Maintenance News

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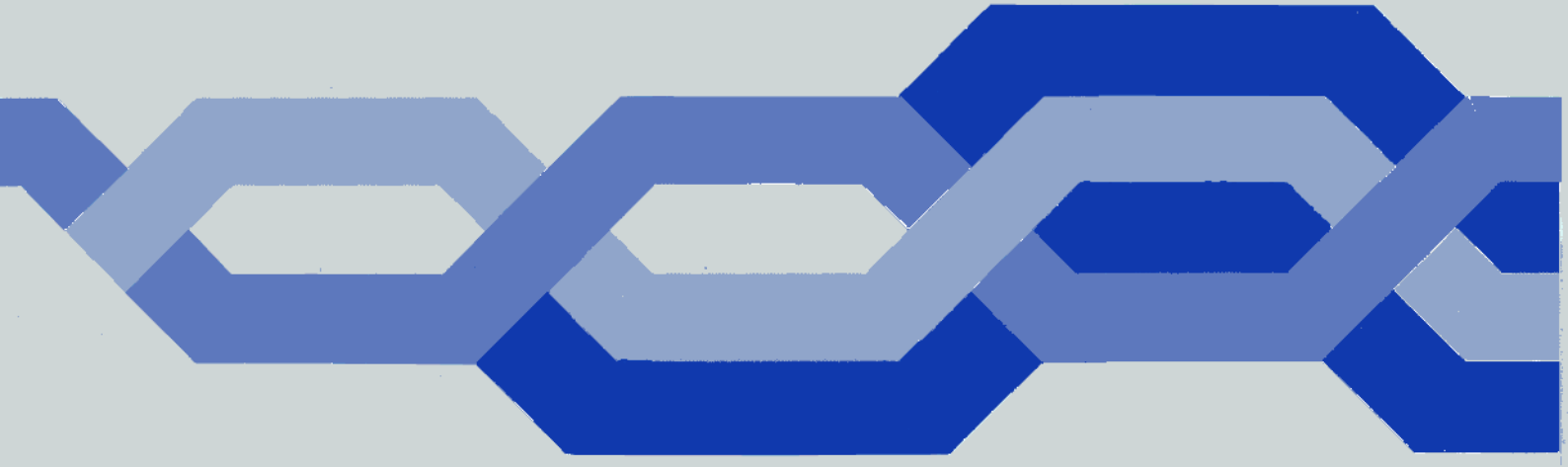

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Maintenance News

Maintenance News aims to provide a medium for two-way communication between maintenance engineers throughout British Telecom. 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 301, 203 High Holborn, London WC1V 7BU. 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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Editorial

There are two reasons for giving Maintenance News a facelift in silver this time. Firstly, in celebration of issue number 25 and, secondly, to act as a marker on your bookshelf in the otherwise white-edged display of back numbers!

I make no apology for plugging "Repair Care", following the mailing to all Area managers during September of a new brochure bearing that title. The brochure describes the kind of services available from British Telecom's 58 Area Repair Centres (ARCs). Between them, they dealt with more than 200,000 electronic units last year. One of their more important tasks, as BT enters the new era of accountability to its customers, is to maintain quality. Area Repair Centre managers will be learning more of this during the coming months as the new standards of quality are implemented. Les Waller's article in this issue, "Quality in the Field", introduces us to some aspects of this topical subject.

Ron Quinney
Editor

No noise is good noise – Telcare

by **Roger Sutton** LES 4.2.1

Noise is not a new problem. Even so, transmission difficulty is still the main cause of concern to customers using the automatic telephone service. BT has taken a fresh look at the problem so that remedial action could be started to improve noise and transmission performance.

Telcare

BT introduced Telcare (TELecom Customer Attitude REsearch) to assist in its drive to improve service quality and to tailor its services more closely to meet customers' requirements. Telcare is a system of monthly, nationwide telephone surveys with computer assistance. To ensure complete impartiality this task is carried out by external research agencies. They use trained interviewers and conduct over 1.5 million interviews nationally a year. Interviewers ask for customers' perceptions of one of four main telecommunications activities: Provision of Service, Repair Service, Telephone Billing and Automatic Service.

In the Automatic Service survey, a random sample of customers was asked a number of questions regarding their last telephone call. Results showed that noise and poor transmission were the main causes of customer difficulty – noise being the most significant factor.

Causes of noise

A special study was carried out to determine the main causes of noise in the network and to propose remedial action. Many investigations had been carried out in the past, but all had concentrated on a specific part of the network in isolation from both the rest of the network and customer experience. The most important aspect of this latest study looked at the network as a whole and related the problem to customer opinion. The investigation team visited customers who had reported noise faults to a Repair Service Control (RSC). Detailed investigation was made of each customer's complaint, using diagnostic questions, test calls and some purpose-designed testing aids. Any noise encountered was recorded, measured and its source traced.

Results

Not surprisingly, the team proved that reproducing and locating noise faults – particularly intermittent ones – was very difficult and was not aided by existing test equipment and procedures. Figure 1 shows the team's findings as to the causes of noise and compares them with the results recorded by the same RSC in the preceding month.

