, 33 the country code for France, and 1 the trunk code for Paris.

The initial digit 0 routes the call to the GSC, as for a STD call, and seizes a register access relay set (RARS) and controlling register. On receipt of the 10 completing the international prefix, a free international register (INT REG) is associated with the controlling register and stores all subsequent dialled digits.

Once the INT REG has received the country code, it pulses out up to three Strowger (10 pps) routing digits to set up a connection over trunk selectors in the GSC to an outgoing relay set giving access either direct to the appropriate ISC or to the transit network. A SSMF2 sender/receiver is then associated to control further progress of the call and simultaneously an international call timer (ICT) is associated with the RARS to ensure metering at the appropriate rate when the called subscriber answers.

If the call is routed direct from the GSC to the ISC, the ISC sends terminal-proceed-to-send signals and in response the SSMF2 sender/receiver sends the digits of the international number in SSMF2 fast signalling mode. This also happens on a call routed via the transit network, but first the TSC has to set up a connection to the appropriate ISC. The TSC therefore sends a transit-proceed-to-send signal to the GSC, and INT REG responds with 10 to identify the call as an ISD call, followed by a third digit (called the 'inserted C digit') to identify the wanted ISC.



Note: The CRT routiner will also, by use of the MF2 Test unit, test association with and function of Sender/ Receivers and International Registers when Test call 13 is provided.

Operator-controlled calls
An on-demand manual service to international destinations that cannot be reached by ISD will be needed for many years. Callers in the provinces dial codes that route them to international control centres (ICCs) at Glasgow and Leicester, where there are automanual switchboards having four-wire switched access to international circuits Callers meeting with difficulty in making ISD calls are also routed to the ICC, by the assistance operator. There may be up to ten more ICCs by the mid-1980s. At present there is also a two-wire board at Brighton, provided as an expedient.

Testing of equipment
The INT REGs at a Strowger non-director GSC are tested by tester TRT 208, and ICTs by TRT 227. THQ/NPD control their issue for acceptance testing, after which they remain on site for maintenance use in clearing faults and routing testing to *TIs E6-R5545* and *R5546*.

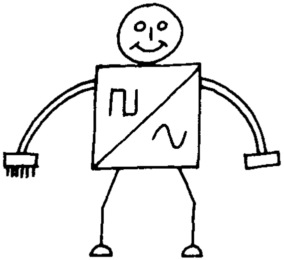
Acceptance testing is to Testing Specification TE1821, which calls for INT REGs to be tested in association with one controlling register and one RARS. *T1 A6-D4109* will recommend extension of 'call through' tests to include all controlling registers and RARSs.

The controlling register routiner, when modified to include test call 13, will set up an ISD call and check for correct association between a controlling register, INT REG, and SSMF2 sender/receiver

Before the ISD facility is introduced at a GSC there are three weeks of engineering tests to ISC test numbers, followed by four weeks of joint engineering and traffic testing of meter pulse rates, quality of service, and quality of transmission checked on calls to tones and recorded announcements in foreign countries. Then, with the satellites turning gently in the golden glow of the setting sun, the contractors, clerks of works and traffic staff say farewell – and leave us to it. Sv6.5.6 (01-432 1344)

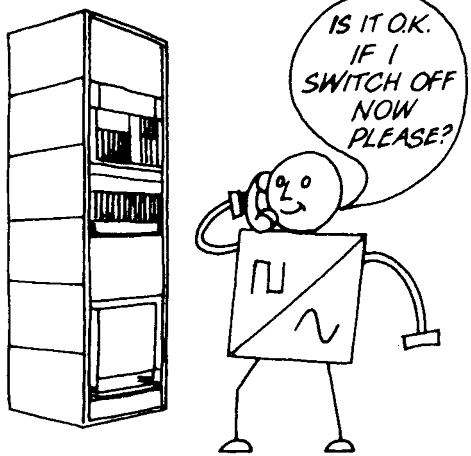
This is 'Datamate'

Datamate uses his digits wisely



This character appeared, as it were in a dream, to Ron Quinney of Sv7.1.2, the Datel maintenance group in THQ. As you will see over on the right, DATAMATE is a positive thinker and does all the right things.

If all were like him there would be no 'working party faults' or other drop-offs to arouse the ire of Datel customers, and life would be much sweeter. Does he appeal to you? Can you improve on his name or appearance? Since customers complain about services besides Datel, perhaps he should have a less specialist name, like Jack Testwell. Or, if more can be learnt from negative thinkers, perpetrators of drop-offs, including safety drop-offs, how about Ivor Diss? From the editor's point of view, it would be very handy to have a small space-filler, especially on pages without other illustrations. £10 for your idea, if we adopt it. Editor



Datamate never works on a dataplex system without first informing the DNCC

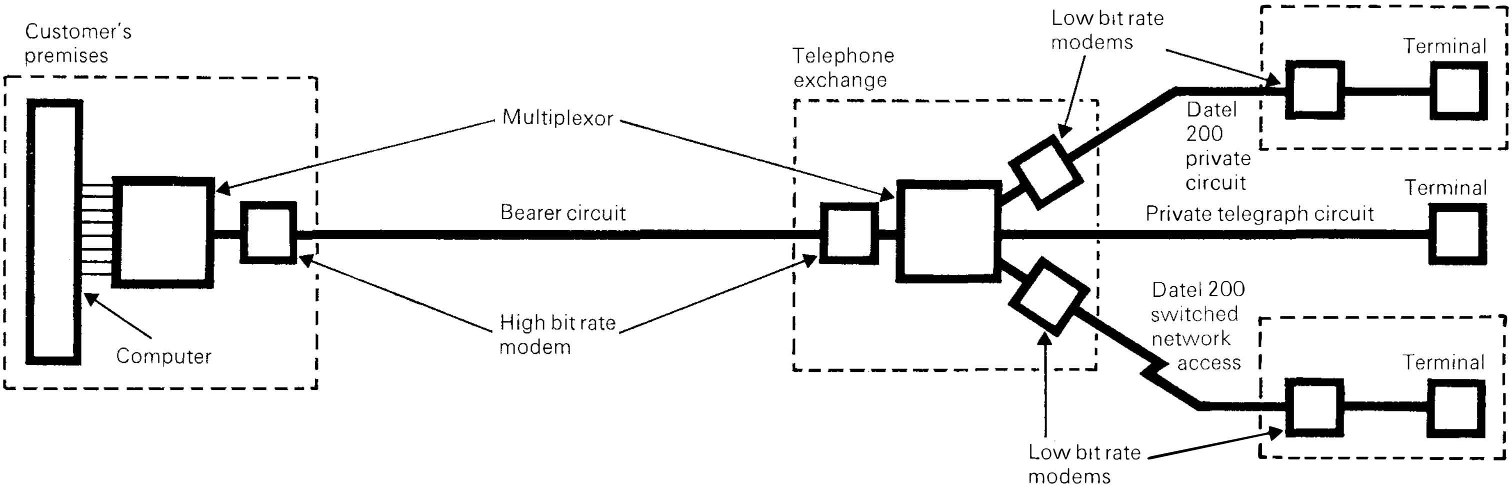
Dataplex

by **Ron Quinney,** Sv7.1.2

Dataplex is a DATA multi PLEXing service which in effect extends a customer's computer bureau facilities to his clients in an area many kilometres distant. For example, a data multiplexor could be installed at a London computer bureau and a similar multiplexor in a suitable location in (or near) Aberdeen – possibly in the telephone exchange (the customer then does not have to provide accommodation). These two multiplexors communicate with each other by means of data modems connected at each end of a 4-wire tariff T (Engineering Performance Specification EPS 25) bearer circuit. This link conveys digital data in voice frequency analogue form at either 2400 bit/s using high bit rate datel modems 7B, or 4800 bit/s if modems 15A are used ; the choice depends on the designed capacity of the Dataplex system required by the customer.

At the computer site the PO multiplexor interfaces with the computer by means of standard control and data interchange circuits, one such interconnection for each data channel multiplexed. At the remote multiplexor site, the individual channels are connected to low bit rate Datel modems 2 which are accessed from the exchange final selectors. Thus the bureau's clients in the remote telephone area are able to access the computer bureau at local call charge rates – a much more attractive proposition to them than making calls to London !

Point-to-point Dataplex network showing alternative access



The equipment

The equipment provided to multiplex the Datel 200 services operates in the time-division mode. That is, each channel (or circuit) is allocated a series of specific time-slots in the aggregate data stream, each sufficient for one data character to be assembled and transmitted. The allocation of time-slots for each channel is achieved by a strapped module specially designed for the Dataplex network concerned. Included with these character-interleaved data are coded signals which convey the status of the modem and computer interchange circuit conditions from one site to the other. The PO title for this equipment is *TDM 2A* and the service provided is known as Dataplex *2/TDM 2A*.

Maintenance

Maintenance arrangements for the Dataplex service have been agreed with Regions, Areas and with other THQ Departments. As soon as notification is received of a new network, the Maintenance Divisions of the Regions concerned are advised. Sufficient notice can usually be given to arrange for special training for the Datel field maintenance officers who will become involved; and to establish the essential fault reporting and handling arrangements, so that the customer can be advised in good time, and to ensure that adequate maintenance spare modules are located conveniently close to the multiplexor sites.

