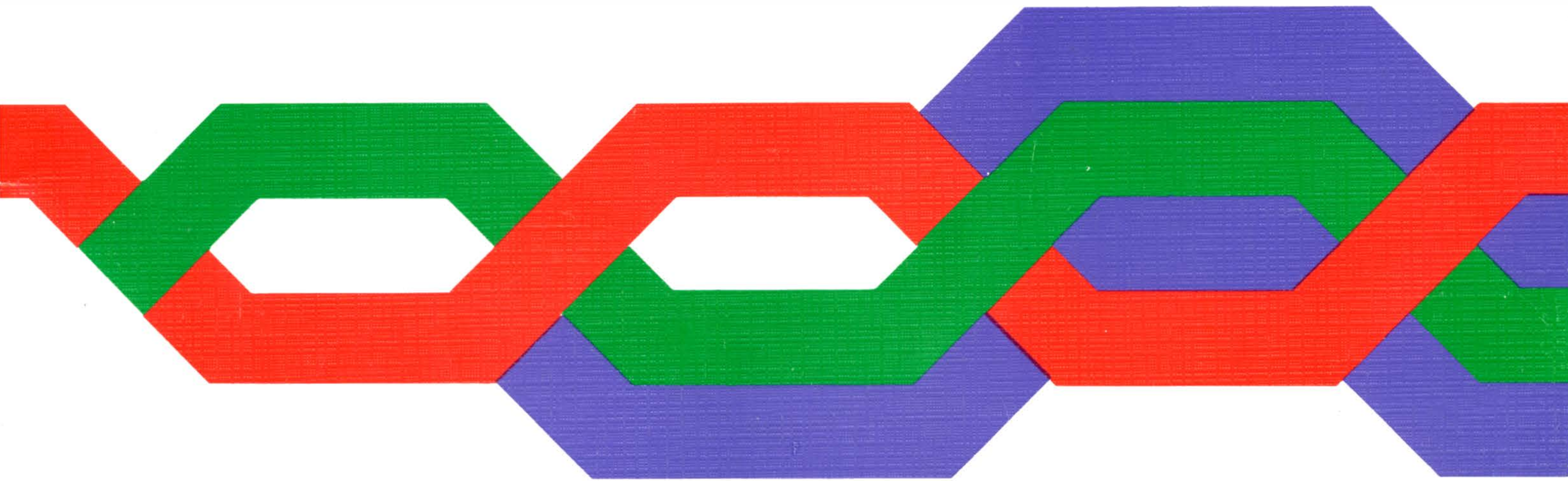
Post Office Telecommunications

Maintenance News 6

Autumn/Winter 1974



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Maintenance News 6

Editor D J Manning, (01-432 1380)

Room 4034 Tenter House
Moorfields, London EC2Y 9TH
Telex 88 30 51

Letters.

Distribution policy

While agreeing in principle with *Maintenance News* I think in these days of paper shortage and high costs it is a complete waste of PO money to issue it to every member of the maintenance staff.

E Sanderson, Newcastle

For the present it remains our policy to distribute to each member of the staff in the hope of encouraging maximum response from the field. The cost per copy is quite low, both in materials and in people's time. I have had many (and would like more) letters, mainly from AEEs and below, showing lively interest in the contents of the magazine. It looks like becoming a genuine means of direct communication between THQ and the man in the field. This is what its sponsors hoped – see the letters from top management in issue one.

Editor (01-432 1380)

Cross-connexion cabinets

The adverse observations of THQ/Sv5.1.1 on the MTR Shelves Distribution (in issue four) cannot pass without comment in defence! The need to 'rummage' for pairs only occurs among E-side pairs and these are colletted and stored to the side of the shelves. D-side pairs are located in permanent positions on the shelves.

The shelf type cabinet was introduced when faults due to loose pins, disconnected jumpers and low insulation on PC 100 assemblies accounted for a large proportion of underground service failures. The shelf principle overcame these faults, increased the capacity of cabinets by 50 per cent, dispensed with the jumper field, eliminated a tail joint, and showed a considerable cost saving.

R G Tungate, MTR/PLX2

I don't think our comments on the article 'Cleaning up the underground in Coventry' can be taken as questioning the overall benefits MTR have derived from the use of Shelves Distribution. The advantages you claim are fully accepted. The Coventry article does however, speak of rummaging for un-numbered pairs and this can occur amongst E-side pairs in shelf-type cabinets if collets have been lost off spare pairs or if records are incorrect and a pair to be picked up is already connected to a D-side pair.

We prefer that both D-side and E-side pairs be located in fixed, numerically identified positions and this is why Cross-Connection Strips no 1 were developed. This has the added advantage of being able to replace individual screw-type assemblies as they become faulty. To minimise the number of jumpers required we proposed some time ago that E-side pairs be terminated non-sequentially and this principle is now applied in T I A2 C1116.

E N Harcourt, Sv5.1.1 (01-432 1378)

Night routining

The objective (stated in the article in issue one) of routining every item of switching equipment every night needs to be challenged. As a planner I can see how much extra equipment has to be accommodated, often in limited space, as the quantity of equipment tested per routiner is reduced to meet this objective - to say nothing of the extra cost. Surely the number of routiners ought to be based on how many fault dockets can be dealt with next day? There is no point in accumulating too many dockets for the maintenance officer to cope with.

H S Garner, NWTB

The objective of night routining is not to provide a pre-determined work-load for the daytime, but to remove all service-affecting faults from the system before the morning build-up of traffic. When a routiner is first operated at night large numbers of dockets can be expected, but they can be reduced to manageable numbers by a systematic approach to fault clearance.

Some fully loaded routiners cannot make a complete test of every item each night and in these cases the routiner cycle is limited to functional testing on the week-nights, Monday to Thursday, full tests being done over the weekend. The SSAC 9 relay-set routiner is a special case, but the same principle applies: it is supplemented by the trunk and junction routiner, which makes a daily functional test of all SSAC 9 circuits, so allowing the relay-set routiner to continue its slower progress through the relay-sets, making full tests of each, including all limit tests.

There have been some reductions in the maximum permitted loading of routiners, but further reductions to meet the 'each night' objective are not envisaged.

K J Henley, Sv6.5.5 (01-432 1348)

Service observations

I have no doubt that when first introduced, telephone service observations (TSOs) gave a good idea of the quality of service provided by local exchanges, because most of the traffic terminated within the exchange of origin. With today's complex networks, however, so much traffic terminates elsewhere that this is no longer so and observations results reflect the performance of the network as a whole. Nevertheless, TSO figures are still used for management by objectives and failure to reach the target figure brings discredit on the exchanges concerned.

It is outgoing service that TSO figures measure and so there is a tendency for maintenance effort to be concentrated on outgoing equipment at the expense of the incoming equipment and service to the customer suffers. True there are maintenance aids such as call failure detection equipments (CFDEs) and test call senders which do help to improve incoming service; and I have heard that equipment is being developed to generate test traffic and provide a better measure of the quality of service being given. I hope that performance measurements obtained in this way will, in future, replace TSO figures; but meanwhile the use of these figures as targets is distorting the application of maintenance effort and I suggest this should stop.

R A Radnedge, LTR/CY

The TSO procedure was introduced in the early 1930s to measure the quaiity of the automatic service as seen by the customer - and customers do not as a rule distinguish between calls of different complexities, except that they tend to think separately about the STD service, which has been separately measured since the 1960s.

TSO results are intended to be seen as neutral measurements of our maintenance efficiency, not as guides for the direction of maintenance effort. In our complex network we have to find trouble spots by reference centre techniques (see issue three) coupled, as you say, with the use of CFDEs and test call senders.

In the future we will be introducing the measurement and analysis centre (MAC) system which will generate programmed test calls through the exchanges connected to the centre and produce call failure results separately for own exchange, local dialling area, and STD calls (see issue three again); and it will be possible to assess the quality of service incoming to individual exchanges. These results will become the means of assessing local performance targets in place of TSO results. TSO figures will still be taken, however, as measures of the quality of service seen by the customer.

It will take time for general introduction of the MAC system and meanwhile we will have to continue to use TSO results for setting targets.

A F Yaxley, Sv7.2.2 (01-739 3464 x7717)

Call office maintenance in Midland Telecomms Region.

Pay-on-answer (POA) coinboxes are more complex than older types of coinbox and more vulnerable to damage and vandalism. This, together with the modifications necessary for decimalisation, resulted in a steady deterioration in our public call office (PCO) fault rate, reaching a peak of 26 reports a year for every CO by 1971 / 72. Visiting each CO on average once every two weeks cost too much in labour and ways to deal with the problem over and above national equipment improvement programmes had to be devised. The national programmes dealt with equipment modification and strengthening, conversion to fluorescent lighting, introduction of the kiosk no8, polycarbonate glazing and testers TRT 240 for POA mechanisms. This article describes what MTR has done to deal with the problem.

Wherever possible, specialised functional PCO maintenance teams have been set up at the larger centres; usually these are controlled by specialist Report Control Officers (RCOs) at Repair Service Controls (RSCs). This has created staff interest, improved job satisfaction and more effective control. A Call Office Liaison Officer (COLO) has been appointed from the existing AEE complement in each Area to co-ordinate PCO work and to provide specialist coin box expertise. These officers form a Regional Call Office Quality of Service committee which is chaired by a level 2 officer from RHQ. The committee meets regularly to discuss PCO service and problems.

Because RWTs account for approximately half the reports processed, attention has been focussed on them. Analysis showed that over 90 per cent were continuous paytone (CPT), coin inserted NU tone (CINU), cut off after money inserted (COAM) and coin slot jammed reports. Many abortive visits were being made to test PCOs following these reports, causing staff frustration and poor productivity. Further investigation produced positive evidence in one Area, with support from others, that some 75 per cent of such reports were not faults at all, but either deliberate or accidental misoperation by customers. Arrangements were therefore made with operating staff to pass CPT, CINU and COAM reports to the Fault Reference Centre (FRC) instead of to the RSC. Here a matrix of the fault intake shows the common location, if any, of several reports such as a particular PCO or telephone exchange. PCO's are not visited at the first report but passed by the FRC to the RSC or exchange for attention only if a given number of reports are received within a certain time, the number and time scale being decided in the light of local circumstances. Coin slot jammed reports are passed direct to the RSC and half of these turn out to be RWT. As a field trial in two Areas such reports are recorded by the RCO but no action is taken unless a second report for the same PCO is received on the same day or next day - then normal attention is given. In this way abortive visits are avoided in the majority of cases where no fault exists or the FRC matrix suggests an exchange fault.

In some Areas a modified A1053 procedure has been introduced. Whenever a PCO fault history card becomes full it is passed to the supervising officer for examination. A cursory inspection shows whether excessive faults have occurred and whether any special action is needed. This could be increased frequency of cash collection, replacement or re-siting of badly vandalised kiosks, systematic routine inspection, staff training or identification of equipment requiring attention or redesign. One advantage of this procedure is that all PCO fault cards are inspected at intervals proportional to the fault rate.