The main points to note are

- the lower percentage of faults proved on to the customer's apparatus (45% against 68%)

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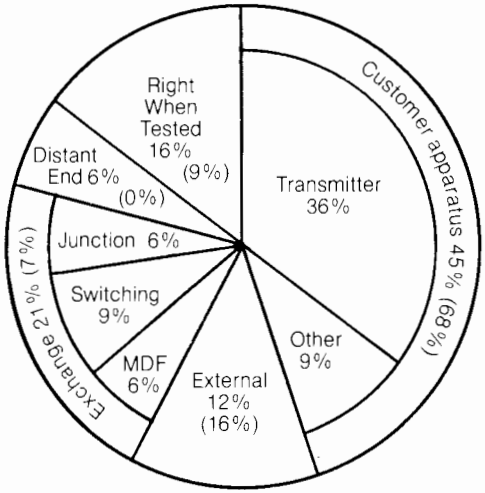
Figure 1 Causes of noise



Figures in brackets are for the previous month at one of the RSC's visited

- the higher percentage of faults proved into the exchange and network (21% against 7% – a figure that is well above the national average of 3%)
- the higher percentage of faults proved Right When Tested (RWT) (16% against 9%).

The results showed clearly that the carbon granule transmitter was the single main cause of noise.

Exchange and network faults

These results demonstrate the difficulty field staff have in proving faults into the exchange and beyond. The team found that the only effective way of achieving this was by following new procedures and using specially designed testing aids. It is particularly important to locate and clear such faults as they can each affect many customers. One of the faults found during the investigation provides a good example: – a customer had been complaining of noise for at least six months and five unsuccessful visits had already been made by BT engineers. The cause of this fault was a faulty clock card on a major 24-channel PCM route which affected several channels of the system. Clearly this fault must have affected a very large number of other customers during this period and would have generated many other unsolved complaints. The affect on customer opinion caused by this type of fault is only too obvious.

Customer apparatus faults

Because of the difficulty – outlined above – of proving exchange and network faults, there is a tendency for the Customer Apparatus and Line (CA & L) engineers to change the telephone transmitter if no other fault is readily apparent. This tendency is indicated by the significantly higher percentage of 'clears' recorded against the customer's apparatus in the period before an investigation. This is quite understandable and has some public relations benefits. But a problem arises when this action is recorded as the clear for the fault, often leading to a repeat complaint from the customer. It means too, that the business is planned on false statistics. The new procedures do not preclude the changing of transmitters – in fact, carbon granule transmitters are replaced by electronic types on all noise or transmission complaints.

Right when tested (RWT) clears

Staff have a natural reluctance to record 'RWT', preferring to demonstrate that they have found a fault. This is shown by the lower number of RWT 'clears' recorded in the period before an investigation. Analysis of fault reports from several Areas indicates that this can lead to a repeat fault rate of as much as 27% for noise and transmission reports at some RSCs.

Distant end faults

Six per cent of the faults were proved to be at the distant end, something that is very rarely, if ever, considered or proved at present. An example would be that of a customer who regularly called one number and often experienced noisy calls. Because the fault could have been at either end of the connection, it would only be by chance that

the customer with the fault would be the first one to complain.

Co-operation

It was found that there was a general lack of co-operation between exchange staff and CA&L staff. To ensure that a noise or transmission fault is correctly localised, the line needs to be split at the MDF, so it is essential for exchange staff to fully co-operate with CA & L engineers tracing customer complaints. Such co-operation needs to be immediate to maintain a good public image. A 'line splitting' box – known as an Exchange Interface Unit, has been developed to simplify this task and to hold an already established exchange connection. This unit should be widely available soon.

Another important discovery was finding whole verticals of unsoldered new work on MDFs – and these were not wire wrapped joints! It was also found that the Tele 282 – which was designed for exchange use only – is unsuitable for localising noise faults in the field.

Plan of Action

The investigation showed that BT's resources needed to be directed more effectively if the situation was to improve. The main points resulting from the Action Plan are to:

- obtain customer cooperation for diagnostic tests
- make test calls to non-metering 'quiet' lines and/or distant customers
- introduce a minimum procedure for CA&L engineers to assist them in the difficult task of 'proving' noise and transmission faults
- set up special teams, Noise Action Groups (NAGs), for handling the more difficult faults
- accelerate the replacement of carbon granule transmitters
- use specialised maintenance aids for the location and clearance of noise and transmission faults
- keep adequate records to allow 'blackspot analysis' (see MN 21).

Pilot area results

The Action Plan was issued nationally in October 1983 and the first four Areas to adopt it were closely monitored. The results from these Areas over a four month period confirmed the earlier results and also showed the following benefits:

- the number of noise and transmission reports to the RSCs was significantly reduced
- the number of repeat noise and transmission faults was reduced
- a reduction in the number of needless customer visits
- the NAGs identified several particularly bad exchanges. The evidence they were able to provide enabled the local manager to use his resources most effectively to improve the noise and transmission performance at those exchanges
- several junction faults were identified, each affecting many customers. In one instance all 30 channels of a PCM system were found to be faulty which is likely to have affected many thousands of customers before eventually being located
- a reduction in the number of written complaints and Telcare Area referrals
- an increase in job satisfaction.

As a result of the experience gained, modified procedures were issued nationally in April 1984. Most Areas have adopted them, or are in the process of doing so.

Now it's up to us

The need to improve our noise and transmission performance, and our image at this time of liberalisation, competition and privatisation, has been highlighted by the Telcare results. The new procedures and Noise Action Groups have proved to be a tried-and-tested method of achieving these aims. But the ultimate success of this drive will depend on the degree of commitment and dedication of the maintenance engineer.