Fault control

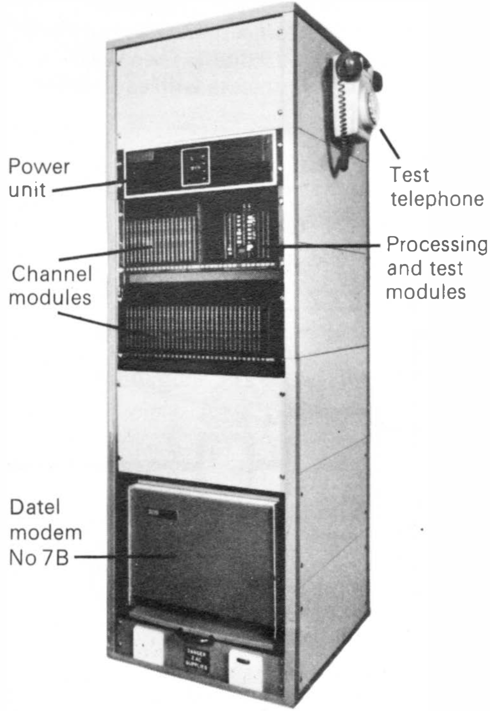
The main fault control for Dataplex networks is invariably the trunk maintenance control centre (TMCC) at the 'A' end of the 4-wire bearer circuit, and this is designated the data network control centre (DNCC) for the network. All faults on the Dataplex service, apart from the remote dial-up Datel 200 accessing services, should be reported to the DNCC directly by the computer manager (or line controller) at the computer bureau. A nominated officer within the PO acts in liaison with the customer's line controller should service difficulties occur. Faults in the remote Datel 200 access services are reported by the user to his local fault reporting point (usually '151').

Information on fault reporting is presented to the customer in a specially produced booklet, which also contains details for using the many built-in diagnostic aids that are a feature of the TDM 2A.

An essential feature in the maintenance of Dataplex services is that all officers involved must have ready access to relevant documentation, including a 'straight-line diagram', strapping information, channel allocation, circuit numbers and, telephone numbers of maintenance controls and other contact points useful in helping to restore these important data services.

It has been said that Dataplex is like a customer putting all his eggs in one basket. So it is. For this reason everyone concerned in maintenance should react swiftly when a Dataplex fault is reported. If you really were that computer bureau manager, you would have to answer to your bosses if you lost all those important Aberdeen clients because of bad PO services. Our job, in maintenance, is to get all the eggs in that basket from one site to the other without damaging any!
Sv7.1.2 (01-432 9164)

Typical Dataplex 2/TDM 2A rack at the customer's computer site



Reliability of customer apparatus

by **Peter Lane,** Sv5.3.4

Mr Partington, then Head of Sv5, wrote in his general article on plant reliability surveys in MN2 about the field studies needed on new items of customer apparatus. This article tells in more detail what has been done.

There are two preliminary points to be made. The first follows from Mr Bampton's article on reliability terminology and measurement in MN8. Philosophically, we define the reliability of an item of equipment as the probability that it will operate for a given period of time without failure. In practice, however, we measure reliability in terms of failure rate. You could say that in telecommunications plant maintenance we are more directly interested in unreliability. We need to know failure rates for logistic purposes, including making provision for spares, and to calculate maintenance costs for tariff purposes, as discussed by Mr Turner in his MN7 article on the cost of a fault report.

The second point is that in basing measurements of customer apparatus reliability on its in-service maintenance performance we necessarily get subjective values because we cannot exclude customer reaction. However, by using large samples in representative areas we minimise the effects of individual foibles and variations in usage, obtaining average results representative of the population within certain statistical confidence limits.

Part of our responsibility in Sv5.3.4, then, is to measure the 'in-service maintenance performance' of new customer apparatus or components. When items are going to be installed in significant quantities in the field, we have to ensure that they are satisfactory before being generally released. Laboratory tests on the initial offering do not reveal all possible interactions, and prototypes are normally hand-made in manufacturers' model shops. What is needed is to make evaluations in field conditions on production samples. This takes into account the practical effect of the random mechanical and electrical tolerances introduced by production tooling and manufacturing techniques.

Product trial

The field evaluation begins with a product trial. A small quantity – some 100 or 200 – of the item from the first production contract is installed in customers' premises, free of charge, in a variety of situations and circuit configurations. All installations are closely monitored for the duration of the trial – usually two to three months – to discover initial customer reaction, assess the effectiveness of staff training and published documentation, merits of particular design features, and any problems in installation or maintenance.

Market trial

After successful completion of the product trial, a market trial is conducted by making a limited number – usually about 3000 – of the item available on rental, so as to assess the size and nature of the market for it. The trial tests the reactions of customers to the product, in particular to its price, and provides means of assessing promotional requirements and the potential for follow-on sales. It usually lasts four or five months, depending on market reaction.

Maintenance study

The field study to measure reliability runs concurrently with both product and market trials and continues afterwards for long enough to determine how the item behaves beyond early life and to ensure that there are no early wear out effects. Usually a minimum period of a year is needed to establish from an adequate sample quantity the failure pattern of the item related to time in service.

It is convenient to consider fault reports, recorded over relatively short periods of in-service time – say each week. The ratio of failures each week to the population of items working during that week gives the 'instantaneous failure rate' or 'hazard rate' of the item and can be plotted against the in-service life. A week-by-week plot of instantaneous values would give a variable curve from which it would be difficult to detect trends. Cumulative values of hazard rates are therefore plotted against service life and the pattern can be more readily seen. The slope of the curve is used to assess performance in percentage failures yearly. It will be seen in most cases that it improves after early life.

The curves shown are from a UK study of subscribers' units of WB900 subscribers' 1+1 carrier systems and an ETR study of pushbutton units in self-contained keyphones.

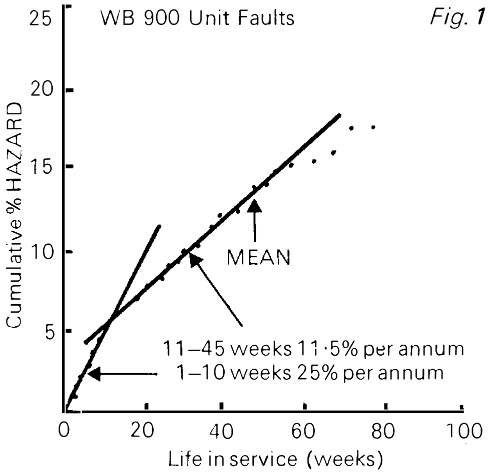


Fig. 1

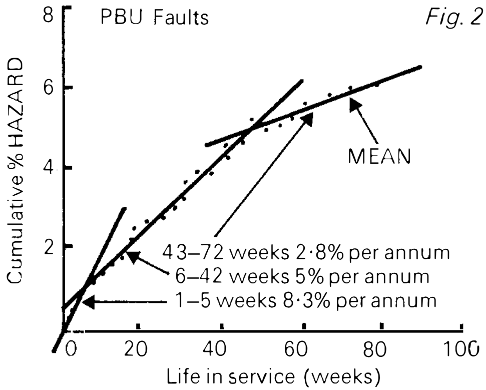


Fig. 2

Since one can be more confident of fault rate measured over a large population of items, the most useful results are obtained towards the end of a study period. Then large numbers have had a sufficient life in service for the failure rate to have settled down. This is shown just before the mean of the hazard rate/life in service graph.

The population is affected by such factors as cessations and replacements as well as by the rate of installation. Altogether the population is said to be 'multiply censored'; (the last syllable of the word 'multiply' is pronounced as in 'simply'). The two sample size graphs show this censoring of the two populations. The one for *WB900* units shows the predominating effect of a long time to install. Beyond the mean in-service life of the population the sample size is inadequate for reliable results.

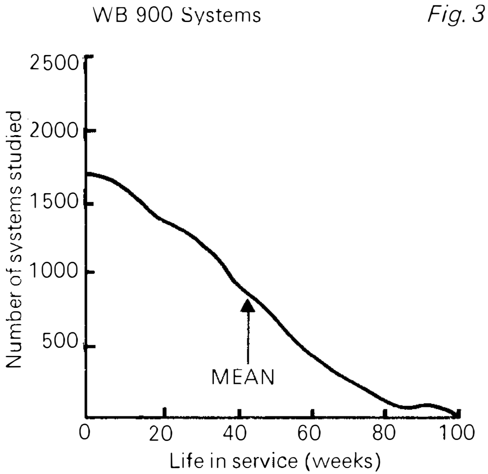


Fig. 3

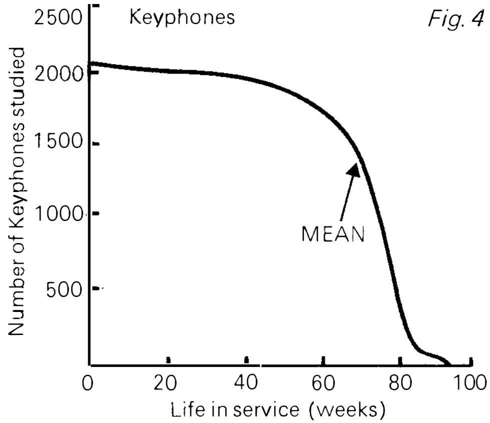


Fig. 4

The next hazard rate curve gives an example of time-dependent failure in dc-keypads, which suffered from silicon contamination and exhibited marked 'wear out' characteristics after six months.

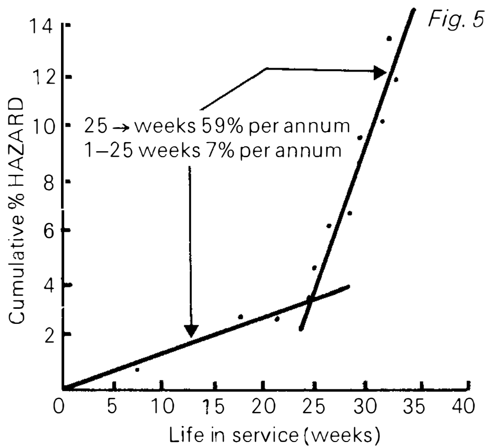
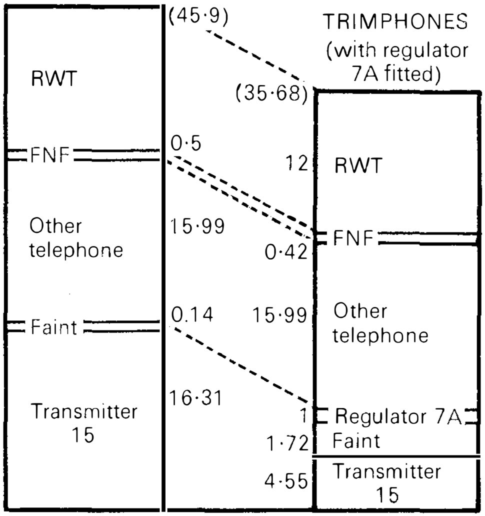


Fig. 5

The pillargraph shows the effect on fault reports per station per annum of fitting regulators 7A in trimphone telephones to reduce the high incidence of transmitter 15 faults. The right hand pillargraph shows that transmitter faults were indeed reduced, but there were additional failures introduced on the regulator itself and by speech loss caused by the regulator shunting the transmitter. Accurate recording of specific failure information is important in field studies, as the pillargraph shows. It is essential in all studies to identify any component or part significantly worse than a norm, and this could not be done with an overall measurement only. RSCs are asked to use identifying codes for fault clears, for the purpose of machine analysis.