Serviceability checks were made in several Areas: maintenance AEEs visited PCOs at random on a pre-selected day. Test calls were made and a questionnaire completed; this provided valuable information on the condition of the installation as well as realistic quality of service data free from reports due to customer mis-use.

At exchanges the POA mechanisms used to test CFC relay sets were overhauled regularly every six months.

A prolific cause of service failures, mainly intermittent in nature, which results in much wasted effort in overhauling coin box mechanisms and CFC relay sets, is the production and detection of the end of coin

Ken Mitchell of Leicester attends a fault at a kiosk no. 8

pulse train 60 mS disconnect signal. An analysis of service affecting faults on POA mechanisms in MTR showed that some 11 000 faults a year were attributed either to the mechanism ON 3 springset, or to the mask springset adjustments which generate the disconnect signal. This signal was considered to be unnecessary, a circuit modification to the CFC relay set was devised to remove the facility, and a Regional works specification issued to modify all MTR's relay sets to AT 5716. This is still being carried out. The PCO service of two exchanges now modified was monitored, and the results showed that cut-off reports of this type had been reduced by half with no adverse effects.

The standard steel conductor handset cord is inflexible, subject to early fracture, and difficult to change. An MTR design of handset cord is now being constructed locally at most coin-box overhaul centres, and brought into use throughout MTR. This consists of a normal handset cord contained in a flexible stainless steel tube. Experience so far shows that it is at least as robust as the standard steel cord and much less prone to fracture and vandalism.

Finally Head Postmasters were reminded of the importance of rigidly adhering to cleaning schedules, so reducing the temptation of children to jam slots with rubbish. Contract cleaning at some centres is proving more effective than direct labour.

These measures have combined to drastically reduce the PCO fault rate in MTR to 17.8 reports a year for each call office. In addition the manhours saved by reducing abortive visits has not only allowed more time for routine maintenance but also reduced the manhours spent on each CO. In 1971/72, 28.11 manhours were spent on each CO, now the figure is 24.69 - a reduction of 12.2 per cent.

R F Smith, MTR/SM 2.6 (021-262 4040)

Some of the measures described in the MTR article are typical of those adopted in all Regions. Others are those in which MTR is co-operating with THQ in trials and experiments. These should not be introduced in other Regions except on advice from THQ.

D Webb, Sv 5.3.5 (01-432 9386)

Batteries in telephone apparatus.

As electronic circuitry is introduced into customers' apparatus, such as self-contained keyphones, subscribers' carrier equipment, and future designs of autodial, a need has arisen to provide power for operating the circuits independent of the mains supply. This has been achieved using nickel-cadmium batteries inside the instrument, kept fully charged by trickle-charging from the line or from a power unit. On charge, a battery draws 3mA via a 15 kΩ shunt across the line. A 'throw-off' circuit detects changes in line potential and disconnects the charging circuit for one minute, for instance when the handset is lifted or the line is tested by an insulation routiner (LLIR) or by the subs app and line tester (SALT).

Batteries used in the first generation keyphones made by GEC and TMC have been accepted as standard for telephones; they are 4.2V and 7.2V respectively giving a current of 15-20 mA on load. Subscribers' carrier equipment uses a similar battery of 10v giving a load current of the order of 50 mA.

Early versions of these batteries were made with a shrunken sleeve covering. New types designed to a PO specification for use in second generation keyphones are enclosed in plastic boxes colour-coded for ease of identification. The GEC-type is coloured red and coded 'Battery, Secondary no 22' and the TMC-type is blue and coded 'Battery, Secondary no 23'.

To ensure that batteries are fully charged when issued, a charger-dispenser which can hold ten batteries has been developed, something like a cigarette machine. Batteries are put in at the top and removed from the bottom after a pre-determined time; the keyphone charger is coded 'Battery-charger no 4'. A similar device is being developed for subscribers' carrier equipment.

A drawback of using these batteries is that there is no way of determining the state of charge, the voltage remaining constant until it drops sharply when the charge is exhausted. The only way to be sure of the state of charge is to discharge the battery and recharge for a predetermined time.

In our limited experience – two years' service in GEC keyphones – nickel-cadmium batteries have proved reliable and their estimated life is six to eight years. It is, nevertheless, PO policy to eliminate batteries in future development of telephone apparatus. This will simplify wiring, the cost of the maintenance visit to change the expired battery will be eliminated, and there will be no need for arrangements to supply fully charged batteries to field staff.

The keypad Trimphone developed by STC is to be put on trial this year in the LTR. This instrument uses a capacitor to store enough charge from the line to power the electronics, and it is expected that all future self-contained keyphones will use this type of circuit.

A B Lion, Sv 5.3.2 (01-432 9282)

Identifying fault-prone PBXs.

In considering any scheme for preventive maintenance a method of identifying fault prone plant has to be applied. It has been calculated that the customers' apparatus fault rate on business connections is about four to six times that on residential connections. A high proportion of these faults are at PBXs, both on switchboard equipment and on extensions. Regular routine maintenance of switchboard equipment helps to reduce faults here but though this has been tried on extension equipment no improvement results. Certain extensions are fault prone and these can be the cause of a high SU fault rate: one PBX had 53 SU faults in one year on 45 extensions, 26 on just six extensions. A concentrated effort to remove the basic cause of faults at these six extensions would produce a great improvement in the fault rate.

With the present method of recording faults on PBX and PABX extensions it is not easy to identify rogue extensions; relying on memory alone to produce a list of high-fault PBXs is not accurate enough. A simple system of pin-pointing those installations with a high fault rate is needed - such a system has now been introduced at a number of RSCs in the SETR.

A703 fault cards are made out both for common equipment and extensions, except in the smallest PBXs and PABXs where one card is adequate. One line of the fault card is used for each individual complaint. The number of lines available is such that if the card is completed within one year further action is taken; this is equivalent to a fault rate of 0.40 to 0.50

Briefly what happens is that when the RCO makes an entry on the last line of the fault card he notes the date of the first entry. If it is within one year the card is earmarked for scrutiny and an analysis is made of all entries during the period. To make this simple a special form has been devised which when completed shows at a glance the rogue extensions or apparatus. The fault histories of these extensions are then examined to see whether there are any fault patterns which the primary faultsman may have missed. Using this simple procedure, information is easily gained to enable purposeful and directed preventive maintenance to be applied.

Using this technique the small proportion of extensions which produce the majority of faults are clearly identified, and the trouble is automatically brought to light as soon as complaints rise above a predetermined level. Another advantage is that time consuming detailed analysis is only undertaken when necessary, keeping labour costs to a minimum.

J A Harrington, SETR/SM2 (0273 201518)

Maintaining the new 60 MHz cables.

The laying of the first coaxial cable between Birmingham and Manchester for the 60MHz FDM systems will begin at the end of 1974. A second cable will follow between Birmingham and London.

These lead-sheathed, polyethylene-protected cables will have 18 2.6/9.5 coaxial pairs.* In tunnel sections, and where they are fed into surface stations, they will be laid as three separate six-pair cables. These smaller cables will have a special 'alloy B' lead sheath and this will also be used for all maintenance lengths as well as anywhere the cable is likely to be subject to severe vibration. The alloy imparts a stiffness to the sheath and helps to prevent creepage and sag between cable bearers.

Two 102mm PVC duct ways are being provided over the major portion of the routes, buried at 1.2m (double normal depth). Spare ways for maintenance purposes are being provided where over-ground provision of interruption cable would not be possible.

Providing these cables poses several new maintenance problems: a very high degree of serviceability is essential because of their very high circuit capacity. As initially equipped for 60MHz FDM, every two coaxial pairs (one for each direction of transmission) can carry up to 10 800 circuits, but the cable is being manufactured to a very stringent specification so that eventually it may be used in a digital mode at frequencies up to 500MHz, when its circuit capacity will be substantially greater.

By far the greatest proportion of service-affecting coaxial cable faults is caused by damage, either by outsiders or by ourselves. This danger should be reduced on the new cables as they are being buried twice as deep as before, routed as far as possible clear of areas likely to be subjected to civil engineering activities, and segregated from other cables. In addition, a polyethylene warning tape is to be buried 300mm beneath the ground surface over the track to deter would-be excavators.

The depth of the ducts, although giving an extra degree of protection against damage, has its disadvantages. Access to the track will require a relatively large excavation which will need shuttering. Perhaps we should be thankful that the practice adopted in Japan, where they have buried similar cables at over twice our depth, is not being followed.

Every effort will be made to repair cables on site. The alternative of renewing lengths is daunting. For instance, the cable is being provided in lengths of up to 550m, requiring cable drums of 2.7m diameter (nearly nine feet) and 7200kg weight (over seven tons). Suitable winches and vehicles are being made available for dealing with these massive drums, and a robust 2.4/15.8 solid dielectric interruption cable has been developed.

When a coaxial pair is to be repaired *in situ* it must first be positively identified by following a strict three-stage procedure in conjunction with staff at the repeater cases on either side of the fault. This is needed because the coaxial pairs are random jointed on installation to prevent joints becoming unwieldy. The procedure ensures that the coaxial pair to be worked on is completely isolated at each end of the section and that power cannot be inadvertently connected to it. While the pair is being repaired the remaining working pairs are still fed with power at up to 1 000V, but the power feeding system is so designed that under the most adverse conditions if contact is accidentally made with a live conductor the current is limited to a low level and power is cut off within accepted time limits.

In an 18-pair coaxial cable, attention will occasionally be required to the inner layer of six coaxial pairs. To gain access, some of the outer layer pairs will have to be pieced-out. Short lengths of prepared flexible single-pair coaxial patching cable, which can readily be jointed in to the obstructing pairs, enabling them to be moved away from the faulty pair, will reduce this problem.

Coaxial conductor repairs will be carried out with the aid of repair kits made up in packets, comprising special split ferrules, insulating disks and shrink-down sleeves. These will enable joints to be brazed and completed more efficiently than by using former techniques.

**A coaxial pair is what was formerly known as a coaxial tube.*

Unlike earlier coaxial cables the first 60MHz cables will not have their repeater cases pneumatically isolated. Contactors will be fitted at each case, monitoring both the case and cable pressure. There will be a pneumatic switch to isolate the case for maintenance purposes. When low air pressure causes a contactor to operate, it will extend an alarm signal to the control station, identifying itself by means of its associated electronic equipment. Timing circuits will be actuated and a print-out will indicate the sequence and timing of subsequent contactors operating. From this information estimations will be made of the location of the leak to within 200m and of the approximate rate of leakage. A more precise location can then be arrived at on site

Cable winch unit

by the preparation of a pressure gradient graph. The leak will be cleared using existing techniques.