(01-432 2337)

Telex Plus – the store-and-forward facility for telex customers

by **Fred de Boise** BTI/IB2.3.2

Although the national Telex service was first offered to the public in 1932, it was not until 1978 – 46 years later – that a computerised Stored Program Controlled (SPC) telex exchange was opened in London's St Botolph's International Gateway. Once established, thought was given to providing customers with an extra facility – that of depositing their telex messages for automatic delivery, or making repeated attempts to deliver them. An important feature would be advising the customer whether or not the delivery had been successful.

After a small-scale trial, it was decided to incorporate this feature in a second SPC telex exchange installed at Keybridge International Gateway. This feature – known as the 'Store-and-Forward' unit (SFU) – was ready for service in 1983. An enhanced version of the SFU, which has been called the "Telex Plus" service by BTInternational, will be ready soon.

Telex Plus facilities

The protocol for inputting messages includes a 'conversational' call set-up procedure during which the customer can request 'HELP'. A message can then be input either from the teleprinter keyboard, from paper-tape, or memory, and is delivered as soon as possible after it has been input to the system.

Four types of address specifications are possible – single address
multi-address,
pre-recorded address lists (PRA),
and mixed addresses and PRA.

A PRA list enables each customer to store up to 100 telex UK/International addresses on a service computer list. To telex each number on his PRA list, a customer sends his confidential access code, together with the message to be sent, to Telex Plus. That message is then sent automatically to all the numbers on his PRA list. A customer may maintain any number of PRA lists, but any one message can be sent to a maximum of only 10 PRA lists.

Reference information returned for each message, includes a unique message reference number, and a date and time reference.

Delivery advice information gives advice of non-delivery or delivery automatically.

BT's facilities

The facilities offered to BT include:

- access barring for each incoming trunk group,
- inhibition of a transmission on a trunk group when a pre-determined occupancy threshold is reached,
- inhibition of output message transmission for pre-determined periods by using special 'destination' country codes (known as CCITT F69 codes),
- number of output message attempts is adjustable for different error conditions,
- adjustable time interval between output attempts,
- optional automatic advice of delivery
- journal of information on delivery or non-delivery.

Pre-Recorded Information (PRI)

PRI is stored on the Telex Plus system and is available to customers at any time. PRIs are currently used to provide service information and up to five can be stored on the system.

□ **System outline** – the functions of the various components in the Telex Plus system are explained with reference to Figure 1:

Bus to Packet Adapter (BPA)

- sets up incoming calls to the Store and Forward (S&F) units
- sets up S&F outgoing calls to the basic switch over the Inter-Unit Bus (IUB)
- provides transmission-rate control processing on incoming and outgoing S&F calls
- transfers data characters on a call basis to and from the IUB
- assembles and disassembles data packets of Telex Multiplexed Format (TMF) characters
- manages and routes database request packets from S&F units to the appropriate front-end queues, and sends them to the

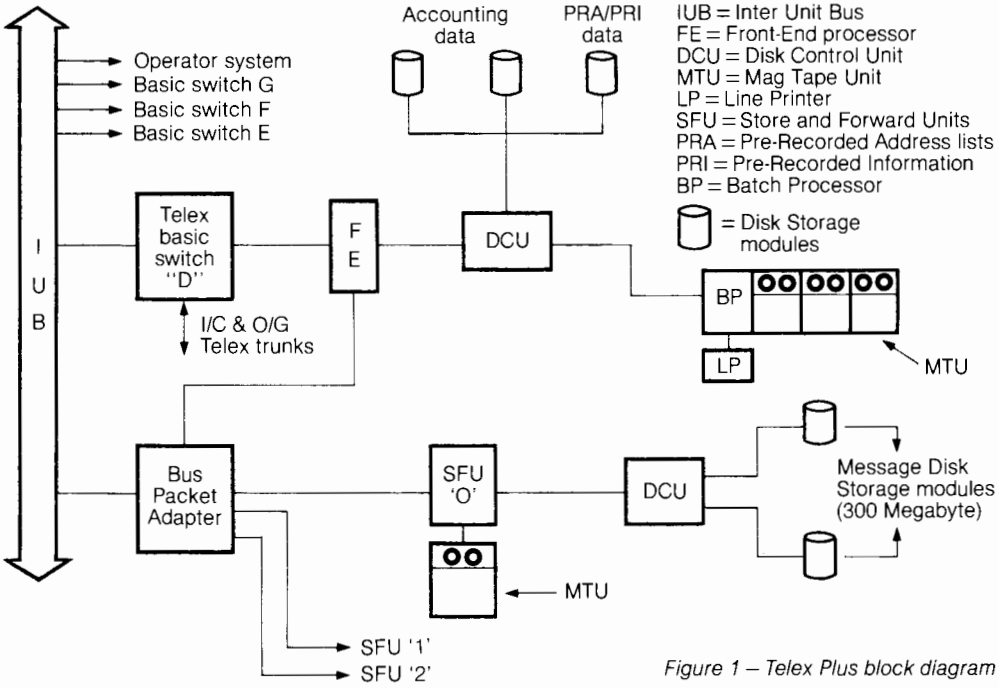


Figure 1 – Telex Plus block diagram

front-ends when the queues are polled, and
- passes various records, statistics and maintenance read out (MRO) fault messages from the S&F units to the front-end, as well as passing control date/time information and unit identity to the S&F units.

Store and forward units (S&F)
- accept incoming calls, validate incoming protocol and secure incoming messages on the 300 Megabyte moving-head disks
- queue messages for output on normal or deferred queues with delivery information for each caller address for the message
- set up outgoing calls for messages secured, monitors for the end of all addresses for the message, then sets up advice of delivery/non-delivery for that particular message and queues this for output
- compile journal records for each message when the last advice of delivery/non-delivery has been sent
- compile accounting records for each successful or unsuccessful outgoing call and sends this to the front-end
- compile S&F statistics which are output to the front-end.