Fault reports per station per annum *Fig. 6*



Type approval
After equipment has satisfactorily undergone field studies it is given type approval. It is not then practicable for us to continue surveillance further. With subsequent modifications and supply by different manufacturers there is a chance of equipment becoming unsatisfactory. Vigilance by field staff and feedback of information on *A646s* are therefore essential.
Sv5.3.4 (01-739 3464 x7777)

Partially skipped gradings

Readers will remember the article on partially skipped gradings (PSGs) in MN4. There was a fuller description in the IPOEE Journal of October 72. The Teletraffic Applications Co-ordinating Committee has been considering replacing O'Dell gradings by PSGs for some time, but have concluded that the economic advantages that can in theory be obtained cannot be realised in practical conditions. So PSGs will not become standard.
Steven Heap, OP9.7.4 (01-432 1454)

Dangerous earthing at subs' premises

A case has arisen where the earth for a shared service installation was incorrectly provided by using the Electricity Board's earth in an area where the power supply was by overhead distribution. The power line and neutral were reversed and so 240V ac was connected via the bell circuit to the PO line.

TI A2 E1006 says that if the power supply to the premises is by overhead distribution the PO must specially provide its own earth-electrode system.

Keep your eyes open for incorrect earth connections – *they are potential death traps.*
SETR/SM3.1

News on call offices

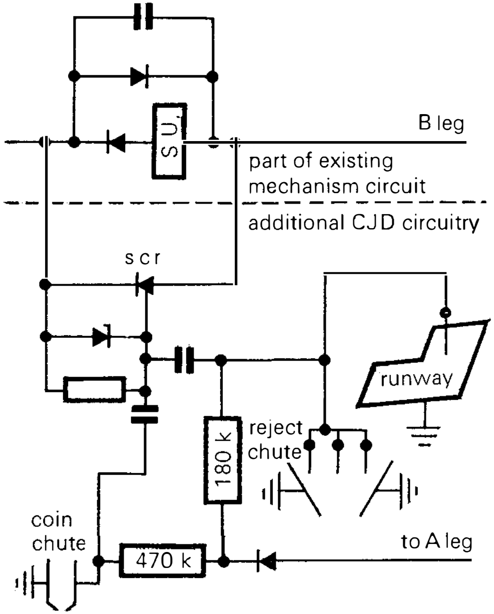
by **Geoff Balls,** Sv5.3.5

This article looks at some of the call office problems currently occupying us at THQ and outlines remedial measures in hand.

Coin jam detection

For many years we have been plagued by a recurring problem at renters' coinbox installations where – for a change – the fault lies not with us but with the customer. When a renter fails to clear the cash container before it fills, coins build up and eventually jam the mechanism. When this happens a maintenance visit is necessary to 'unjam' the mechanism and restore service. A device designed to save these expensive visits is shortly to be evaluated in several Areas. It is known as a coin jam detector (CJD) and is a development of an original idea by NETR Service Division. The principle is simple and makes use of the fact that the coin slots are mechanically unlocked to accept money by the operation of a relay (SU) in the mechanism. The CJD circuit is designed so that if a coin (or other metallic object) becomes lodged at any one of three points in the mechanism, a silicon controlled rectifier (SCR) is triggered to short circuit the SU relay thus locking the slots to prevent the insertion of further coins. Additionally, the device puts a resistance earth condition on the 'A' leg which can be measured from a test desk. The resistance of the earth is dependent upon where the jam has occurred and the Repair Control Officer (RCO) may then, upon receiving a 'coin slots jammed' report, test the line, see where the jam has occurred and take appropriate action. If, for example, the jam is in the chute immediately above the cash container then all that is required is to ring the renter of the box and ask him to clear the cash container. The CJD coin chute self clears when the cash container is removed and hence no engineering visit is necessary. A jam indication from either the coin runway or the reject chute contacts confirms the need for an engineering visit.

It is thought that the device will also have an application in public boxes in some Areas, particularly where large seasonal variations in usage are experienced and the Postal coin collection staff find it difficult to empty the cash containers at sufficiently frequent intervals. Here, again, a full container will require only a Postal visit as removal of the container releases the two coins in the chute. Since no build up of coins can occur in the mechanism, mechanism damage, which is often caused when jams are cleared, is eliminated. As a bonus, reject chute stuffing will now be less profitable, since the number of coins in a reject chute jam is reduced to a minimum.



Handset cords

Introduced in 1966 as the standard handset and cord assembly for public call offices, the Handset 11A has undoubtedly reduced the incidence of handset theft. Protection is mainly provided by the four high tensile steel conductors which resist casual cutting by pocket knives and similar instruments. Unfortunately, the penalties arising from this protection have tended to outweigh the advantages! Because of its inherent stiffness the PVC sheath tends to crack an inch or two from the handset. This cracking is followed by fatigue failure of one or more of the conductors due to the concentration of stress at the crack line. Cord failures occur after six to eight weeks at heavily used boxes, requiring complete handset replacement.

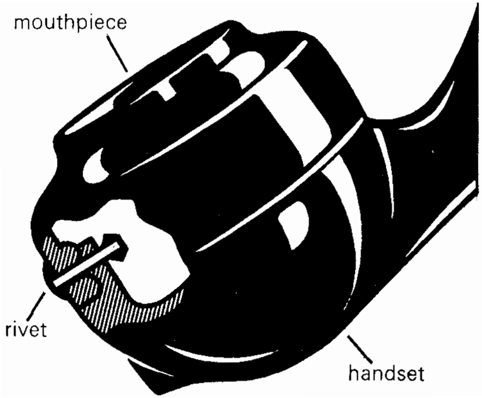
As a short term improvement, a softer grade of PVC has been called for on future contracts. For the future we are exploring a new approach to the design of handsets and cords for PCOs which we hope will result in the introduction of two alternative items.

Firstly, for most applications, a soft, flexible non-curly cord with a single stranded steel wire (Bowden cable) down the centre. This will be anchored to the handset for the coinbox to take the strain of pulling and should resist cutting at least as well as the existing 11A. An elbow will probably be provided at the coinbox end to ensure that the cord hangs naturally and does not become trapped in the door hinge. Being more flexible the cord should not require a weighted handset so this will reduce costs and wear and tear on the handset cradle. With normal tinsel conductor terminations the cord will also be locally replaceable.

Secondly, for vandal-prone situations we hope to obtain, or develop, a segmented or coiled stainless steel flexible sheathed cord, also secured at both ends. A suitable sheathing has proved difficult to find as existing types can be unwound using the handset as a lever, thus exposing sharp edges. We are now in possession of what seems to be a more acceptable type and things look much more promising.

Door closers

Scotland has had problems with some new door closers which were very slow in operation. Customers were closing the doors themselves and breaking the linkage. This problem has been resolved ; but as a result of our investigations we believe that by changing the basic method of fitting the closers we should be able to simplify installation and also improve control over the door. This will give much better protection to the hinges and restraining straps in high winds. We also hope to eliminate the old bugbear of left and right hand closers by using a universal type.



Handset rivets

In spite of the special tightening that we should give to the ear and mouthpieces of public telephones, inset theft and damage is still a problem. We hope we can soon say 'has been', for we now have a way of rivetting both pieces to the handset body with special plastic rivets, which can be removed for maintenance. An instruction for the modification will be issued shortly.

The rivets are cheap and easy to install. Early reports from Birmingham, where they are already in use, are very encouraging.

Slot blockers

The coin slots of our pay-on-answer system are an open invitation to the public to fill up the slots with every conceivable type of rubbish. Over the years there have been a number of attempts to design a blanking plate or slot blocker which would at least keep some of the rubbish out, but with little success. The latest design which THQ are experimenting with, however, looks very promising. When the slots are locked against coin insertion, the device completely closes the slots against all objects except when brute force is used. When they are unlocked, the slots are still closed to exclude soft objects such as bus tickets, but will open with a collapse action to allow coin insertion With fingers crossed, we are arranging for a small number to be made so that we can test the reaction of our customers. A complete cure is unlikely with our present system, but this device could bring great relief for a relatively small outlay.
Sv5.3.5 (01-432 9386)

Locating air leaks in cable sheaths

by **Graham Holland,** Sv5.1.2

This feature introduces three new methods of locating leaks in pressurised cables, a sonic detector and pneumatic bridge for underground leaks, and an ultra-sonic detector for leaks in aerial cables.

Detection of leaks

First indication of a defect in the sheath of a pressurised cable is obtained by the EPMC from the pressure gauge or flowmeter readings received from telephone exchanges, repeater stations, or radio stations. As the cable pressure falls, pressure alarm circuits at the exchanges or stations are actuated by the operation of contactors provided at jointing points along the cable or of pressure gauges with alarm contacts provided in buildings and cabinets. Flowmeters are associated with cables, mostly in the local network, that are fed with air continuously; any change in the indicated air flow means that a large leak has developed relatively near to the air-feed point.