The repeater cases (CR 6A) to be used for the first 60MHz cables are very different from our existing cases, not least in cost. They are constructed of silicon-aluminium alloy, coated with nylon, and to guard against damage to the nylon coating they will be individually cathodically protected. They will be sited in modified MR11 manholes and many of them will thus be normally under water. Their nominal spacing will be 1.5km with three 500m lengths of cable between successive cases. The two intermediate joints will be housed in modified MR2 or standard MR11 manholes.

The laying of the first 18 coaxial pair 60MHz cables not only means a very large PO expenditure - we also face a considerable challenge in the external field to maintain them.

D W Finch, Sv5.1.2 (01-432 1306)

Introduction to data transmission and Datel services.

Data and data transmission have acquired in recent years important and specialised associations with computers and similar equipment. But read on, for data transmission in the modern sense only means the transfer of information over distances by electrical means. So the techniques involved are not entirely unfamiliar to telecommunications engineers. Indeed it might be said that it all started with telegraphy more than a century ago. Modern data transmission makes increasingly extensive use of the PO tele-communications system and all maintenance staffs have some part to play in its success.

As in telegraphy, the information to be transferred from A to B is in coded form; it also commonly involves machine to machine communication, which is usually less tolerant than human beings of any shortcomings - but more of this later. In passing it is interesting to reflect that coded transmission is pretty old in itself - smoke signals and tom-toms might reasonably be regarded as primitive forms of data transmission over a distance.

A particular feature of modern data transmission is the adoption of the simplest way of representing information and transmitting it, namely by the two-state or binary method (on or off, positive or negative, frequency x or y) to record and transmit the information, instruction or data.

Taking everyday numbers (digits) as an example, these are based on 10, the denary system. They can be represented in a binary form as follows:

Denary number	Binary equivalent
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
and	
999	1111100111

Binary digits are abbreviated to *bits* and the 0 and 1 elements can, of course, be represented and transmitted electrically in many ways. Obviously the various combinations and sequences of 0 and 1 can be arranged to represent letters (alpha-numeric coding) or indeed any type of information needed by the users of bits. It happens that bits is the electrical language used by computers, for example when storing information on magnetic tape and doing calculations; and it is probably fair to say that much of the jargon in data transmission and services derives from their close association with computer applications. But other applications of bits will be familiar to maintenance engineers in other fields, for example PCM systems, in which the speech signals are encoded into bits for transmission purposes, and at the receiving end decoded into speech signals. Even the method of identifying a wire in a cable by testing for the presence or absence of a battery is a binary method of receiving information.

One advantage of the two-state signal is that it can normally be readily recognised through a background of noise, for the signal representing 0 or 1 is either there or it is not. But unhappily an interfering signal which looks like a 0 or 1 signal cannot be distinguished from a genuine signal and, unless precautiouns are taken, can alter the information and cause errors; for example, if 110101 were the code for 'switch on' it might be changed by interference into 110111, which might be the code for 'switch off'. So beware of disturbing circuits carrying data transmissions — they are not so tolerant as speech transmission of the odd clicks and bangs!

It will be realised that sending a long sequence of bits would be expensive in circuit time unless done at high speed: the more bits per second the greater the rate of information transfer and the shorter the time the circuit is used for a particular piece of data. As you never get anything for nothing, it is a fact of life that the higher the speed the wider the bandwidth required of the circuit. Hence low speed data signals up to 100 bits per second (such as 0 and 1 transmitted as positive and negative dc signals equivalent to a 50 Hz square wave signal) can go over a teleprinter circuit or telex - but a 4800 bit/s data transmission currently needs a high-quality speech-band circuit. Of course, it is not possible to use dc on such a circuit and the binary signals have to be transformed into voice frequency signals.

These data transmission services are called Datel services - data over telephone circuits - although the term is now used more generally and not limited to telephone circuit use. It is a responsibility of the Telecommunications Business to provide and maintain effective means by which data can be carried over the PO telecommunications system. The data-handling staff, and the equipment to generate and process the data are, in general, the responsibility of our customers.

In later issues of *Maintenance News* we intend to describe some of the applications of data transmission and talk about the ways in which the PO provides and maintains the various Datel services.

B N S Allen, Sv 7.1.2 (01-432 9155)

Radiophone service.

The first radiophone service was introduced in the South Lancashire area in October 1959. It was a small system, employing five traffic channels and one control channel over which the radiophone operator would call the mobile customer to set up the connection. Each channel had a separate 'go' and 'return' frequency but the mobile had a press-to-speak key, which made the system simplex in operation. A larger system was opened in July 1965 to serve the Greater London area, with nine traffic channels and selective calling over the control channel.

With both these systems, the time to set up a call could be quite long and in built-up areas they suffered from ignition interference. Neither system could offer the customer privacy from other mobile customers who might wish to overhear a call. To overcome these drawbacks and to expand the service to cater for more customers, radiophone system III, was designed

Radiophone system III

This system became operational in London in April 1972; it worked alongside the original system until December 1972. During this period new customers were put on system III and customers on the old system were gradually transferred to the new system. By January 1973, system III had taken over the whole of the London service and the original system was recovered.

London radiophone system III has four radio stations, three sited at the same locations as those of the previous system. The fourth is a new station added to improve the coverage of central London. The central radio station has been equipped with traffic channels only, since the control channel coverage in the central area from the outer radio stations is quite adequate.

Mobile equipment

The mobile equipment usually consists of two interconnected units: one unit houses the transmitter and receiver and is mounted in the boot or some other convenient place in the vehicle; the other unit, which has the channel selector, handset, on / off switches and call button, is mounted on the dash-board. The mobile equipment is capable of operating on ten channels, one of which is the control channel and the remainder traffic channels. When the equipment is switched on and is not being used for a call, it monitors the control channel frequency awaiting its particular coded calling signal. Each mobile has a unique five digit radiophone number assigned to it.

Making radiophone calls

The best way to illustrate how the new system works is to describe how a radiophone call is set-up. Following a request from a customer wanting a radiophone number, the operator at the radiophone centre keys into the control channel the five digits of the wanted number. The control equipment converts each digit to a specific audio frequency tone. The resulting train of five tones is sent over land lines for sequential transmission from up to three of the radio stations for the radiophone area. To simplify the design of the selective calling decoder in the mobile equipment an eleventh tone, called the repeat tone, is used for the second of two identical digits when these occur in succession in a radiophone number

If the wanted customer has his mobile equipment switched on within the boundary of the radiophone area, on receipt of a correctly coded calling signal a lamp and a short audible alarm operate. At the same time the mobile equipment automatically transmits an acknowledgement signal tone on the return path of the control channel to the radiophone centre. When it is convenient for the customer to answer he selects an appropriate free traffic channel and presses his call button. Because the equipment has received a call from the operator it is primed to respond with a burst of tone at a specific frequency, which is detected by the equipment in the return path and causes the response lamp to glow on the traffic channel at the radiophone centre. This indicates to the operator, who may not be the one who originated the call, that the customer calling on this particular traffic channel is doing so in response to a call from the centre. The operator asks the customer for his radiophone number, and finds out from the operator who has the call in hand the incoming circuit to which the mobile customer should be connected.

A mobile customer originating a call similarly selects a free traffic channel, but in this case a different tone is transmitted back to the radio station when the call button is pressed. The tone is detected and causes the originating lamp to glow on the traffic channel at the radiophone centre. The answering operator then follows the customer's request in the usual way.

Radiophone centre

The radiophone centre is housed at an auto-manual centre (AMC) with sleeve-control switchboards. A number of positions, usually four, located near the centre of the radiophone suite, have access to the control channel equipment. These are the booking positions handling incoming calls for the service from the public switched telephone network (PSTN). The remaining positions in the suite, the controlling positions, handle traffic from the mobile customers. All positions have access to all the incoming circuits from the PSTN and to the traffic channel multiples.

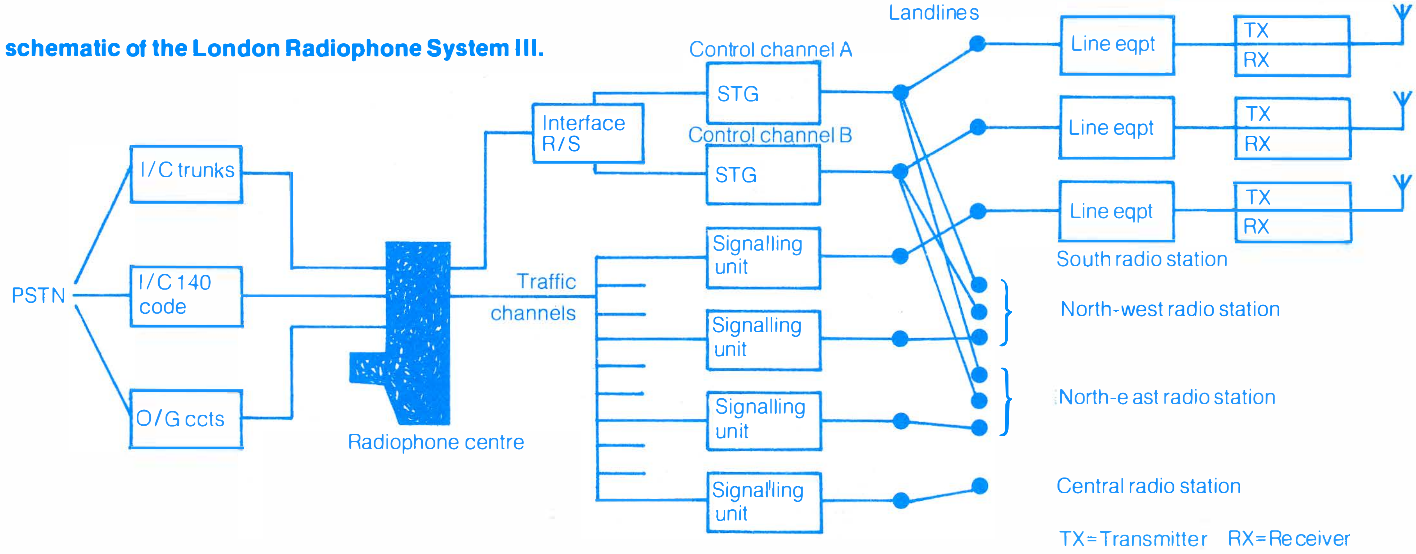
Control channel equipment

The control channel equipment consists of two identical four-wire circuits to each outer radio station, which are used on alternate days. Each control channel go path has a proprietary design of sequential tone generator (STG) which uses solid state transistor-transistor-logic (TTL) circuitry based on integrated circuits. The STGs are located in the control exchange, which is in the same building as the AMC. The digits keyed into the STG are converted into tones which are sent over land lines to the radio stations. Transmitter keying signals are also produced by the STG and sequentially turn the control channel transmitters on and off.