Front-end processor
- loads the BPA and basic switch subsystems with software
- polls for accounting, MRO messages, statistics, journal records and database requests from the basic switch subsystems and the BPA
- passes broadcast date/time and unit identification messages to all basic switches and the BPA
- routes MRO messages to the appropriate machines
- queues database requests to appropriate tasks and disk storage module (DSM) response to the BPA
- writes journal records and accounting records to the appropriate 80 Megabyte DSM.

Batch processor
- produces accounting tapes from the disk records
- handles operator database update requests for the PRA and PRI data
- handles auditing of front-end A and B database DSMs to ensure system integrity.→

Operators can compare disks and copy disks
- produces database tape back-ups for disk 'images'
- allows operators to do journal searches at customers' request, for advice of messages
- disk back-up tapes can restore database PRA/PRI information for the 80 Megabyte DSM.

Maintenance – Magnetic Disk Unit – apart from normal preventive maintenance, such as keeping filters and magnetic heads clean, tests are made with a Field Test Unit (FTU) (TB304B). This checks all functions on the disk unit, including read, write, head alignment, and so on. The FTU is an off-line tester, meaning that the drive cannot be selected or used while tests are being performed with the FTU.

Magnetic Tape Unit – The SE Labs tape unit has built-in micro-diagnostics, with 99 switch-selected test programs. An indicator gives a 'run', 'pass', or 'fail' indication. In the event of a fail, an indication is also given by means of an error code which can be related to a program listing.

S&F Processor – this is tested using a test and verify (T&V) diagnostic program associated with the system. The main purpose is to test the various items of hardware comprising the Central Processor Unit (CPU) and peripherals. In all cases the T&V programs are resident on the system disk and need not be loaded from paper tape.

The processor T&V is designed to thoroughly exercise the CPU logical, shift, and skip instructions in differing modes of operation. If a T&V test fails, a number is output on the printer which can be related to the lookup table.

No difficulties are expected with the maintenance procedures on the new equipment, as they closely follow those already in use for the basic telex switch. To ensure secure fault handling, fault reports contain date, time, and call reference numbers.

Summary of system

For interest, the main dimensions of the system are –
- maximum message size, 8000 characters (about 20 minutes, or 120 lines of text)
- multi-address messages: maximum of 100 addresses per message
- maximum of 10 PRA codes per message
- maximum of 100 addresses per PRA
- maximum of 100 authorised users (selection codes) per PRA
- absolute maximum number of addresses per message is 1090 (10 PRAs with 100 addresses, plus 90 single addresses)
- maximum of 14,000 PRAs
- maximum of 5 PRIs
- journal capacity of 7 days
- storage capacity for 88,000 messages (average message of 1200 characters)
- BPA will handle 11,000 calls per hour (average message of 1200 characters)
- each SFU will handle 5500 input calls per hour (average message of 1200 characters)

(01-936 3322)

Re-program your memory fast

by **Graham McLachlan** LES1.5.3

Programmable memory devices are used in many modern electronic systems to allow the facilities offered by a system to be easily upgraded or modified. Using this flexible approach, BT has the ability to meet customers' needs for additional system facilities quickly, and to keep ahead in today's competitive markets.

The use of these devices in equipment supplied by BT, requires us to be able to re-program them when necessary. In the past this has been done either by removing devices from the printed wiring board (PWB) and then re-programming, or re-programming them using a purpose-built board programmer. It is not always practical to equip Area Repair Centres (ARC's) with dedicated board programming systems and, given the increasing usage of this type of PWB, BT is investigating advances in board programming systems to cope with future growth and technological advances.

Against this background, an order has been placed for what has been described as the world's first universal EPROM (erasable programmable read only memory) board programming system. This system was launched recently in the UK by Data I/O, and will be evaluated for use in ARCs.

The board programmer, known as the 156A, will be allocated to an ARC with the facilities to provide a rapid system software update service for local exchange and call connect systems, such as System X, UXD5, TXE4A and Monarch.

The new board programmer will have 32 times the capacity of current purpose-built board programmers. It is universal in as much as it can handle the types of work performed by all existing programmers, at the same time providing flexibility to meet future needs.

If the evaluation is successful the system will be installed in strategically-located ARCs around the country to provide a fast, nationwide, software update service. *(01-432 2818)*

Transverse-screen cables for digital transmission

by **Ian Dufour** LLS2.1

Transverse-screen cables were introduced specifically for carrying 2Mbit/s digital line systems. Their origin lies in two decisions taken in the mid-1970s –

- An international decision to adopt a 2Mbit/s and 30 channel hierarchy, whereas BT had been using 1.5Mbit/s and 24 channels.
- The decision by BT to adopt digital switching (System X), which affected overall system economics to such an extent that digital transmission between exchanges became the norm.

The result was that digital transmission requirements at the new – and largely untried – 2Mbit/s rate escalated beyond anything previously foreseen. At the time it was expected that the first few years growth in the junction network could be contained on the existing metallic-pair (quad) CJ cables with the use of optical fibre systems (OFS) in the later years. It is now a matter of history that the 2Mbit/s systems met with difficulties which substantially increased the cost of using existing cables, and the economics were unfavourable to the early introduction of OFS in the junction area. The resulting gap in the planners 'tool-box' was filled by transverse-screen cable.