Once it is known that there is a leak in the cable sheath, a series of pressure readings is taken over the defective section, by connecting a manometer to the Schrader-type air valves attached to some of the joint sleeves. From these readings a pressure gradient graph is drawn to indicate the likely position of the leak. The leak is often at a jointing point and its precise location is usually indicated by the formation of bubbles in leak detecting solution applied over the joint sleeve and cable sheath.

Underground repeater cases are pressurised separately from the cable. If the pressure contactor within the case operates, giving an alarm, the likely leak points on the case have to be carefully examined.

Location between jointing points

When a cable pressure defect is proved to be between jointing points the maintenance engineer has, or will have, the following methods of locating it.

Detector Leak 3A (*TI E3 G0318*)

This is the quickest method to use and gives results if the air escaping at the leak point is producing audible noise. The detectors will soon be available in quantity. The detector leak 3A is basically a microphone contained within a metal probe which, when attached to small diameter rods, can be inserted in the duct and advanced over the cables to pick up the sound of the escaping air. It is connected by a trailing lead attached to the rods to a detector whose output is monitored by both headphones and a meter. If the escaping air is producing audible noise it will first be heard in the headphones and, as the probe nears the leak, indicated on the meter. Maximum meter deflection indicates the position of the leak.

If the duct contains water the escaping air will make a considerable noise as it bubbles through it. The microphone is waterproof and can easily locate leaks in these conditions.

Tracer gas

This is a well-proved method for use in dry duct conditions when the leak is inaudible to a detector leak 3A. A gas/air mixture (*TI E3-G0316*) is introduced into the cable and the point at which it escapes from the cable located using a detector leak 2B (*TI E3-G0315*). This samples the air within the duct by means of a trailing tube rodded over the cables in a manner similar to that used with the detector leak 3A.

Manometer 3A

Tracer gas cannot be used to locate a leak if water is present in the duct, and neither of the above two methods can be used if the duct is too congested for rodding. In these circumstances an advanced form of aneroid manometer, the manometer 3A, can be used to obtain a more accurate pressure graph. Manometer readings have to be corrected for altitude and for the time it takes to actually obtain them over the defective section. The method can give a location accurate enough to excavate.

Pneumatic bridge

The effectiveness of the above methods depends very much on the conditions encountered on site. For instance, an obstruction in the duct may prevent rodding as far as the leak. A novel method of overcoming most of the problems has been developed by Research Department and they are now gaining field experience with it. It uses a pneumatic bridge, analogous to the electrical Wheatstone Bridge, to locate a pressure defect within a cable length. Results so far have been most encouraging.

It is not always practicable to excavate at the indicated point of leakage to make an *in-situ* repair. Even when it is, replacement of the faulty cable length may sometimes be the economic thing to do, especially if the cable is a small one.

Aerial cables

Locating leaks in pressurised aerial cables – often necessary during the 'shooting season' – at present requires use of an elevating platform to examine the cable sheath between supporting poles. To enable leaks due to shotgun pellets and other causes to be detected from the ground, a tester is being tried which transforms any ultra-sonic noise produced by the escaping air into audible sound. A parabolic reflector directed towards the cable collects some of the ultra-sonic emission and focusses it onto the transducer of the tester. The transformed sound can be heard in ear phones.

All the above aids, and any superseding magic box that may be devised in future, are supplemented by the testing officer's invaluable knowledge of his own patch.
Sv5.1.2 (01-432 1307)

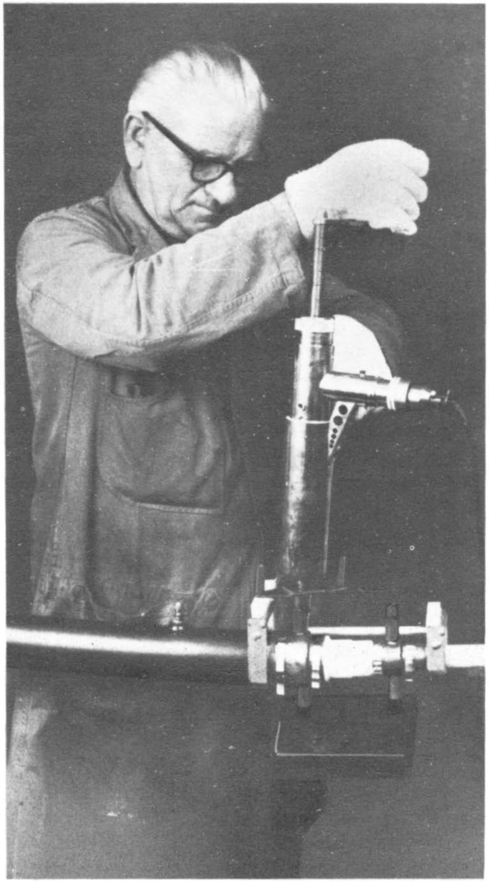
Injection moulding for closing joints

by **Terry Smith,** WMTB

The introduction of polyethylene sheathing for underground and aerial cables brought with it problems of making long-life joint closures. Many methods have been devised, but time shows them to be less reliable than plumbed joints on lead-sheathed cables. The reliability of the lead plumbed joint stems in part from the ability of lead and solder to form a homogeneous mass when heated. Heating similarly produces a fusing together of two masses of polyethylene and this can make a joint as reliable as the cable sheath itself. In practice molten polyethylene at a carefully controlled temperature is injected into pre-formed moulds shaped to form the joint closure.

In Wales and the Marches we now use the injection moulding technique of Telephone Cables Limited for all direct labour junction cables and E-side local development schemes. Jointers prefer the method, and it produces joints of improved reliability. The soundness of a joint closure can be checked by visual inspection followed immediately by pressure testing. Cables can be pressurised quickly and handed over to maintenance with confidence.

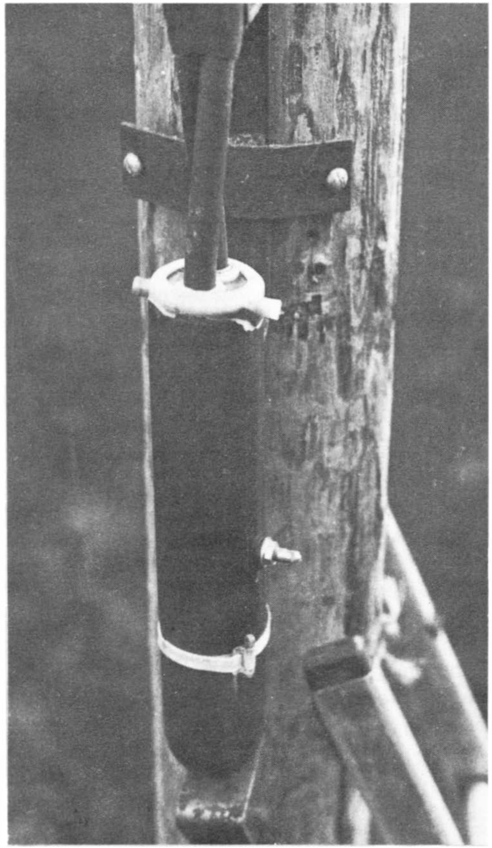
We have trained selected maintenance jointers in the new technique for these cables and Area Maintenance Divisions have bought the equipment for it.



In WMTB Service Division we recognised the advantages of injection moulding for repair of faulty epoxy putty joints. Methods have been devised for single-ended joints in aerial cables and for in-line joints, without spurs, where the sleeve is re-usable. Both methods have been registered with the ECOPC as a field trial.

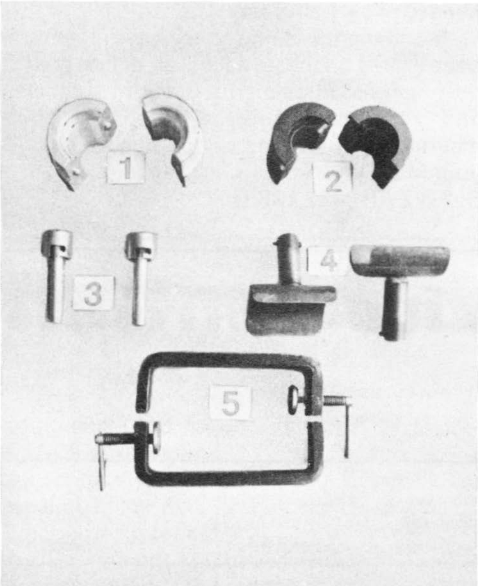
Single-ended joint

Epoxy putty aerial cable joints are particularly unreliable. To repair one the faulty epoxy wipe must first be removed and the cable sheaths cleaned. A split polyethylene plug is fitted into the end of the sleeve to form the inner face of the mould. A split aluminium plug is fitted round the cables to form the outer face of the mould. A shell-mould is clamped into position and heated polyethylene injected to complete the moulded closure. The picture shows a finished joint with the shell-mould and aluminium plug removed.

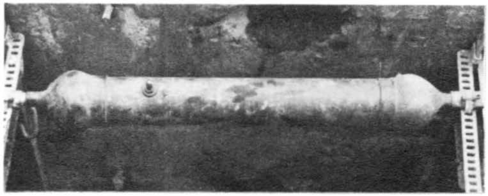


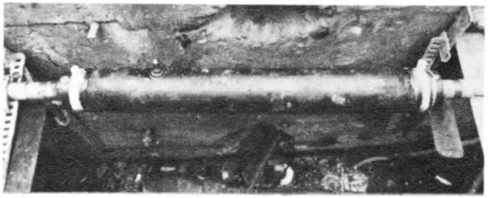
In-line joint

Special piece-parts have been developed for this technique. In the picture they are:
1 aluminium split plug, 2 polyethylene split plug, 3 shell mould alignment tools, 4 shell moulds, 5 clamps.