In the return path of each control channel is the acknowledgement tone detector. In the London system this is located at the radio station and phantom dc signalling is used; but in the provincial systems it is in the control exchange and ac signalling is used.

Different routes are used where possible for the A and B control channel land lines to avoid disruption of the service by cable breakdowns.

Block schematic of the London Radiophone System III.



Traffic channel equipment

Every traffic channel appears in the switchboard multiple as a two-wire circuit, but it is converted to a four-wire circuit by the hybrid in the signalling unit at the control exchange. To ensure that an adequate degree of modulation is obtained from the PSTN for the FM radio transmitters a constant volume amplifier is inserted in the go path. Also in the signalling unit is the re-radiation suppressor, which prevents speech from the mobile customer going out to the radio station transmitter by inserting a high degree of attenuation into the go path. Each traffic channel is connected by land line between the control exchange and the radio station at which its transmitter and receiver are located. The 'call, respond and cleardown' tone detector unit is in the return path and, depending on the type of signalling used, it is located at either the radio station or control exchange.

Radio stations

The radio stations are sited on high ground or high buildings so that the transmitting and receiving aerials give a good coverage. The number of traffic channels

London Radiophone area of coverage

assigned to each radio station is related to the amount of traffic the station handles. There are also A and B control channel transmitters and receivers at the radio stations, except at the central radio station of the London system, which has no control channel equipment.

Test mobiles

Two test mobiles, which are modified maritime VHF transceivers capable of receiving 60 channels, are sited within the radiophone area, usually at the control exchange with their aerials mounted on the roof.

One of the test mobiles is permanently tuned to the control channel and is given a special radiophone number. An operator can check whether a particular radio station is radiating the control channel by inhibiting the other radio stations of the system using a special key in the switchroom, and then keying the radiophone number of the test mobile into the control channel equipment. If the equipment in the control exchange and the appropriate land line and radio station are functioning correctly the operator gets an acknowledgement signal back from the test mobile in the usual way.

The second test mobile acts as a standby for the first and is also used for routining the traffic channels and other maintenance purposes.

Maintenance and repair

Radiophone customers can either hire their mobile equipment direct from the manufacturers, or buy it outright. Although equipment is built to meet a PO specification, it is the responsibility of the customer to ensure that equipment is repaired and maintained.

The radiophone equipment at the AMC, control exchange and radio stations is maintained by PO staff except for the proprietary STGs. These have been placed on a short-term maintenance contract with the manufacturer, because although they are highly reliable they are also complex; and because there are, at present, few of of them. During the period of the contract PO expertise will be developed so that STGs also can be maintained and repaired by PO staff.

Expansion

Radiophone system III has been operating in the South Lancashire radiophone area since December 1973. The original system there still has a number of customers on it but these are being gradually transferred to the new system.

The Midlands radiophone service, which serves Birmingham and Coventry and their environs, opened in August 1974. A further four radiophone systems are planned to open in the near future to serve South Wales and Bristol, South Yorkshire, Newcastle and Teesside, and Glasgow and Edinburgh. It will be possible for any customer to use his radiophone in any of these areas but he may find that the number of traffic channels available to him in certain areas may be restricted compared with his home area. Each customer is issued with a channel selector card that shows which traffic channels are available when travelling outside the home area.

R P Burns, Sv6.5.3 (01-432 1302)

The PO wideband cable TV distribution scheme.

Since the PO entered the cable television field in the mid-1960s it has gained considerable experience in the development of distribution schemes of this type. The PO has the advantage of being able to share duct space and other external hardware between the telephone network and the new TV cable system; but so far the cable TV systems have been restricted to new town developments. The first scheme was based on the use of frequency division multiplexing (FDM) techniques on coaxial cables capable of transmitting frequencies up to VHF. Introduced at Washington (NETR) and followed by Irvine (Scotland) and Craigavon (Northern Ireland), all three systems distributed TV signals to subscribers' premises at VHF – suitable for reception on 405-line standard receivers or modified 625-line UHF sets. With the planned phase-out of 405-line sets and the large increase in single standard 625-line UHF monochrome and colour receivers, it was decided that distribution to the subscribers at VHF was not satisfactory in the long term. Therefore in 1972 a hybrid scheme was evolved at Milton Keynes (ETR) based on the VHF systems for main line working, but distributing TV signals to the subscribers at both 405-line VHF and 625-line UHF; this allowed most commercially available receivers to be used without modification. The hybrid scheme proved to be very successful and subsequently plans have been made for the conversion of the existing VHF systems to hybrid working. The following description is based on the Milton Keynes hybrid scheme.

At present the systems are restricted to the distribution of normal broadcast TV and radio programmes with the possibility of additional local interest and educational channels being available in the future.

The System

The TV and radio signals are received 'off air' at a carefully located aerial site called the headend. The headend is a mast, usually 30m high, with individual channel antennae feeding down to modulators, amplifiers and combining units. The signals are transmitted along the main coaxial highways from the headend at VHF (30-270MHz). The reason VHF is used is that the transmission loss at UHF is high and therefore the UHF portion of the system is kept to a minimum; translation to UHF takes place near the subscribers' premises. The main highways have wideband amplifiers placed at approximately 400m intervals which are dc power fed along the coaxial cable. The maximum number of amplifiers used in tandem is at present limited to 12 by system transmission parameters. The translators, which can supply up to 80 subscribers' outlets, retranslate the incoming VHF signals to UHF (450-750MHz) for distribution to subscribers. All line equipment is mounted in footway boxes, cabinets or in specially made cavity wall boxes in subscribers' outside walls. The whole scheme uses underground cable distribution terminating on a standard double socket TV/FM radio outlet plate inside the subscribers' premises.

Maintenance

The PO must provide a good service for the TV systems as subscribers are usually very soon aware of system faults. The maintenance team relies mainly on subscribers reporting faults to a centralised fault control to locate failures. As viewing times do not coincide with normal PO working hours, serious faults affecting many subscribers have to be dealt with by call-out. The high percentage of faults reported as system faults which subsequently prove to be subscribers' receiver faults will have to be accepted as normal for this type of maintenance until a solution to this problem can be found. Single fault reports are usually attended to within 24 hours. Most faults other than obvious system faults usually require visits to subscribers even if only to satisfy the subscriber of the availability of system signals. To do this portable TV receivers are used including a colour receiver for colour faults. These monitor sets are also used to make routine observations of picture quality on the system. The day to day maintenance man also uses a sophisticated level-measuring set when faulting or doing routines.

To check overall performance of the main highways a sweep frequency measurement is made at six-monthly intervals. The sweep frequency generator is plugged into the headend in front of the launch amplifier at off-peak viewing times and measurements made progressively along the routes using an oscilloscope at amplifier points. Any necessary adjustments can then be made for gain or equalisation down the route, keeping the system within the accepted transmission limits.

The line equipment has so far proved to be reliable, the few major failures being due mainly to external causes such as cable damage by digging equipment or amplifier flooding during a storm.

Future development

The aim for the future is to move towards an integrated local communications network of which the coaxial type of cable system could form an important part. One of the latest developments of interest to maintenance engineers is the use of a 'back path' through the system for sending back information to the headend in the reverse direction to normal transmission from the peripheral distribution points. When this facility is initially provided it will be used to transmit system alarm information to the headend.

Cable television will continue to expand from the 2 000 000 subscribers already on various commercial systems in Great Britain today, and the PO will continue to take interest in all new aspects of local network communication.

A W J Wilson, Sv 7.2.4 (01-432 1326)

The transit network.

To provide full national STD access it is necessary to route some calls over more than two GSC to GSC links in tandem. On such routings transmission losses must not exceed the 7dB maximum permitted; the number of routing digits generated by controlling register translators must not be more than six; and the post-dialling delay must not be appreciably longer than on other STD calls.

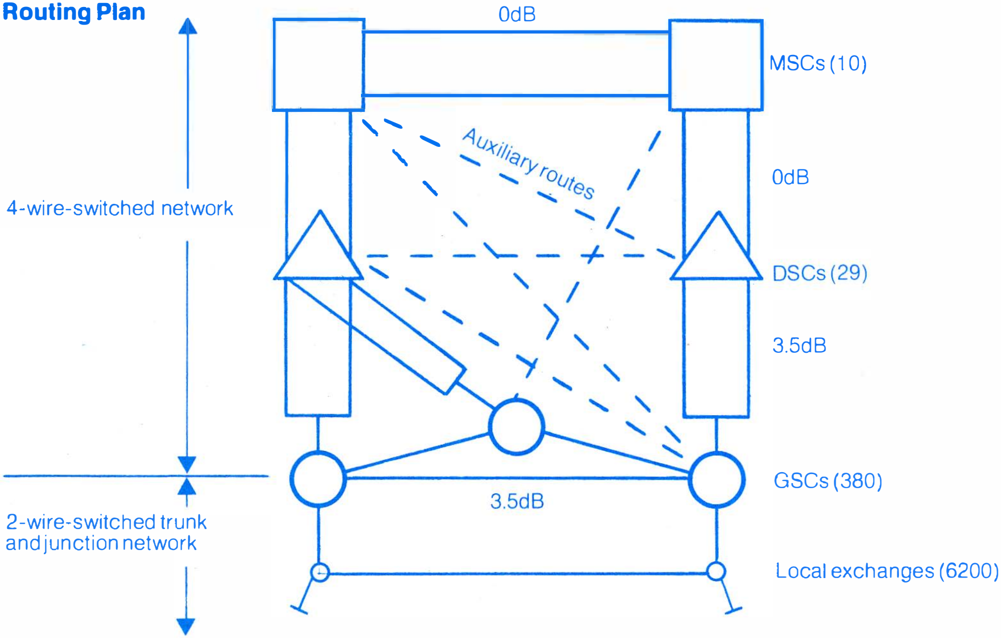
The transit network is designed to meet these requirements. It is a four-wire switched network using TXK4 exchanges as transit switching centres (TSCs). The transmission losses in the network are GSC - TSC 3.5dB and TSC - TSC 0dB. The line signalling systems used are signalling systems AC11 (SSAC11), DC3 (SSDC3) and AC12 (SSAC12). These systems are similar to SSAC9, SSDC2 and SSAC8 respectively, except that there is no pulsing element. Routing information and supervisory signals are transferred by signalling system multi-frequency No. 2 (SSMF2) in which each digit and supervisory signal comprises two pulses of 80mS duration, each pulse being a combination of two tones between 540 and 1980Hz.

Structure of the network

The transit network has been engineered to carry traffic which cannot be economically routed over two GSC to GSC links and the small amount of traffic which cannot be routed over two links because of limited translation capacity. The country has been divided into ten main switching centre (MSC) areas. Each MSC is connected to all other MSCs by 0dB loss circuits. Every MSC area, (except the London MSC area) is subdivided into districts each with a district switching centre (DSC). A DSC has a 0dB loss route to its own MSC and to any other TSC if a route is justified by the traffic. Every GSC has an incoming and outgoing route with 3.5dB loss to its home TSC, which may be either a DSC or MSC. Routes may be provided to or from other TSCs if justified by the traffic.