Design

The design of transverse-screen cable had to balance the requirements of a number of characteristics, namely: DC resistance, attenuation, near-end crosstalk (NEXT) and far-end crosstalk (FEXT). All of these were interactive, but the DC resistance was of prime importance because of power-feeding limitations. The remainder affected the maximum distance achievable between regenerators. It is worth noting that the principal factors affecting the cable parameters are –

- the diameter of the copper conductor which affects the DC resistance;
- the attenuation, influenced by the diameters of, and rations between, the conductor and the insulation;
- NEXT, influenced by the screen design;
- FEXT, influenced by the screen design, the layout and twist length of the pairs. (A more detailed technical explanation can be found in British Telecommunications Engineering, Vol 1, January 1983.)

Aluminium foil

Over and above the technical requirements, was a need to have a cable which could be produced in quantity at short notice by the British cable industry. The end result was a cable combining a simple pair structure, common in most respects to the widely-produced 0.6mm local distribution cable, with a simple aluminium-foil screen used to separate the two directions of digital transmission.

Benefits

Apart from being a low-cost cable design, →

transverse-screen cables have the added advantage of being simple to install using existing practices and techniques. Many of these installation benefits are passed on to subsequent maintenance operations –

- Long length cabling (typically 500m and up to 1000m) means less joints to make and maintain
- Straight joints – pair 1 to pair 1, pair 2 to pair 2 and so on – means no complicated jointing schedules and subsequent records
- Shrink-down sheath closures give a first-class long-lasting seal in minimum time
- Limited testing minimises acceptance time both initially and after faults
- Limited range of stores items and manpower skills means better chance of reducing installation times and fault outage times.

Applications

Transverse-screen cables were introduced for junction network applications but they are now increasingly to be found in the local network. Here they are used for 2Mbit/s private circuits – MegaStream for example – and, soon, for 2Mbit/s links from digital PBXs to digital exchanges.

Although transverse-screen cables have been a vital link in the digitalisation program there is now considerable hope that optical fibre systems will be economical on quite a wide scale in the junction network. Optical cables could well displace transverse-screen cables for new provision within a couple of years or so. For local applications the transition will take rather longer but there is a fair chance that it will happen.

(01-357 3354) Editor's note: Optical fibre systems will be the subject of a future article.

New TIPs

by **Iain McIntyre** LCS/OPS1.2

TIPs (Telecomms Improvement Plans) were introduced in 1966. An essential part of these plans is setting invidividual targets for Regions, Areas and often for individual units in Areas. The level at which the targets are set takes account of differences and problems facing particular parts of the country, but it has always been an objective that TIPs should be challenging and just 'within reach' if an effort is made to achieve them. As well as the special considerations affecting Areas, there is a continuing need to improve the quality of the service we are giving to our customers throughout the UK. This need to improve is the major factor which influences targets.

Changes

From April 1984 a number of TIPs have had their definition changed or have been replaced by something new. These changes are listed in the table. This article explains the reasoning behind the changes.

Some of the changes were needed simply to tidy up definitions to take account of the change in BT's monopoly status. For example, TIP1 is now 'faults per exchange connection (EC) per annum' instead of 'fault reports per station per annum'. With plug-in telephones, customers can change telephone instruments without involving BT and there is no possibility of keeping track of the number of telephone stations in use in future. For the sake of continuity, **fault reports** will still be measured – by means of a new TIP (TIP1A) – but it will also refer to ECs per annum. There is also a relatively minor change to TIP2 in that carried forward faults are now only counted once.

Most of the changes are more fundamental, however, and have been made to ensure that our TIPs reflect more accurately the service **as it is seen by the customer**. For example, TIPs52 and 53 measure the whole path of a dialled call, whereas the superseded TIPs3 and 4 measured only from 1st selectors or 1st code selectors on local calls, and from the register access relay set on STD calls. This meant that failures to obtain dialling tone, or to get access to the GSC, were not recorded. It should be noted that TIPs52 and 53 have now been formally split into their plant defect and plant engaged elements, TIP52A, 52B, 53A and 53B respectively.

In recent years provision-of-service targets have been revised at intervals by shortening the target timescales. TIPs19, 20A and 20B are not strictly new TIPs, but the changes in definition which have taken place make them more testing. Inevitably this will bring BT's performance in providing service, up to customers' expectations.

Private circuits

Business customers, not surprisingly, place great importance on speedy repairs to private circuits (PCs) and it became obvious that the TIP2A definition 'percentage of faults cleared by the end of the next working day' was not

good enough. It has been replaced by 3 new measures: TIP42 – 'PC faults cleared in 4 working hours' TIP43 – 'PC faults cleared in 12 working hours' and TIP44 – 'percentage repeat faults'. These TIPs show how important it is to effect speedy repairs, but it should be noted that if there is a temptation to make temporary or inadequate repairs in the cause of speed, the result could be a good TIP42 but a poor TIP44!