The epoxy putty wipes are removed and the cable sheaths cleaned. The aluminium split plug and special shell moulds are used to mould a polyethylene split plug to each cable butt. The sleeve is re-positioned over the joint and shell moulds fitted to mould the split plugs to the sleeve. The pictures show a joint before and after repair.





Future developments

We are continuing to investigate methods of repair of faulty epoxy joints with spur cables and the use of split sleeves where the existing sleeve cannot be re-used.
WMTB/SMD/S3.1.2 (0222 391377)

Answering sets

by **Roy Domville,** Sv5.3.2

When an ordinary telephone is left unattended, incoming calls receive 'ring tone, no reply' and so are ineffective. This is unsatisfactory to many subscribers, for instance those who have one-man businesses and are often out. So some of them have an answering set connected to the telephone. This machine answers a call after about 10 seconds of ringing and plays back a message pre-recorded on a loop of magnetic tape. The telephone itself is used to do the recording. The machine gives an indication when a message is being recorded on it, or checked, or played back to a caller. If a subscriber has two or more answering sets he can transfer messages from one to another using a plug and cord.

There are two types of answering set – the 1A for messages lasting up to 20 seconds, to let people know where the called person is and when he will be available, and the 2A for messages up to three minutes.

Both types are produced in different manufacturers' versions. Sontronic make the 1A/1, 2A/1 and 2A/2. In these machines, the slack of the tape loop, the part of it not passing the record and replay heads, is stored as free convolutions in a tape tray. Tape control is achieved by a small hole in the tape which allows light from a lamp to impinge on a light detector as the tape passes it. This causes the tape to stop at the end of the message. The tape loop in the 2A/1 and 2A/2 is a Mobius loop – that is, it has a 180° twist in it, so that both sides of the tape pass the heads in turn, halving the length needed for a three minute message. Both sides are coated with magnetic material. Since the tape has to pass the heads twice before stopping, the tape control hole is punched towards one edge and so passes the light detector only once.

The 1A/2 and 2A/3 are made by Ansafone. In the 1A/2, the tape passes round five pulleys, one of which is adjustable to take up any slack. In the 2A/3, the tape is stored in a small cassette which automatically takes up any slack. Tape feeds from the centre of the cassette, round two pulleys, to the record and replay heads and from there back to the outside of the cassette, going round only once per message. There is a short clear length in the tape loop which in passing the light detector stops the tape at the end of the message.

On-site maintenance should normally be restricted to changing tape loops and lamps, lubrication and minor adjustments; but the work detailed in *TI E5 F3115* can be done if you have the necessary tools and parts. If you cannot clear a fault, fit a spare machine. Do not use magnetised tools because contact of such a tool with the record/replay heads will result in poor performance. The special hexagonal wrench needed to remove the control knob will be found retained by one of the base screws, and should be replaced after use.

The machines need routine maintenance if they are to operate efficiently. The routines in *TIs E5 S5303* and *S5304* should be done yearly. Lubrication as in *S5305* is needed every half-year.

Maintenance Guide Notes have recently been issued on these machines, giving brief descriptions, adjustments, diagram numbers and TI references. If you are called upon to maintain an answering set, be sure to have your MGN with you.
Sv5.3.2 (01-432 1383)

Testing 'wires only' telegraph private circuits

by **Bill Hill,** ex-Sv7.1.2

Most telegraph private circuits terminate on PO machines – teleprinters, reperforators, auto-transmitters – or on PO broadcast, conference or line-switching equipment. These normally work at 50 bauds, although some machines can be supplied to work at the higher modulation rate of 75 bauds. Customers with low speed data collection systems require to receive and transmit at higher speeds, the most common being 110 bauds, and have to buy and maintain commercial machines. The PO provides and maintains 'wires only' telegraph private circuits up to the interface with the customer-owned plant. The customer is expected to prove his machine or equipment trouble free before reporting the PO circuit faulty.

So both the customer and the PO need to test their own section of the overall circuit either side of the interface. At this point, or as near as practicable to it, a device is needed to apply test conditions towards the PO line and a loop or disconnection towards the customer's terminal equipment. This is done by a Switching Unit 15A which is provided on every 'wires only' telegraph private circuit. As is described in *TI E7 A3013*, it contains a rotary switch applying the following test conditions:

	Test conditions	
Switch position	*To PO line*	*To equipment*
1	Through	Through
2	Dis A and B	Dis T and R
3	Loop	Loop
4	Earth A dis B	Loop
5	Dis A earth B	Loop
6	Reversed	Through

Operation of the unit is very simple for the customer and he is usually willing to co-operate in testing the PO line to save a visit by a faultsman. All he has to do is lift the lid of the switching unit and turn the knob to the position requested by the testing officer at the RSC or other testing station and return it to position 1 for normal working at the end of the test. He will probably have used the switch to test his own equipment before reporting the PO circuit faulty and it is in his interest to co-operate in PO testing to keep down out-of-service time.

Not all customers are aware of the purpose of the Switching Unit 15A and how to operate it. Testing officers or visiting faultsmen should do their best to explain, pointing out that the table of test conditions can be found on the inside of the lid of the unit.

The Switching Unit 15A was introduced in 1971 and earlier versions did not have the line reversing facility on switch position 6. Visiting faultsmen should check that the facility has been provided, and if not arrange for a modified unit to be fitted. Works Spec TG 4438 covers the modification of units in service and the internal wiring of the unit is shown on diagram TG/TGW2192A. Incidentally, the modification was introduced partly as the result of an awards case.

Finally, it is important that the fitting of Switching Units 15A should be noted on circuit record cards so that testing officers are aware of their existence.

This article was written by Mr Hill before his retirement. Any enquiries about it, please, to:
Dave Butler, Sv7.1.2 (01-432 9159)

Electronic repairs by FacD

by **Ian Jackson,** P&S3.8.2

Over 300 different items of electronic equipment used, for instance, in PCM, Datel, SSAC9M, radio links, TV systems, and subscribers' apparatus, are now being repaired at London, Birmingham and Edinburgh factories.

Traditionally, Factories Division (FacD) has done most of the electronic repair work for the Supplies Division of P&S. The work is supported from factories headquarters process and development laboratories, whose job it is to interpret test specifications and quality assurance standards, and to design and build specialised test equipment and connecting jigs. To cope with the wide variety of different items now being handled a range of programmable automatic test equipments (ATEs) has been designed to assist in diagnostic testing down to component level and in functionally testing repaired units against performance specifications.

The facilities for diagnosing complex faults quickly and reliably and for comprehensive functional testing following repair have been so much in demand from engineers in the field for the repair of plug-in modules and other easily transportable items of equipment, that it has become a significant part of the electronic repair work of the division.

Until recently the procedure for requesting FacD to repair an item has used form A343. This is now to be used exclusively by P&S4.3 calibration laboratories for the repair of test equipment. With this change and the formalisation in *TI E1 D0520* of FacD's role in electronic repair a new form – F579 – has been introduced. The procedure for using it in sending items for repair is covered in *TI G3 B4005*. This TI includes appendices listing all items of electronic equipment for which FacD have repair facilities. For many of the items special packs are available to prevent damage in transit and the availability of these is also shown in the appendices.

We now hold pool stocks of many of the items listed and this means that you may not have to wait for your original item to be repaired – in fact, in an emergency, a telephone call to the appropriate factory can get you a replacement on its way even before you have made out the F579. Other items are handled by 'repair and return', but here again we are flexible and in an emergency will give the repair of an item overriding priority.

We aim to provide quick, efficient, low cost, high quality repairs to meet service needs. We keep items and their associated paperwork easily traceable both in the factory and in transit. This and the need to keep transit time to a minimum are the reasons why many items are collected and dispatched either in a FacD delivery van or by 'Red Star' rail services.

The EEs in charge of the electronic repair shops and their staff will always be pleased to discuss any general problems with the repair service we give or particular problems on the repair of specific items of equipment. Their telephone numbers are:
01-804 2400 x 280 for Brian Yallop at London
021-772 2361 x 2152 for Ray Meers at Birmingham
031-337 1221 x 273 for Peter Hughes at Edinburgh

If your problem on items repaired by us is a technical one our development laboratories may be able to help. Please contact Ron Dawes on 021-622 1580.
P&S3.8.2 (021-622 5546)

Remote printout for CFDEs

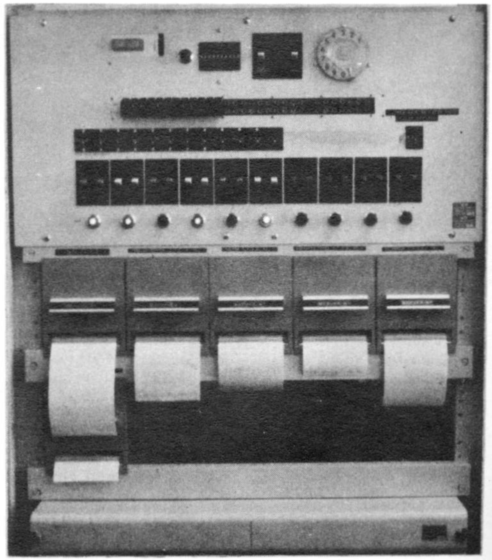
by **Ted Hall and Geoff Collins,** SETR

During exchange visits round the Region in 1973 it was found that call failure detection equipments (CFDEs) were often not being used. The reason usually given was that too much time was needed for analysing the printout from the associated printer meter check (PMC). So it was decided to try printing out remotely at Reference Centres. The staff there would get instant call failure information to help them in the drive to improve network performance. In true PO style we decided on the trendy initials REFPO (remote equipment fault printout) for the new equipment needed. The system was tried out at a GSC near London which, with its dependent exchanges, was giving below average local auto quality of service.

Since the majority of exchanges at the time were equipped with CFDEs no 1, printers were provided at the Fault Reference Centre (FRC) for each remote CFDE, so as to avoid loss of information due to observed calls on different exchanges overlapping.