There will eventually be 39 TSCs in the network. London MSC is divided into separate incoming and outgoing units and does not act as an intermediate TSC. It is designed to handle originating and terminating traffic for the London central switching units and sector swtching centres.

Routing Plan

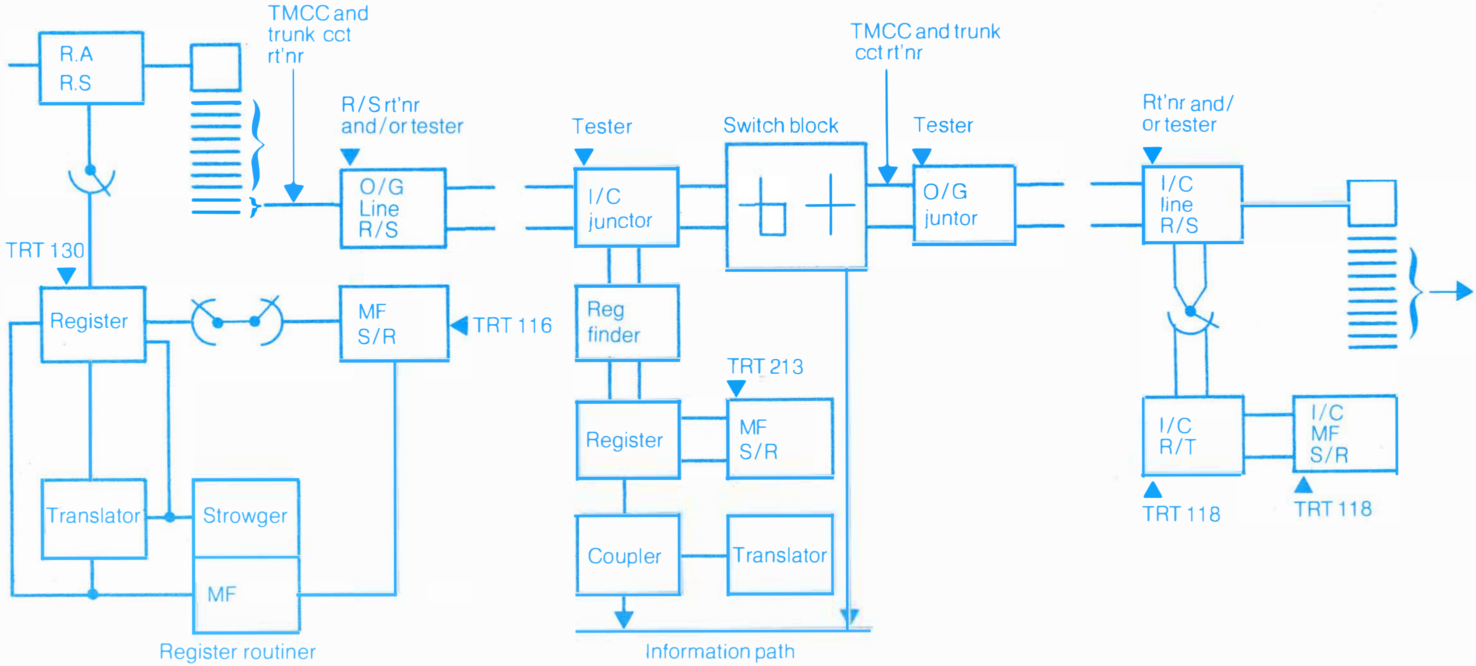


Setting up a call

A call routed over the transit network progresses as for an ordinary STD call up to the point where the GSC register applies to the translator for a routing. The translator recognises the national code as one needing a transit routing, instructs the register to associate a SSMF2 sender/receiver and provides local routing information to route the call to an outgoing TSC circuit. In Director area centres the need to associate an SSMF2 sender/receiver is signalled to the magnetic drum R/T by the outgoing line relay set.

As soon as an incoming junctor at the TSC is seized, a register and SSMF2 sender/receiver are associated with it. The TSC and GSC sender/receivers check that they are associated by exchange of prefix signals; the TSC then requests the GSC to send the national A, B and C digits (the first three digits after the STD prefix 0) in MF form. The GSC sender/receiver converts the Strowger digits stored in the register to MF form and transmits them to the TSC. The TSC register uses this information to route the call to the appropriate outgoing route and the TSC common equipment is then released. Further TSCs on the routing repeat the above sequence.

When the call reaches the objective GSC the incoming line relay set is associated with an incoming register translator and SSMF2 sender/receiver. The incoming R/T calls for digits from the originating GSC one at a time, commencing with the C digit of the national number. This digit determines the routing to the appropriate charge group; subsequent digits route the call to the called subscriber. The common equipment at the originating GSC is



released on receipt of a number-recieved signal from the incoming GSC, the call is then switched through from subscriber to subscriber and the incoming GSC common equipment releases.

A repeat attempt facility provides for one automatic repeat attempt to be made to set up a call if it fails after the sender/receiver is associated with the register at the outgoing GSC.

Implementation

At the time of writing (September 1974) there are 27 TSCs in service and two ready for service; 253 GSCs have outgoing transit access and 254 incoming transit access. As yet, however, the amount of traffic being carried is low compared to the network capacity because not all translator strappings have been done at GSCs and many dialling code booklets await revision.

Maintenance and surveillance

Maintenance policy for the network requires automatic routiners for the main service-affecting items that are provided in large quantities. Certain of these routiners are backed up by manual testers for faulting purposes. Where routiners are not justified manual testers are or will be provided.

The TXK4 TSCs each have an automatic fault detection and print-out system which monitors the progress of all calls through the TSC.

All line circuits are routined by a trunk and junction or trunk circuit routiner applied to the exchange side of the outgoing line relay set or junctor. These routiners pass test calls to answering sets in the destination exchanges and check the transmission loss.

Equipment	Manual tester	Routiner
GSC register/translator (MF functions)	TRT130	Register routiner MF test unit
GSC Incoming register/translator	TRT118	
GSC outgoing SSMF2 sender/receiver	TRT116	Register routiner MF test unit
GSC incoming SSMF2 sender/receiver	TRT118	
TSC incoming SSMF2 sender/receiver	TRT213	
GSC line relay sets SSAC11	TRT65B	AC9/11
GSC line relay sets SSDC3	TRT165*	
TSC junctors SSAC11	TRT209	
TSC junctors SSDC3	TRT210*	
GSC - TSC same building junctor	TRT211*	
TSC - GSC same building relay set	TRT212*	

**These testers are not yet available.*

Trunk Maintenance Control Centres (TMCCs) are provided at all GSCs and gain access to outgoing transit circuits in a similar manner as to all other trunk circuits. The TMCC testing positions are provided with the extra equipment necessary to route a call using SSMF2. Similarly at a TSC standard TMCC facilities are provided except that all equipment is for four-wire access. The method of use of these facilities is given in *TI E13 D1040.*

The network is provided with traffic and service meters to keep a check on the performance of the network. *TI A6 G4013* gives details of meter provision for equipment at TSCs.

In outgoing equipment at GSCs each SSMF2 sender/receiver is provided with 'seizure' and 'repeat attempt' meters. Whilst it is not possible to determine the number of successful or failed calls from the meters, the ratio of seizures to repeat attempts can be determined for each sender/receiver. By comparison between sender/receivers one with an abnormal failure rate can be detected. When interpreting results it has to be remembered that a call uses a different sender/receiver for the repeat attempt when the first attempt fails.

In incoming equipment at GSCs a 'first fail' meter is fitted to each incoming register/translator. When a call fails the register/translator prepares itself for one of two functions on the next call and operates the meter. If the next call fails the register/translator locks out of service; if the call is successful the first fail mark condition is removed.

Quality of service

The in-built security features of the system, for example the 'compelled' signalling between registers, the low fault liability of the TXK4 switching units and the automatic repeat attempt facility, minimise the effect of plant defects on service. Maintenance procedures have been devised to limit the period during which faulty equipment is likely to remain in service. Initial field trials have shown that the quality of service obtained over transit routings is comparable to direct STD routings, provided equipment is tested at the recommended periodicities.

Transit performance is unlikely to be seen from telephone service observations (TSO) 'STD Originated' results because of the small number of such calls represented in the sample. An improved measurement will be available when the measurement and analysis (MAC) system becomes available from 1976. In the meantime we lack day to day assurance that an acceptable quality of service is being experienced by customers using transit routings. Uncontrolled test-call sending would undoubtedly overload the network and result in a worsening of service, and suitable monitors to record the results of live traffic are not available in quantity.

An interim solution to this problem is being sought but from our own field assessments we have concluded that a satisfactory service results when routines are applied as scheduled and fault print-outs are followed up intelligently.

A J Crome Sv7.2.3 (01-432 1360)

Internal self-inflicted wounds.

Issue two of *Maintenance News* carried an article about self-inflicted wounds in the external field. The same sort of thing happens with equipment maintenance and in most cases it arises directly or indirectly as a result of construction work. This does not mean that we do not inflict a few wounds ourselves but we should be able to do something about those within our own organisation; it is much more difficult when you have to bring influence to bear on people in other parts of the business.

The external maintenance problem has one main aspect - damage to cables. Equipment, on the other hand, is subject to attack on many fronts. Examples come to mind at once and in most cases they show that anyone concerned with internal maintenance in Areas, RHQs or THQ has an additional job to do — to make sure that his colleagues in other disciplines are not doing anything making good maintenance more difficult or reducing the quality of service.

The following are just examples, no doubt you can think of others:

1. Delay in completing works specification modifications because of the pressure put on installing additional multiple and calling equipment.
2. Taking traffic recorders and routiners out of service unnecessarily during construction work and, when it is necessary, failing to bring them back into service as soon as possible.
3. Inadequate design or installation of ventilation or cooling plant resulting in maintenance staff leaving windows open. Of course we cannot always blame faulty design or installation - maintenance staff have been known to operate this sort of plant incorrectly.
4. Gradual erosion of maintenance space because of shortage of floor space for equipment.
5. Shared service, with all its disadvantages from a maintenance point of view. We have not put sufficient effort into de-sharing or avoiding shared service for new supply. The new class of work for de-sharing will move this work from the CS productivity index so we should now be able to put some pressure on our installation colleagues to reduce the number of shared service lines.
6. Regrading work carried out without regard to peak traffic periods - some gradings are large enough to justify the equivalent of an A60 procedure before regrading takes place.

7 Delay in introducing partially skipped gradings as a solution for varying unbalance in gradings. In spite of the obvious service advantages on certain gradings THQ departments have been delaying us for far too long. (*There are serious doubts about the cost of using PSG in existing exchanges* — Editor.)