Telcare

As part of the drive to make all BT staff customer orientated, targets have also been set, for the first time, for overall Telcare measures. Customers in all Areas are asked each month what they think of the service they have recently had from BT. Three hundred interviews are undertaken using the latest computer-aided telephone interviewing techniques, in each of the following categories –

- Provision of Service: business
- Provision of Service: residential
- Auto service: local
- Auto service: trunk
- Repairs: business
- Repairs: residential
- Billing

As mentioned in the article by Roger Sutton 'No noise is good noise', the preliminary study of the Telcare results has shown some major additional causes of dissatisfaction. For example, too many customers say that they had difficulty in trying to contact BT to

TIP	Definition	
	Old	New
1	Fault reports per station per annum	Faults per EC per annum
1A	—	Fault reports per EC per annum
2	Fault reports cleared by end of next working day (carried forward faults counted each day until cleared)	Fault reports cleared by end of next working day (carried forward faults count once only
6	—	Repair service PCA25
2A	PC faults cleared by end of next working day	Replaced by TIP42
3&4	Calls failed due to BT (local and STD)	Replaced by TIPs 52A, 52B 53A and 53B
42	—	PC faults cleared in 4 working hours
43	—	PC faults cleared in 12 working hours
44	—	PC % repeat faults per month
19	Res orders completed in 12 working days or customer's later required by date (CLD)	Res orders completed in 8 working days or CLD
20A	Bus small orders completed in 8 working days or CLD	Bus small orders completed in 6 working days or CLD
Telcare	—	New survey

Res = residential customers
Bus = business customers
CLD = customer's later requirement date

EC = exchange connection
PC = private circuit
PCA 25 = percentage of calls answered in 25 seconds

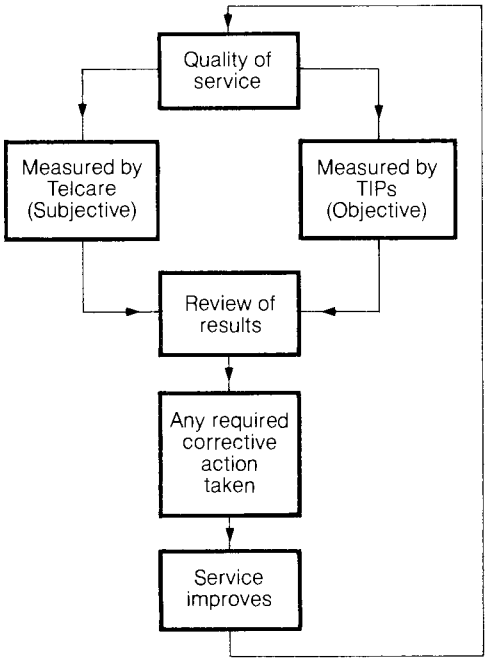
→

report a fault. To keep this important aspect of the service under review and to stimulate improvement, TIP6 has been introduced. It measures the percentage of calls answered in 25 seconds by the repair service.

Comparisons

But, is it realistic to react to our customers' recollections of the service they got? Won't different people have different standards and expectations? Figure 1 shows the situation we would normally expect to find. If the service is good, then the TIP measures (which are **objective**, that is they can be measured with reasonable accuracy as in say TIP2 'percentage fault reports cleared by the end of the next working day') and the Telcare measures (which are **subjective**, that is we record whether the customer is satisfied or dissatisfied) will be good. If the service is bad, then we would expect both to be bad. In practice we are finding that, generally, the best Areas as measured by TIPs also have the best Telcare results.

Telcare results can also be used to check whether the TIP targets as set are in line with the standard of service which our customers expect. For instance, a proportion of customers are dissatisfied with the time it takes BT to clear a fault. Telcare results have been analysed to show what length of time – from reporting a fault to completion of repair – they would be satisfied with. This analysis showed that business customers are less easily satisfied than residential ones. It was also possible to determine what the average fault clearance time would need to be in order to reduce the level of dissatisfaction to a figure which would give rise to few complaints. This sort of analysis is useful in helping to work out our priorities as we move into the era of competition, for we will only succeed if we can provide the service that our customers want, at a realistic price.
(01-432 4310)



Quality in the field

by **Les Waller** OPS2.2.5

What is Quality?

Quality can be defined as having been achieved when the product or service does what the customer expects it to do and what BT says it will do. Essentially quality means 'fitness for purpose' or 'conformance to a set standard'.

Does BT have a Quality problem?

Surveys of completed work, completed records and completed Advice Notes – allied to discussions with staff at all levels – have highlighted the need to improve quality standards over a wide area involving Sales, Planning and Works as well as Maintenance activities.

Who is to blame for Poor Quality?

Traditionally maintenance staff tend to blame:
- poor standard of construction work
- bad planning
- inadequate techniques
- 'fire brigade' maintenance policy
- inadequate supervision
- poor quality stores

Field surveys have shown the main reasons to be:
- lack of initial or refresher training
- inadequate supervision.

What is LCS doing to improve quality?

LCS Headquarters has set up a Quality

Council and LCS Areas have appointed Quality Managers to give added impetus to the drive to improve quality throughout LCS.

The recently compiled LCS Quality Manual states that to improve quality in the field there must also be:

- a dedicated quality policy
- quality management disciplines
- detailed quality plans.

To achieve this improvement LCS HQ is providing Area managers and staff with the means of achieving the required 'quality standards' by introducing detailed Quality Plans involving the use of specially designed checklists.

In essence these take the form of:

- a quality control system whereby first line supervisors use a formalised inspection procedure to check samples of completed work done by their staff. The staff too are helped, not only by receiving objective supervision and guidance, but also by being issued with a concise summary of the standards of work required.
- a monitoring system enabling higher management to ensure that the quality control system is doing its job and that problems identified are being acted upon at the appropriate level.
- a management information system which integrates quality control and monitoring procedures.

Where are quality systems being applied?

Quality checking systems have been designed to cover work in the field and in telephone exchanges.