The method of signalling the observed dialled digits from remote CFDE to FRC was chosen after a series of experiments. Loop-dis signalling was used over a two-wire link of maximum loop resistance 2000 ohms. The 'print' signal was an earth applied to the loop line.

The photograph of REFPO shows the printers for six remote CFDEs at the bottom, and the control panel at the top. Immediately above the printers is a row of 'busy' lamps, with test and monitor keys above. Next comes a row of 'total calls' and 'total faults' meters for the six circuits, then test and patching jacks. At the centre top of the panel, to the left of the dial and control keys, is a digit display unit. Top left are the controls for a loudspeaker amplifier, which can be used to monitor any of the two-wire lines.



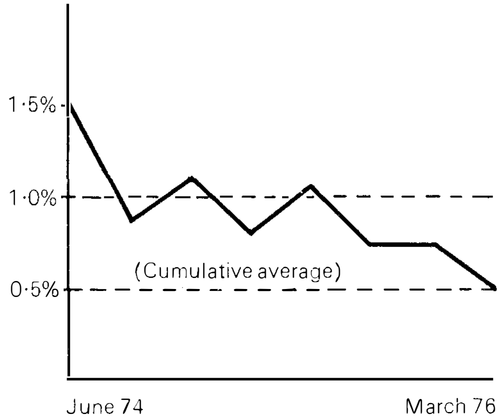
The printer is a commercially available item known as a 'Moduprinter', chosen for its comparative cheapness, simplicity and reliability. It provides the necessary memory, storing each digit of an observed call, resetting without printout on a 'good' call, or printing and then resetting on a faulty call.

Now that CFDE3s are rapidly replacing CFDE1s, REFPO could be simplified. The inbuilt memory of the CFDE3 is such that it needs access to a printer only when it has detected a faulty call. So it would be feasible to provide only one printer at the FRC for a maximum of, say, ten CFDE3s. There would be the possibility of losing overlapping faulty calls, but with ten circuits to a printer the risk would seem acceptably small. In any case, the 'total calls' and 'total faults' meters would show when this congestion was occurring.

Instead of the Moduprinter it might be possible to use a tester TRT 302 at the FRC. This is a portable digit display unit with printout. It would need to be modified to printout 'circuit identity' and 'fault identity' codes. The CFDE3 detects 'no tones', 'open trunks' and 'premature metering' failures and provides appropriate output signals. These would have to be detected and converted to operate the distant TRT 302.

The graph of the observed percentage of call failures due to plant defects for the six exchanges monitored by REFPO shows that there has been a steady improvement in quality of service. We would claim that call failure information given to the Reference Centre by REFPO has helped.

SETR/SM1.1.2 (0273 201237)



From central collation of printouts as described, a fault pattern may emerge which would not be obvious from printouts at individual exchanges. We see nothing against other Regions extending the use of CFDE3s in similar ways, provided the equipment does not interfere with service to customers, and the costs can be justified by results.

Use of REFPO with a printer per line does not make full use of CFDE3 facilities. However, the SETR design group see no great problems in implementing their proposals for one printer, preferably a modified TRT 302, to serve up to 10 CFDE3s.
J A Wood, Sv6.5.6 (01-432 1342)

Answer to the 3300B indicator problem

by **Roy Domville,** Sv5.3.2

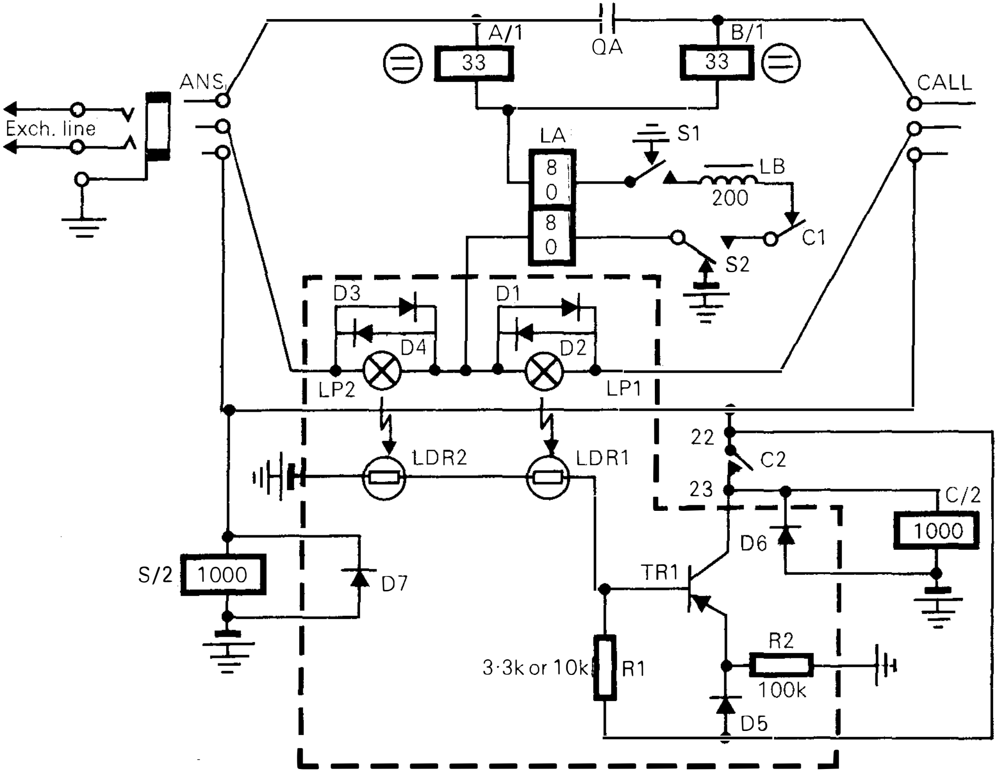
For many years the yellow supervisory indicator 3300B on 10+50 switchboards has been a maintenance problem because its small contact – which pulses when an extension dials through the cord circuit to the public network – has only a short in-service life. Contact failure results in the operator having no indication of through-clearing. This gives rise to lost calls, over-metering, service complaints, and high maintenance overheads.

Now Pye-TMC Components have produced a small semi-electronic device called a detector-driver, which eliminates from the circuit the contacts of a pair of cord circuit indicators. Since the indicator contacts are no longer used, through-dialling from extensions has no detrimental effect. There is no change in operating procedure.

All components of the detector-driver are shown within the dotted line in the simplified circuit diagram. LP1 and LP2 are miniature lamps protected from overload by diodes D1 to D4. They are separately encapsulated with light-dependent resistors LDR1 and LDR2. When either lamp lights, the light from it changes the resistance of its light-dependent resistor from approximately 200kohms to 20kohms. When LDR1 and LDR2 are both thus reduced in resistance, transistor TR1 turns on, operating relay C. Diodes D6 and D7 reduce the chance of an operator getting shocks from the sleeve of a plug.

To order and fit detector-drivers, follow works specification *S(W)2249*.

The combination of miniature lamp and light-dependent resistor is likely to have many other applications. The lamp and resistor will always be enclosed in a sealed unit, intended to be changed complete if it is suspected to be faulty. If in faulting you do take the cover off the unit and let the light in, you can expect some misleading results.
Sv5.3.2 (01-432 1383)



The independent local radio service

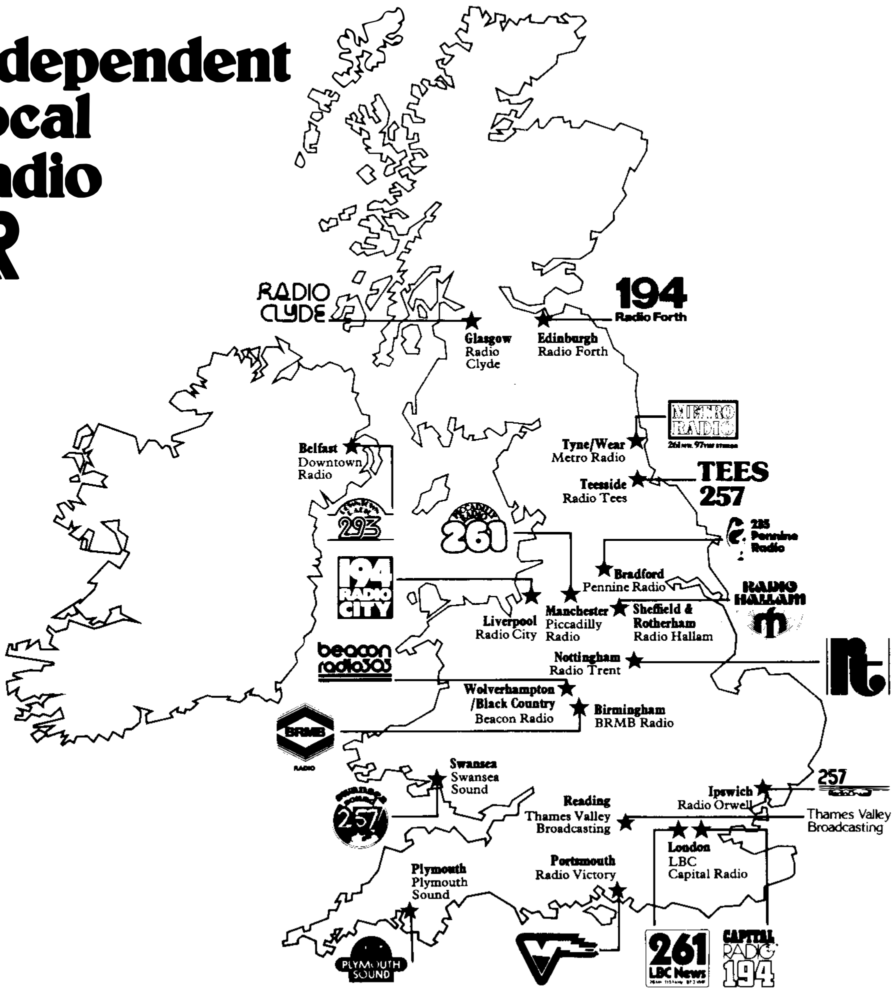
by **Bill Atkinson,** Sv7.3.3

Independent Local Radio (ILR) was first suggested under the Sound Broadcast Act 1964. Subsequently the 1972 Sound Broadcast Act enabled the Independent Television Authority to become the Independent Broadcasting Authority (IBA) with powers to set up the ILR service. The relationship between IBA and the local companies is basically similar to that for Independent Television; IBA is responsible for determining broad policy guidelines under which companies operate and for technical standards; while the companies are devoted to day-to-day programme production. The first ILR station (The London Broadcasting Company) went on the air in London in October 1973.