8 Provision of expedient multiple and calling equipment without regard to the intermediate switching capacity. No one likes equipment waiting lists, but we are supposed to give first consideration to existing customers.

9 Inadequate house-keeping arrangements during construction work - poor dust-proofing, storage or unpacking of equipment in working space, litter left about by contractors' workmen.

You will probably be able to think of many other ways in which colleagues cause maintenance problems; but the more you think about it, the more you have to accept that maintenance people have to keep an eye on other people. This does not just mean maintenance staff on the exchange floor - maintenance men working in Areas, RHQs and THQ are all in the same situation.

F Haworth, NETR/S1 (0532 37591)

Location of microphonic noise in Strowger exchanges.

This article is based on the report of a field trial to detect microphonic noise generated within Strowger exchanges.

The field trial started in 1970 at six exchanges with varied line capacity, type of equipment and general environmental surroundings. The object of the trial was to see whether a suitably designed device for detecting the noise generated within a Strowger exchange was a practical proposition. It was hoped that the results would provide information from which bank cleaning frequency could be determined.

On behalf of Service Department, TDD developed a small detector unit using transistors and integrated circuit components; this unit was associated with a modified artificial traffic equipment, TRT 32. The TRT 32 was strapped to generate mostly local calls. Calls on which noise was recognised and the alarm operated were regarded as failed calls.

Throughout the trial at most exchanges the detector equipment was used for one week in every four in the hold and trace mode so that a call which registered noise could be held for tracing to locate the source of the noise. Selector banks were left uncleaned, all at some exchanges but only a limited number at others to comply with local requirements.

Initial problems were encountered because of faulty components in the detector unit and inadequacy of test facilities and procedures; but these were overcome and eventually the equipment was as satisfactory as the detector design allowed.
The noise detector was used at a level setting of -35dB, which was considered adequate to recognise noise but not loud enough to cause inconvenience to subscribers. Noise faults were recognised at some exchanges but not at others. In many cases when noise was recognised by the detector unit and the circuit held for trace it was found to be virtually impossible to locate the source of the noise generated.

At the very beginning of the trial some 180 000 calls were passed of which only 812, or 0.45 per cent, failed because of noise. As this was during the period when faulty detector unit components were found the results were not considered reliable. During subsequent use of the equipment 171 500 calls were passed of which 226 failed. Out of these failures, 178 were recorded as FNF. Finally, of the total of 226 failures only 15 were considered by the maintenance staff to have been due to either dirty bank contacts or low wiper to bank contact pressure. Of these 15 faults, slightly more than half were on routes where selector banks had been cleaned.

From these results it was apparent that only 0.132 per cent of calls failed through noise. For noise due to wipers and/or bank contacts the results gave a failure rate of 0.0087 per cent or 1 call in 11 500. These figures were rather disappointing, especially considering the effort expended by staff, both local and THQ. It became clear that the use of the noise-detecting device on a national basis could not be justified. More sophisticated equipment, which could recognise a series of short duration 'spikes' of noise which may occur at varying levels, may be the answer. However, at this stage further development testing and subsequent production cannot be justified.

J A Wood, Sv 6.5.6 (01-432 1344)

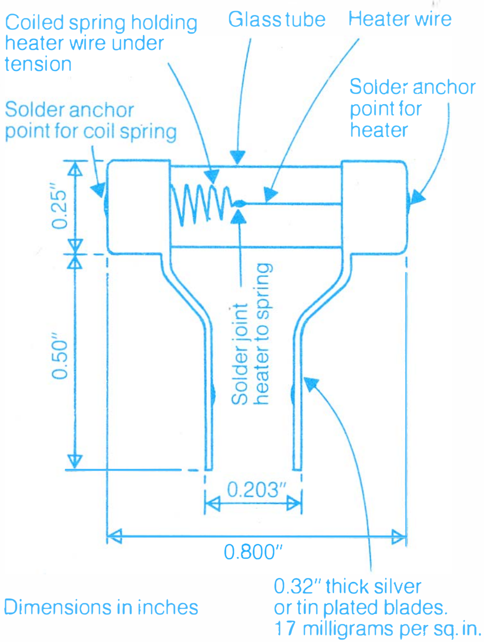
Delay action fuse for motor uniselectors.

A major problem with motor uniselector group selectors (MUGS) is their tendency to stall in service and burn out the stator coils. The causes of stalling are well known to the experienced maintenance man - dirty banks, worn latch details, idler gears and so on - yet they sometimes escape attention in normal routine maintenance.

To prevent the coil burn-out problem we have developed a delay action fuse in the form of an 'N' link - see figure. This fuse has similar characteristics to a heat coil and if it carries excessive current and hence generates more heat than the heater wire can dissipate, it causes a small solder joint to melt. As both heater and coil spring are under tension, the joint separates and the circuit is disconnected. In severe circuit failure conditions when the current flowing in the circuit is abnormally high the heater also acts as a fuse wire, and ruptures in a very short time.

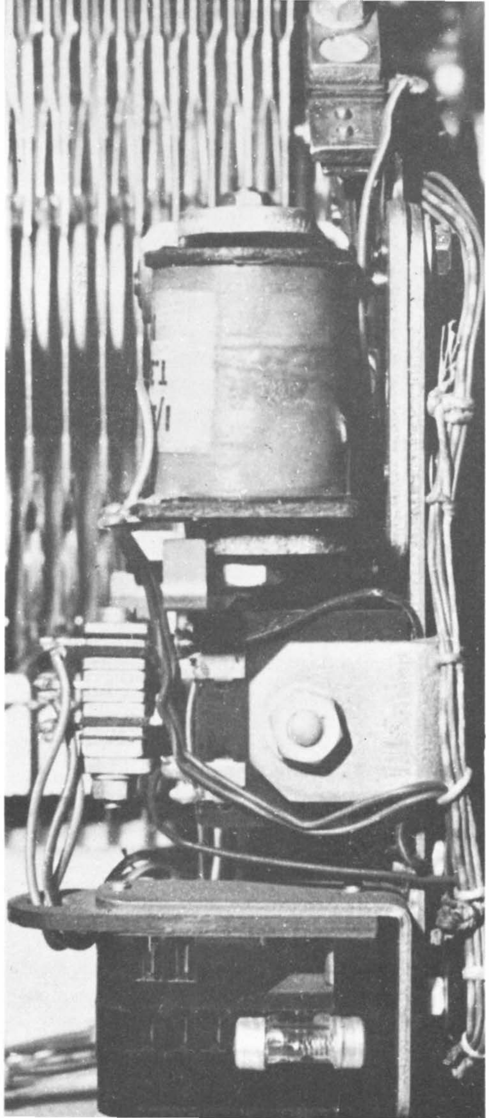
The design limits for the rating of the fuse had to fulfil two requirements, firstly to protect the coil when the mechanism stalls and secondly, to enable the mechanism to hunt freely for a number of revolutions in rapid succession when the mechanism is being automatically routined or a test for correct speed is being made. In fact, the original current measurements taken on a sample of

Delay 'N' link fuse



Dimensions in inches

MUGS indicated a normal running current of 700-800mA. When the mechanism stalled the current rose to about 1A. This information was passed to the fuse element designers, K E Beswick Ltd of Frome, Somerset, who recommended a fuse rating of 315mA, with a rupturing time delay of about 12 seconds when carrying 1A. The prototype 315mA fuse was installed and tested under working conditions and was found to be perfectly satisfactory in every respect; the time delays for the fuses rupturing were very near the theoretical design figures. It is difficult to say exactly when a stator coil is damaged or even weakened as a result of 1A flowing through it, and consequently the fuse time delay is somewhat arbitrary. We tried a small number of the 315mA fuses in service for about one month. During this period we looked at the burn-out times of stator coils in service when carrying 1A, and the results showed that the delay could be extended to 20 seconds without any measurable electrical damage to the coils. This increased delay period meant that the fuse rating could be increased to 400mA with a rupture delay time at 1A of 18-20 seconds. This new element fuse was tried out in quantity at Cambridge trunk exchange, and the trials have shown that it is the complete answer to coil burn-outs. We now have 2500 MUGS with these 400mA fuses fitted and in service, and more on order. The rupturing of the fuse is of course indicated by a normal release alarm in the exchange. Fitting these fuses does not mean that we can neglect basic cleaning and routining functions on MUGS, but it does give us a chance to catch those rogues slipping through the maintenance net.

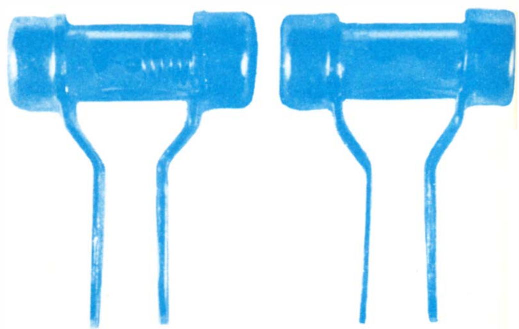


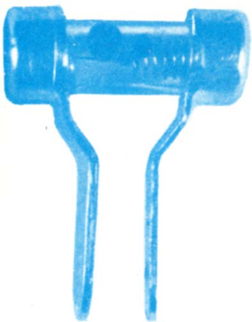
We would like to acknowledge the help of K E Beswick Ltd and our colleagues in THQ/Sv 6.5.6 and Cambridge Area in making this a successful project.

B A Pearce, ETR/S 1.1.1. (0206-89307)

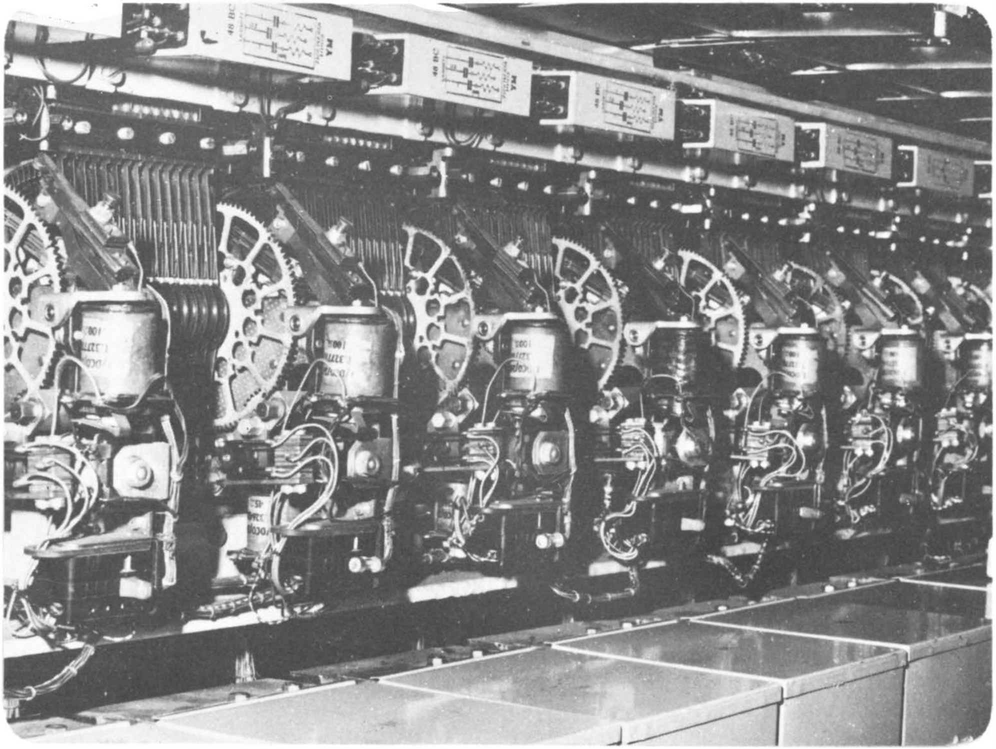
The fuse fitted into the MUGS between test points 5 and 6 and therefore in series with the 50V supply to the latch and stator magnet coils.