In the maintenance field they already cover the work of Customer Apparatus and Line (CA&L) staff, maintenance jointers and faultsman jointers. For internal staff they cover TXE4 night routining. Further systems are being designed and these will cover the majority of outstanding major fields of activity.

For an up-to-date list of Quality Control Projects see Prestel, commencing at page 540161.

What part can I play?

To achieve success from any of the previously mentioned systems, staff at all levels must be totally committed to quality. Quality affects everyone's job in differing ways. During the National Quality campaign the Prime Minister said "Responsibility for achieving quality rests squarely with top management but everybody must recognise that quality is their business too".

Area and District management must 'set the scene' by taking an active interest in quality of work not merely by looking at the 'stats' but also by regular, personal visits to see for themselves the quality of completed work and by initiating appropriate remedial action where necessary.

First line supervisors also have a vital role to play.

The regular, disciplined, use of checklists with the emphasis equally on quality as well as quantity of work, provides a convenient and effective monitoring system which enables weaknesses in both plant and techniques to be rapidly identified. Don't forget the value of feedback. A good quality job is just as worthy of praise as a poor quality job is of criticism.

Finally, field staff themselves. The need for 'pride of workmanship' was never greater than in the new competitive environment. Checklists are there to make sure you don't overlook important items such as comprehensive testing and accurate records. After all, the flight deck crew of a Jumbo jet use a checklist, so why shouldn't you?

The opportunity cost of a poor quality job can be seen as the expense needed to correct the job, or, put another way, the cost of quality can be seen as the expense of doing things wrong. This applies equally to maintenance as to anyone else.

A slogan which has been adopted by us – and which we think should be foremost in everyones mind – is 'do it once do it right'. If we all try and apply that to our daily work the quality of work in BT must improve. *(0423 60781)*

Mini computer maintenance in BT Newcastle

by **Ken Sutcliffe** BTNE/NT/EO1

A report issued by BTHQ in 1982 made various recommendations to guide the business towards the in-house maintenance of its own computers. Newcastle Area – with a population of six similar Alpha Micro mini computers maintained by an outside agency at a high cost – was in an ideal position to take the initiative. So we set about assessing the feasibility of this type of venture – assisted by THQ and RHQ.

Following the study, a maintenance philosophy was formulated which identified the key factors to be satisfied for a viable computer repair organisation. This philosophy has now been implemented in Newcastle Area.

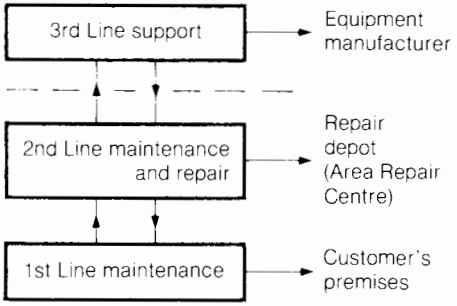
Maintenance philosophy

The overriding aim of the computer maintenance organisation is the rapid restoration of service both of computers and peripherals, at an economic and realistic cost. To this end, the procedure – illustrated in figure 1 – has been established.

First line maintenance

The 1st line maintenance engineer is expected to repair a broad range of computer and peripheral equipment using plug-in replacement units held in a maintenance kit. Routine maintenance and simple disk drive repairs are also within his domain.

Figure 1:
Computer maintenance – stages in organisation



Second line maintenance

The 2nd line maintenance engineer is located in a repair depot. In Newcastle this is the Area Repair Centre (ARC) – being eminently suited for the task. The engineer faults and repairs plug-in units down to component level, carries out repairs to disk drives which cannot be accomplished easily at a customer's premises, and also provides back-up to the 1st line engineer for both software and hardware problems.

Third line support

This is requested from the manufacturer if the 1st and 2nd line maintenance staff are unable to resolve the problem locally.

Training

To carry out these tasks efficiently, the computer maintenance engineers have received thorough training covering repair of the computer and two types of disk drive. To consolidate their training and build on their expertise, the staff are based in the Area Repair Centre where spare equipment has been provided for this purpose.

Types of equipment

The Alpha Micro systems which the Computer Service can presently maintain are–

- AM100 – 2 board CPU using WD16 chip set
- AM100T – 1 board CPU using WD16 chip set
- AM100L – 1 board CPU using MC 68000 processor.

The operating system used is called AMOS.

Coupled to the mini computers are disk drives, and direct in-house repairs can be made to CDC Hawk and Phoenix drives. At the present time Winchester-type drives have to be sub-contracted for repairs.

Peripherals such as VDT's, printers and so on can also be maintained.

ARC equipment

One advantage of basing the computer service in the ARC is the use which can be made of existing tools and test equipment. For example, wave soldering apparatus, logic and signature analysers, and so on. But to repair computer equipment efficiently, various items of specialised equipment have

been obtained. In this case –

- spare system including disk drives
- spare plug-in units
- special disk repair tools and repair aids
- disk spares
- diagnostic tester
- diagnostic software
- comprehensive documentation
- electro-static protection equipment.

These are some of the major items which have been obtained.

Support and assistance by the computer manufacturer is acknowledged as a vital factor in obtaining the repair tools and equipment, and easing BT staff into this area of work.

Encouraging results

Newcastle Area has now received a seventh Alpha Micro system to add to its maintenance commitment, and the early results of the computer repair service are encouraging (the agency contracts have only recently expired). Alpha Micro equipment is in use in other parts of the business on systems such as CAMEO3, CIRAC and CAIRO, and this service will offer a viable alternative to agency maintenance.