The opening of Beacon Radio at Wolverhampton on 12 April 1976 completed the present installation programme. Nineteen stations are now operational. At present this is the limit of the service but the Annan Committee are considering the future of broadcasting in the UK and may make proposals about ILR. The 19 existing

Independent Local Radio

ILR



companies are shown on the map. Each station feeds two transmitters, one in the VHF band carrying stereophonic signals and one in the MF band operating only to monophonic signals. National and international news items are provided by Independent Radio News (IRN) which is part of the London Broadcasting Company. The news is distributed nationally by means of a telex network and a programme circuit network.

The IBA has provided the transmitters, and rents the transmitter feeds and the news distribution networks from the PO. Each company pays an annual rental to the IBA for these services based on the population of their service area. When authorisation was given to set up a station in an area, the franchise was advertised, a specification published, applicant groups interviewed and a programme contractor appointed by the IBA. The time between the programme contractor being appointed and going on air was about six months and only a concerted effort by the Telephone Areas involved made it possible.

PO circuits

The stereophonic feeds to the VHF transmitters were the first permanent circuits of this type provided in the UK and so were a new departure for the PO. They are matched programme circuits of 15 kHz bandwidth, related in phase and level and generally provided on 1.27mm screened pair or polyquad 4. The amplifying and equalising equipment, designed by TD6.1.3, incorporates pre and de-emphasis and, on longer circuits, temperature equalisers.

The ILR service was planned to operate continuously, so no time for routine maintenance would be available on these circuits without the use of special make-good facilities. To ascertain the stability of the circuits, tests at monthly intervals were carried out by Area staff at London, Birmingham and Glasgow for a year ; IBA carried out a series of tests at these and other stations for the same purpose. Analysis of results showed that, except for the predicted variations due to temperature, changes in circuit parameters were extremely small ; and even the longest circuit (40km) remained within performance limits without need to adjust temperature equalisers. So it was decided that periodic routine maintenance on these circuits would not be necessary.

Conventional tariff M circuits are used for the MF transmitter feeds. Most companies rent local circuits to this standard for outside broadcasts from locations of interest ; for example football grounds.

The news network at present consists of tariff M type circuits in tandem, with spurs from the main artery to feed the peripheral companies. The circuits are maintained to individual performance standards ; overall limits, based on actual performance, have also been tentatively agreed with the IBA. This network is currently being re-planned by NPD to consist of multi-point circuits to an overall performance specification.

Operating experience

Generally the standard of provision and performance has been extremely good. Some difficulties have been encountered, the most significant being due to variations in layout of the equipment rack at the studios. This rack is the interface for all circuits between the contractor and the PO, and it would have been preferable if Areas had used a standard layout. This will be proposed for any future stations.

Most of the transmitter sites are Category 1 lightning risk. Although suitable protection was provided as proposed by TD6.1.3 as part of the stereophonic circuit development some circuits proved to be particularly prone to lightning damage. Investigation at the sites showed the problem was due to poor earthing arrangements and the inadvertent application of earth loops to the equipment rack. Closer attention to the earthing arrangements has shown a marked reduction in lightning incidents.

The availability of these circuits for the six month period from 1 August 1975 to 31 January 1976 is shown below, based on a 24 hour broadcast day.

Transmitter Feeds – Availability/circuit/annum	99.986%
News Network – Availability/circuit/annum	99.990%

The figure for transmitter feeds, which is poor in comparison with the IBA television sound network, reflects the fact that these circuits have no make-good facilities. Long outages occur in the event of cable failures, and the situation is aggravated by difficulties in gaining access to the transmitter sites.

The news feed availability figure may be improved in the future with the introduction of extra equalisation in the network of multi-point circuits. Fault reporting on the network has proved to be a considerable problem, mainly because each company uses the news feed differently from all the others and only monitors it for a few minutes at a time. A reported fault at any point on the network can therefore only be localised by checking along the route – not a simple task outside normal working hours. To assist the PO in localisation the London Broadcast Company, which is responsible for the news programme, agreed to check with other companies that might be affected when a fault was reported. However this system has not worked very well, and is expensive and time consuming for the Company. When the network is changed to multi-point a 24-hour-staffed station will be nominated as overall network control and other key stations will be designated sub-controls, thus following standard multi-point maintenance practice.

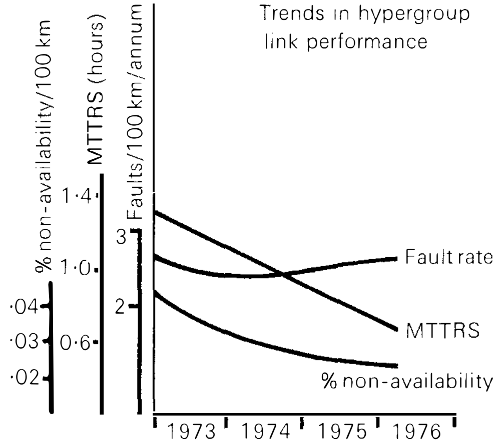
Sv7.3.3 (01-432 1430)

NCC News

Trends in hypergroup link performance since the beginning of 1973

by **Terry Farres,** National NCC

The major indicators of performance of transmission equipment in the trunk network are the fault rates and service restoration times on hypergroup links. Fault rates are conventionally expressed as faults per 100km per annum and restoration time as mean time to restore service (MTTRS) in hours. From these two factors a figure can be derived for percentage non-availability per 100km. The graph shows the trends since the beginning of 1973.



Increasing fault rate

From the graph it can be seen that there is an increasing fault rate starting in 1974.

Table 1 shows an analysis of failures for the financial years 1973/74, 74/75 and 75/76.

An increase in the number of hypergroup link failures is to be expected because the network is growing, but there have been exceptional increases due to faults (including those caused by working parties) on hypergroup translating equipment (HTE), to failures of hypergroups while temporarily re-routed, and also to hypergroup links being overloaded.

TABLE 1
Analysis of hypergroup link failures

	1973/74	*1974/75*	*% annual increase*	*1975/76*	*% annual increase*
Mean length of hypergroup links	72 500	83 000	14·5	95 000	14·5
Hypergroup link failures due to all causes	1 702	2 056	20·8	2 547	23·9
These failures are apportioned as below: Due to RLS failures (Coax and Radio)	1 323	1 557	17·7	1 609	3·3
Due to Translating Equipment	107	147	37·4	290	97·3
% of these due to working parties	9·3	16·3	—	31·4	—
Due to overload conditions	51	49	—3·9	114	132·7
Failures of Hypergroups temporarily re-routed	141	207	46·8	412	99·0
Number of re-routes	1 666	2 108	26·5	2 657	26·0
FNF	80	96	20·0	122	27·1

HTE failures
Over the period the amount of HTE in use has been increasing by about 30 per cent a year. The marked increase in failure rate is probably due to intensification of activity in terminal repeater stations, most work having to be done in normal staffing hours because of restriction on overtime working, and also to work in providing Service Protection Network (SPN) facilities.

Failures of make-good routes
Re-routes are mainly used to maintain service while planned works are done. Most failures are due to patching cords being faulty or being removed. The increase in failure rate is again attributable to the intensification of activity, most of the planned work that used to be done during the night and at weekends being now done during normal staffing hours and extending over more days. This longer use of temporary routing makes the hypergroups more vulnerable to interruption.

Overloads
Overloads are mainly caused during the setting-up of groups and supergroups when incorrectly high level tones are injected at distribution frames. The percentage increase shown in the table from 1974/75 to 75/76 is inflated by a few events which affected exceptionally large numbers of hypergroups, but overall there was an increase of some 50 per cent in events involving overloads.

Mean time to restore service
The steady reduction in MTTRS is due mainly to the use of the SPN – table 2 indicates progress. When full SPN facilities are available, service restoration by re-routing will become easier and quicker and a further reduction in the MTTRS can be expected.
Sv7.1.3 (01-357 2643)

TABLE 2

Mean time to restore service using SPN

	1973/74	*1974/75*	*1975/76*
Number of hypergroups re-routed	343	431	476
Mean time to restore service using SPN	1·40	1·23	1·19
Percentage of restorations less than 1 hour	49·0%	60·3%	63·5%
Percentage of restorations over 2 hours	23·0%	18·1%	13·9%