The comparative size of 'N' link type fuses – the fuse in the centre of the figure has blown. The rupturing of the fuse is indicated by the spring recoiling into the end cap and becoming invisible.





A shelf of MUGS with two delay fuses fitted, second and third from left.



Maintaining the international telephone service.

At present the international telephone service handles some 500 000 call demands daily, including both subscriber-dialled (ISD) and operator-controlled calls. Only about 30 per cent of these calls, either outgoing from or incoming to this country, are successful – in that the called subscriber answers and revenue is collected for the call. There are many reasons for this low success rate: calls may fail due to subscribers – perhaps the caller dials incorrectly or the called subscriber does not answer, or is engaged; calls can fail because switching plant or line network capacity is insufficient to meet the demand; and calls can fail from faults and design weaknesses, and from abnormal congestion induced by international events.

On an international call there are four elements in the call set-up. First, there is the originating local exchange and the route via the national network to the international switching centre (ISC). The second component is the ISC and its line network to the coast or to the earth station; then the cable or satellite linking with the coastal or earth station in the distant administration's network. Thirdly, there is the distant ISC and, finally, the national network and exchanges in the distant country.

So to make a radical improvement in our overall success rate we must eliminate congestion and reduce fault incidence within our own national and international responsibilities, and persuade other administrations to do the same. There is a high degree of agreement and co-operation between administrations and it is recognised that the expansion of ISD brings fresh problems to light, all requiring speedy solution.

It is not intended to deal here with call failures resulting from subscribers' errors or even to define what percentage of calls successfully set up ought to receive an answer signal. Instead we shall examine switching and network congestion, and then see how vital efficient maintenance is, both now and in the future.

The current position is that Faraday and Wood Street ISCs in London, together with their associated manual International Control Centres in London, Brighton, Leicester and Glasgow, handle the international traffic to and from the UK. At these centres there has been, for some years now, a shortage of international switching capacity, international circuits and operating staff. Many circuits are carrying more than their design loading and current statistics present disturbing facts. For switching plant at our own ISCs relief will shortly be available and there is now no shortage of international terminations available for connection: steps are being taken to connect more into service just as soon as manpower resources permit and other administrations can co-operate. There is still a substantial shortage of terminations in the ISCs for national junctions for certain classes of ISD traffic – from London in particular – but again there should be no shortage by the end of 1974, when two further ISCs, Mollison and De Havilland, at Stag Lane in Edgware come into service. Switching capacity for an additional 4200 Erlangs of traffic will then be introduced into the system, and the total capacity of the international telephone service will rise from its current value of about 5000E to over 15 000E within the next two years or so. If our own national network, and those of distant administrations, are able to meet this expansion there should be fewer call failures resulting from shortages in plant and network capacity. Bilateral meetings with other administrations do take place regularly to resolve planning policies and regularise mutual maintenance activities. There is also, of course, close liaison between ETE and NPD on national network aspects.

What then is required of maintenance staff? They must be constantly aware of the need to maintain the currently well-overloaded International network – and access to and from it - at the highest possible level of efficiency. Access to and from the international network takes us right into practically every GSC in our network and in the case of the LTR into trunk and local director exchanges for incoming international traffic. During the past year or so, ETE has tried to improve both maintenance efficiency and call handling capacity: at Faraday and Wood Street, a measure of success has been achieved. This is true also of many international routes.

Some international route and distant end performances still mar the overall achievement and this is because repeated attempts by ISD customers to complete calls over congested routes overload the ISC common control equipment and occupy 'pooled' items such as registers, to the detriment of service on other routes.

It is vital that all national trunks and junctions to ISCs are regularly tested and serviced following TIs and other instructions. It is equally important that equipment at GSCs involved in the setting-up of ISD calls - ISD registers, call timers and so on - are maintained to function efficiently with minimum out of service time. In the current situation, any item of equipment out of service or not performing correctly may seriously degrade the service. The AC11/MF2 equipment installed at GSCs, which frequently completes international calls over direct routes or over the national transit network, is another area of plant requiring special maintenance attention.

At Faraday ISC we now have the following facilities available:

a test number relay sets to assist the regular functional check of ISD access trunks from any GSC - access code 44 123;
b efficiency measuring devices capable of assessing areas of fallibility;
c a nearly continuous outgoing service monitoring system using International Accounting and Traffic Analysis (IATAE) equipment.

When day-to-day difficulties involving ISC equipment do not appear capable of quick solution using normal channels, contact may be made direct to the International Service Co-ordination Centre (ISCC), which has both the expertise and equipment necessary to undertake investigations of a special nature. Telephone numbers are: 01-236 1950; 01-236 2486; and 01-236 4262 x164/5. The telex number is 88 87 65.

At Wood Street ISC the following facilities are available:

a test number relay sets - access code 44 080 (inverted ringing);
b 800Hz reference tone - access code 44 081;
c trunk and junction routiner answering equipment - access code 44 083;
d balanced test termination (600 ohms) on transmit and receive pairs - access code 44 084;
e automatic transmission measuring facilities - access code 44 087;
f facilities equivalent to those at Faraday, items (b) and (c)

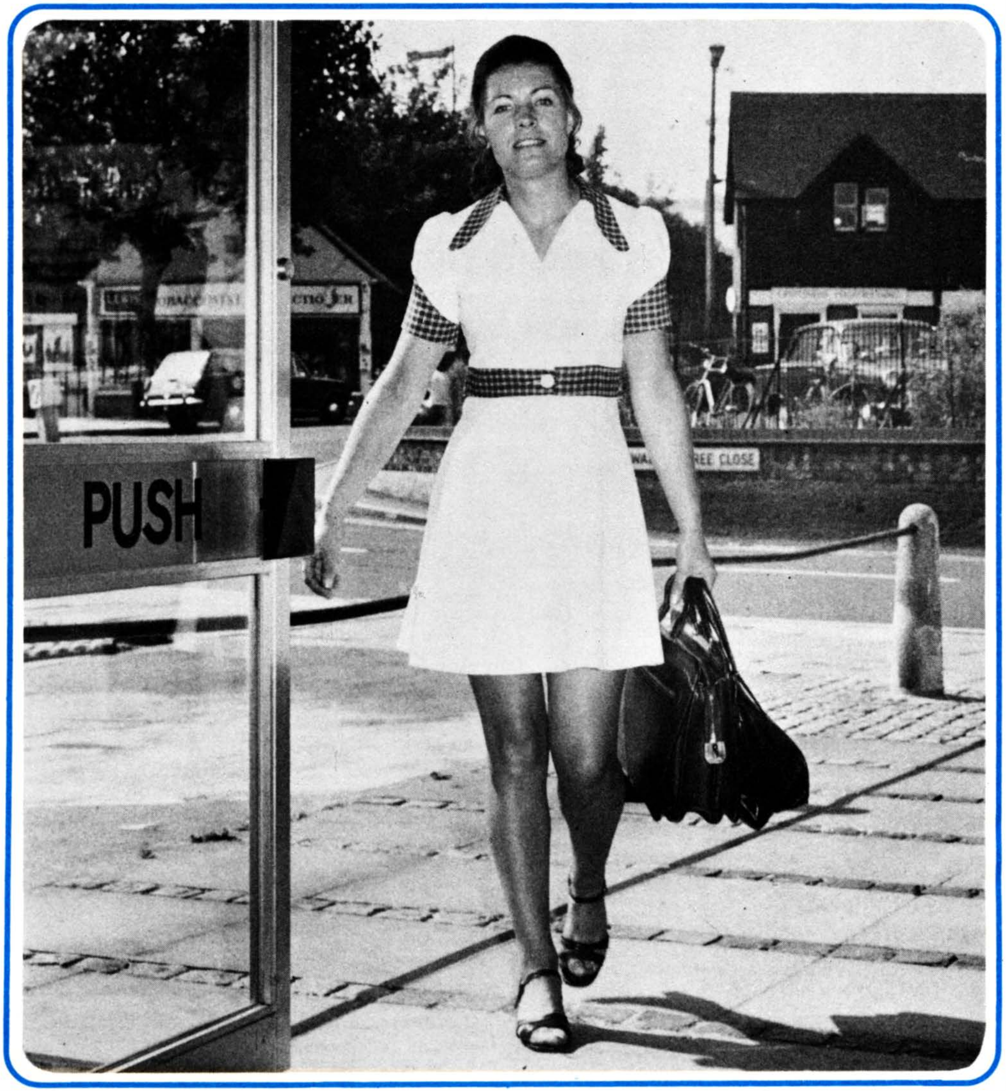
As in the case of Faraday, the services of the ISCC are available when difficulties cannot be cleared in the normal way.

During the last quarter of 1974 Mollison ISC will be brought into service and this will be quickly followed by De Havilland ISC. Mollison ISC has been designed to handle calls that require no UK operator intervention. It will deal with calls to and from a maximum of 14 countries with each of which the UK has substantial community of interest. De Havilland ISC will cater also, along with Wood Street ISC, for all other routes.

There are substantial retrunking and regrading works to be done at many UK national centres. These works present a hazard to efficient maintenance and indeed the multiplicity of ISCs - both in this country and abroad - do present more complex problems to maintenance staff than those of the internal network. Many GSCs will have a single grading giving access to two or three ISCs, and there are added problems of overflow and alternative routings, access over transit routing, and so on.

At some of our ISCs, computerised performance-measuring equipment monitors live traffic so that fault patterns can be seen developing; and very soon ETE will be able to provide this assistance in the location of plant contributing to poor performance. There is also available, at Wood Street ISC for example, call progress indicator equipment which helps in the analysis of signalling difficulties on AC9 and AC11 routes. We also have facilities for alarms if routes depart from standard performance figures. Many innovations and novel features are planned which will assist all facets of maintenance. Nevertheless, a satisfactory service is dependent on the full co-operation of all maintenance staff both at home and overseas. This is our objective and progress is being achieved.

R W Button, ET10 (01-432 3526)



The TSR ~ friend or foe.

Not long ago in *Hello Girl*, the PO magazine for PBX operators, an independent freelance journalist described the work of a typical Telephone Service Representative, or TSR. He pictured a helpful, cheerful and positive person, doing a valuable job in educating PBX operators to make the most effective use of their PBX and the telephone system.

Yet on a visit to one of the Regions at about the same time, comments were heard suggesting TSRs to be a species of female dragon, whose single aim in life was to find fault with the work of honest maintenance engineers. Which view is correct, we wondered.

John Briglin, of the THQ group responsible for TSR activities nationally, says: "Our view is that the TSR does an often difficult job as a trouble-shooter. And if anyone feels that the TSR is only out to stir up trouble, he should ask himself which is preferable - a friendly tip-off from the TSR that something is wrong and trouble may be brewing, which gives us a chance to sort things out locally. Or a massive 'drains-up' operation when a complaint gets to Flag Case proportions."

Mrs Rosemary Price, TSR, Guildford Area.

But, as John Briglin explains, it really should never come to that. Like the repair service engineer, the TSR often goes in cold on a customer visit, not knowing just what difficulty or misuse may have to be sorted out. She may be calling at the customer's request, or on a regular routine visit. Or she may be helping in the commissioning of a new PBX installation, and expected to be the PO expert with the firm's directors hovering nearby, understandably concerned that the new board should justify the money spent on it. The TSR may not even have an instruction book if the PBX is a new type installed for the first time in the Area. That, surely, is a situation that any engineer can recognise and sympathise with. In fact, unless your local TSRs are very different from those we've met, you probably know her as a useful, knowledgeable, but infrequently seen member of Service staff. So - just what is her job?

Her work is described in *TI D6 E4 701* as 'maintaining contact with customer PBX management and staff; advising and training generally; dealing with complaints; in short, active as a trouble-shooter, ideally anticipating problems before they arise.' As already mentioned, special responsibility falls on her when new PBXs are opened. Perhaps inevitably, on engineering aspects, most of her contacts are with construction and repair service staff. Exchange maintenance engineers tend to become involved in the more protracted problems, for example the persistent complaint of 'incoming difficulty' that can be so frustrating to pin down. But that is not the TSR's fault; she just happens to be at the sharp end.

Let's face it. Any TSR tactful enough to convince, say, a Managing Director that he is a dialling-illiterate knows that there is no point in conflicting with her own colleagues, and particularly not with the engineers. If, occasionally, your TSR becomes exasperated, well, don't we all? Don't forget she has considerable pressure on her at times just like engineers.

Re-reading some notes on a recent meeting with TSRs in one of the most hectic sections of Central London, it is clear that they were not short of comments, opinions and criticism about many different aspects of the telephone service. But when the subject of engineers came up, they were for the first time unanimous. "Our engineers are very good", they said, and gave numerous instances where maintenance men had bailed them out in difficult circumstances.

Cooperation is a two-way street, and here are a few suggestions. Be helpful, but not 'pushy' with advice and in sharing your technical knowledge. For example, when that new and unusual type of PBX opens in your Area. If relationships are a bit edgy, be the first to offer the olive branch. And always be ready to compare notes with your TSR; she may have just the clue you need. And that hint about potential trouble can be just as helpful to her as it is to you. Friction simply wastes energy.

Over to John Briglin again. "I really can't see how or why this idea of conflict between TSRs and engineers got started," he says. "There could just be one thing, though. Remember that the TSR makes quite a lot of her visits to major PBX customers on a regular routine call. That is her job. Her instructions call for her to look the switchboard over, and ask if there are any problems. Naturally, on the law of averages, she will sometimes arrive just as serious trouble breaks loose. She is on the spot - in more ways than one - and this often means an urgent call to the engineers. But the TSR's objective in going in to the customer in the first place was not, and never is, to find fault with her engineering colleagues; 'her' engineers as she would most likely describe them. She depends on them too much for that!"

D J Weston, Sv 1.3.1.2 (01-432 1408)

Service Protection Network

NCC News.

Details of the service protection network (SPN) facilities, including the associated switching and access equipment and its method of use, were covered in *Maintenance News*, issue two. The SPN arrangements will also be fully described in *TI E1 A1510*.

Currently, about 65 per cent of the coaxial cable systems programmed to be provided for use in the SPN have now been brought into service. Together with radio protection channels and temporarily spare hypergroup sections, they are now used for restoring service under plant failure conditions and also for re-routing hypergroups to facilitate planned service-affecting works. In this context a hypergroup has a 4MHz bandwidth with a capacity of 900 or 960 speech-band circuits.

It is expected that the installation of the access and switching equipment (ASE) and the associated broadband switching equipment (BSE) will start towards the end of 1974. Until this equipment is available existing procedures will continue with temporary in-station tie-circuits and manual patching facilities being used at both ends of hypergroup sections. Manual patching causes short service breaks of anything from a few seconds up to as much as one minute and to minimise the effects of these interruptions it is necessary to carry out the changeover operations during periods of light traffic (usually between 0000-0600 hours and 2300-2400 hours daily and 0600-1700 hours on Sundays).

In the future, the ASEs will provide single-ended high-speed switching for each direction of transmission of a hypergroup section. This will simplify and improve the changeover arrangements; and changeover will be generally undetectable by customers.

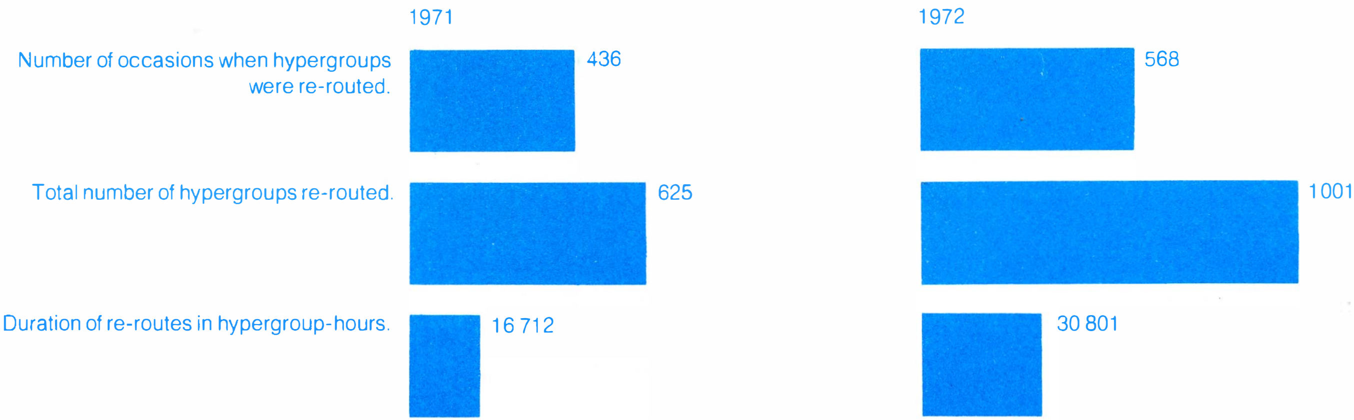
The installation of the ASEs normally mounted on the supergroup and hypergroup translating equipment racks, presents a problem: each of approximately 1300 hypergroups have to be interrupted on more than one occasion. Regional NCCs, responsible for the authorisation of all planned service-affecting works, ensure that when possible the work in the Regions is co-ordinated and that the existing SPN facilities and spare translating equipment are effectively used to minimise the number and the duration of service interruptions.

The bar graphs show the extent of hypergroup re-routes between 1971 and 1973, including the number of occasions when re-routes were effected, the total number of hypergroups re-routed and the total durations of the re-routes in hypergroup-hours. About 25 per cent of the re-routes were to restore service under major plant failure conditions and the remainder were to release transmission plant for planned works.

In the case of hypergroup link failures, the time taken to re-route a hypergroup depends upon the number of SPN hypergroup sections required in tandem to make up the hypergroup replacement section or link and upon whether or not the SPN terminal stations are attended; the time at present varies from about five minutes up to two hours, but the period will generally be less when full SPN facilities are available.

The SPN is particularly valuable under cable fault conditions. Since 1968, the mean service outage per coaxial cable fault (taking all coaxial cables, with or without SPN facilities) has dropped by almost 60 per cent, from about seven hours to three hours, and this has been largely due to the use of the SPN. The duration of the plant outage, as against the service outage, has shown a considerable increase, showing that some cable repair work

Hypergroup re-routes

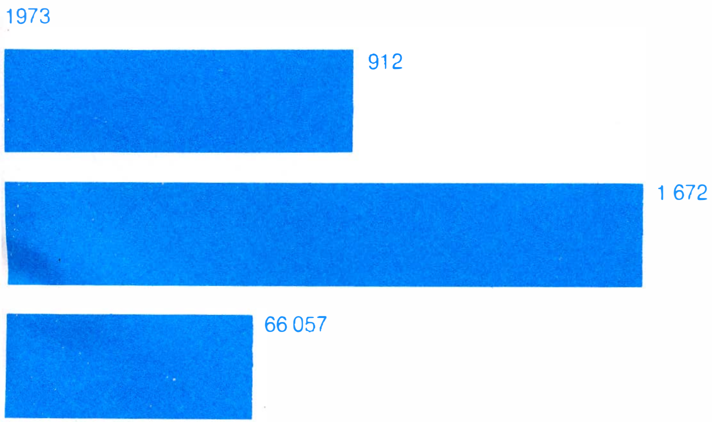


can now be delayed until the normal working day instead of having to be done at night and during the early hours of the morning.

The major use of the SPN is for the withdrawal of working plant from service to facilitate planned works. More than 80 per cent of the jobs on the HF network that need plant to be released are now carried out without any significant effect on service. Without the SPN facilities, all this work would have been confined to preferred hours and, besides causing loss of service, would have been inconvenient and more expensive.

It is apparent that both maintenance and works field staff appreciate and make full use of the SPN facilities that have so far been provided, the installation of the new access and switching equipment should further assist them in maintaining a high standard of service.

R E Moulds, Sv7.1.3 (01-357 2241)



If you have a contribution to offer to *Maintenance News* other than a letter to the editor, please forward it through normal channels to the *Maintenance News* agent for your Region or Telecommunications Board. Letters to the editor should be sent direct to the editor's office.

Send your contributions to...

EASTERN	Mr B A Pearce	S1.1.1	0206 89307
ETE	Mr T M Trotter	ET10.1.2	01-432 5146
LONDON	Mr W J Reilly	Sv2.2	01-587 8000x7387
MIDLAND	Mr D C M Coshan	SM4	021-262 4052
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