Computer assistance in SSC maintenance

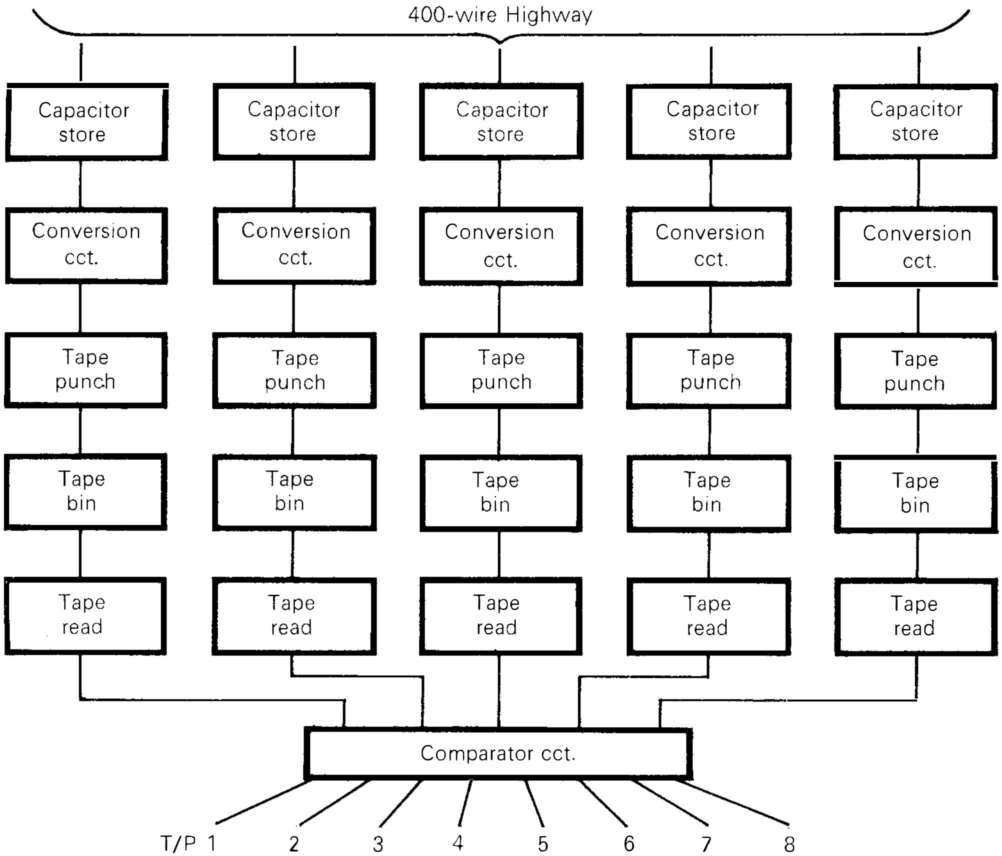
by **Ron Hough,** Sv6.4.5

An article in MN3 outlined the method of using a computer to analyse call failures from TXK1 exchanges to help the maintenance man locate faults. A brief description of the on-line computer system to be used at London sector switching centre (SSC) exchanges was given, and this article enlarges on that description. The system is expected to be operational by mid-1977. The interim system described in the earlier article, using the Barbican computer centre for overnight analysis, has proved a valuable aid in the maintenance of the first SSC units to open for service. This success of an off-line system bodes well for the use of on-line computers.

Equipment monitor
Failure information quantities expected from these exchanges are such that a single channel monitor would be quite unable to cope and many reports would be lost. Multi-channel monitors are therefore installed, one for each of the three separate TXK1 units in the SSC. Failure information is

transmitted from the exchange to the monitor on a common highway, from which it is taken rapidly into the initial capacitor store of one of five information channels. The highway then becomes free to accept another report, to be stored on another channel.

After conversion to teleprinter code the information is punched on to paper tape for longer term storage. The initial capacitor store is then freed. These storage facilities limit the number of reports which will be lost due to the equipment monitor being engaged.



The paper tapes from the five channels are read into a comparator, which routes each report to one of eight teleprinters. These are selected by the maintenance staff to receive reports sorted by the comparator according to fault type and equipment identity.

Computer analysis

It can be difficult to detect failure patterns from the mass of teleprinter printout from the comparator, and further sorting and analysis by computer is needed, as for TXK1 local exchanges. Off-line processing with its attendant problems of tape transport to the computer centre is, however, impracticable for exchanges of the size of SSCs because of the volume of printout. An on-line system has therefore been devised.

A local computer, linked to a central computer at Colindale exchange, will be installed in each SSC. This local computer will collect data directly from the equipment monitor after its conversion to teleprinter code but prior to the punching of the paper tape. It will give an immediate printout of urgent stored programme control – (SPC) reports, then compress the reports into a standard format for transmission over the data link to the central computer, receive analysed information back from the central computer in compressed form and produce in standard format all the reports prior to printing. The central computer will store all the reports and analyse over a 14 day period those relating to failures in the switching area of the exchange. Unlike the local exchange off-line system, this on-line system will print out a block of reports as soon as a pre-determined number, having common items of equipment, has been received

Analysis of a report

The computer performs the analysis by sorting progressively on different items within each report. Figure 2 shows the format of a typical call failure report. Basically, the top line contains information relating to the SPC register-translator equipment and the bottom line to the crossbar equipment. The computer considers the Program Address information together with the last two characters of the Transfer Register output to determine whether or not the failure has been due to the SPC equipment only, in which case the failure information is printed out immediately. Otherwise, the information in the lower line is now taken into consideration and the report is sorted and consigned to a particular location in the computer disc store, which can be looked upon as a 'pigeon-hole', to await the arrival of reports of calls which have failed in a similar manner. The store location selected for a particular failure is dependent upon the stage at which the call failed, as determined by the Router Control Sequence information and the identity of the items of equipment used. When five, or some other pre-determined number of reports involving the same items of equipment have been received, the information contained within the 'pigeon-hole' is printed out on the appropriate teleprinter together with a reference to a particular diagnostic card, which the maintenance officer needs for final location of the fault.

Some intermittent faults will occur so infrequently that a 14 day period will not produce sufficient reports for a diagnosis to be made. Such faults must obviously be causing very little trouble in the network, but if experience shows analysis to be desirable, the computer has sufficient spare capacity to permit extending the analysis period.

Routiners and miscellaneous

Transmission relay group routiners, metering over junction routiners, artificial traffic equipments and out of service detectors use the equipment monitor to record their

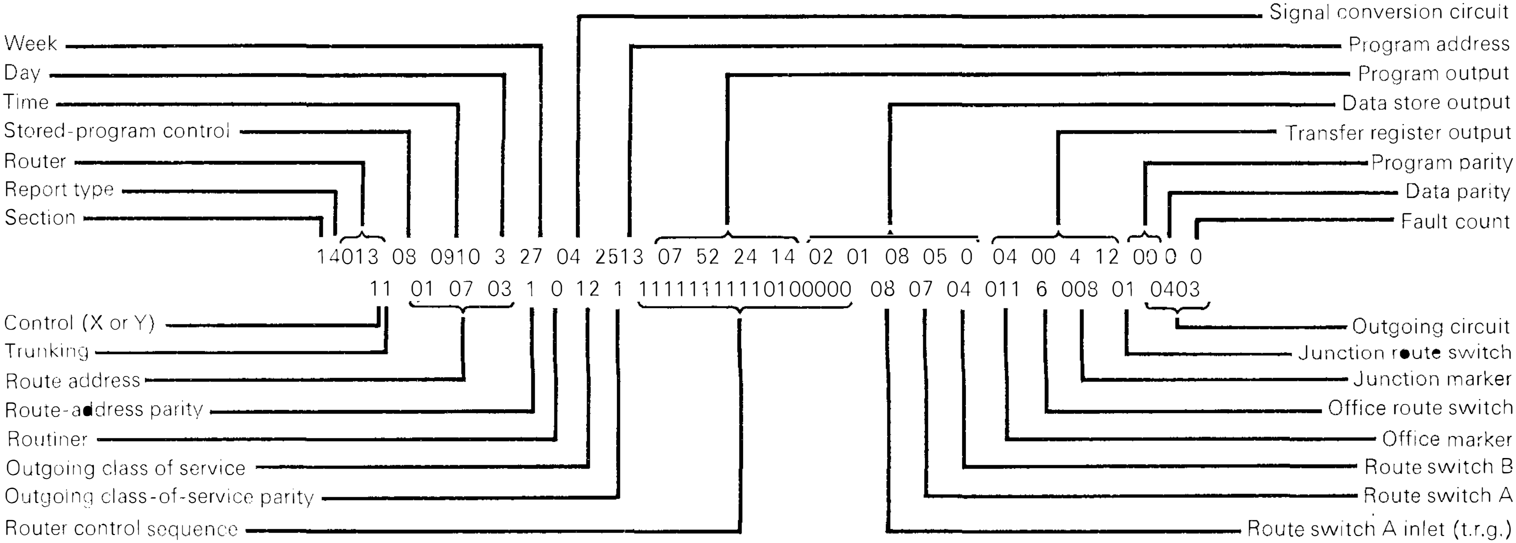


Fig. 2 – Typical printout of fault information

reports. These are sorted into work loads and printed out the following morning in the appropriate unit.

The trunk circuit routiner records its faults on an independent recorder on paper tape. After the night routining cycle, at approximately 4 am, the fault recorder reads this tape, to set the routiners up on the previously faulty circuits and re-test them. Those still proving faulty are recorded once again on the tape. These same functions will be performed by the computer, but the failures will be recorded in the computer store instead of on paper tape. As with the other types of routiner, the reports of still faulty circuits will be sorted into work loads and printed out in this case on a teleprinter situated in the Trunk Maintenance Control Centre (TMCC).

Routiner and SPC only reports, although already printed out, are stored in the computer for seven days so that repeat faults may be detected and brought to notice.

Counts of the different categories of information within the computer are made to provide statistics for management.

Diagnostic room

The existing monitor equipment and associated teleprinters are accommodated in diagnostic room individual to each exchange unit, which will become the focal point of the unit, its staff exercising overall control of maintenance activities. The output from the computer will be printed on only four teleprinters in each diagnostic room. There will be another teleprinter in the TMCC to receive the morning printout of trunk circuit routiner reports.

In the whole SSC at present, associated with the monitors and the trunk circuit routiner, there are 16 tape punchers and readers and 24 teleprinters. It is a considerable work load to service them mechanically and ensure that they are kept supplied with the necessary paper. The computer system will make all this paper tape equipment redundant and leave only 13 teleprinters.

Sv6.4.5 (01-739 3464 x 7764)

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 4034, Tenter House, Moorfields, London EC2Y 9TH. Say what you like but the Editor may tone comments down if he decides to publish. Do please give your full address.

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