Future

The venture is considered as a stepping-stone towards profitable avenues of maintenance, with the benefit of an increase in job opportunities. When sufficient expertise has been established from dealing with this type of computer equipment, an expansion of the computer repair service is envisaged. *(0632 613268)*

The TXD maintenance organisation

by **Adrian Frame** LES4.2.2.

The introduction of System X local exchanges and digital junction switching units (collectively called 'TXDs') will have a marked impact on maintenance activities. Here we look at the proposed structure of the local maintenance organisation (LMO) put forward by LCS Headquarters. While these proposals will be flexible enough to meet most situations, District managers may choose to adapt this structure, or adopt a different policy, to suit local circumstances.

Objectives

The objectives of the TXD local maintenance organisation (LMO) are:

- to minimise the degree to which faults become service-affecting – by observation of the exchange processor output, for example
- to speedily restore service to customers when a service-affecting fault occurs (and the system has not automatically reconfigured to safeguard service)
- the economic and effective use of manpower and other resources, capable of being effective throughout the introduction of TXD and flexible enough to meet the needs of today's competitive environment.

The problems

Stored Program Controlled (SPC) telephone exchanges, such as TXD, present a unique set of problems to our maintenance organisation. Once established, the reliability of equipment using modern integrated circuits gives maintenance staff little opportunity to acquire and retain an in-depth knowledge of the system. Furthermore, the complexity and diversity of the sub-systems within a TXD makes it unlikely that anyone could become truly 'expert' in more than a couple of sub-systems. A traditional maintenance policy based on the philosophy of on-site fault-finding to component level, would require substantial investment in both training and sophisticated test equipment. The reliability of TXD will be such that this level of expenditure could not be justified. Indeed, when the fault is located, on-site board substitution and off-site repair will be the most cost effective maintenance method.

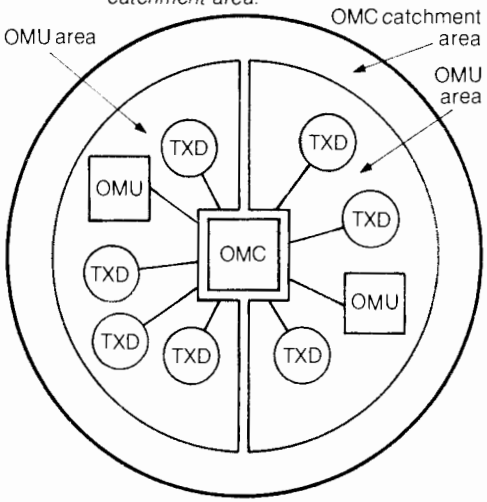
The solution

The maintenance policy formulated by LCS headquarters structures the TXD and concentrates expertise in –

- Operations and Maintenance Centres (OMC)
- Operations and Maintenance Units (OMU)

As shown in Figure 1, an OMC is situated in a telephone 'catchment' area at which, or through which, location various operational →

Figure 1: Typical relationship betweeen TXDs, OMUs and the OMC in an OMC catchment area.



OMU operations and maintenance unit
OMC operations and maintenance centre
TXD telephone exchange digital

and maintenance procedures are performed. OMC users cover several operational disciplines and are dispersed throughout the catchment area. The OMC comprises a processor and its associated port switching hardware, modems and peripheral equipment.

The OMU is an engineering base within an OMC catchment area comprising a number of visual display terminal and hard-copy printer work positions, together with other engineering support facilities. The OMU is the focal point for the maintenance of all TXDs in a defined geographical area.

An OMC may have more than one OMU connected to it. The first OMU – usually co-located with the OMC – is called the 'Main OMU', and the second and subsequent OMUs are called 'Satellite OMUs'. An OMU – together with all the TXDs with which it is associated – is called an OMU Area (OMUA).

(Len Strickland's article (MN 22) describes the OMC in more detail.)

Responsibility for the service given by the TXDs rests with the Engineering Maintenance Manager In Charge of the OMUA. He is responsible for monitoring the service given by all the TXDs in the OMUA and ensuring that maintenance and allied engineering activities are executed in the most suitable way.

The size of the maintenance workforce required to 'staff' an OMU is based on the total number of TXD connexions in the OMUA. Allowances are given for any travelling that may be necessary and other activities performed by the OMUA staff. This staff will be responsible to the Engineering Maintenance Manager for the operation and maintenance of the OMUA as a whole. But, since the OMUA will comprise the workload of more than one Exchange Maintenance Technical Officer (EMTO), each OMUA may be sub-divided into sections with the prime responsibility for the maintenance of particular sections being allocated to individual EMTOs.

The maintenance workload of all TXDs in an OMUA – including OMC and OMU equipment – includes the maintenance duties in the OMU. So, wherever possible, EMTOs will share in the OMU duties on a rotational basis.

How will the TXD-LMO work?

As TXD penetration increases, there is likely to be more than one OMU per OMC. All OMUs will be staffed during normal working hours. But while there is low TXD penetration in an OMUA, the OMU duty may include on-site maintenance of co-located TXD equipment, or other system monitoring maintenance tasks. Areas will assess – and periodically review – the need to staff an OMU and whether to concentrate two or more OMUs into one.

Exchange alarms and automatic fault report output are presented at both the TXD and the OMU at all times. Monitoring of these alarms and ouputs is carried out both at the TXD and the OMU and, if the EMTO is in attendance at the TXD, he will take the initiative for appropriate action. When the EMTO is not in attendance, or for some other reason is not able to deal with the report, the responsibility for initiation of action rests with the OMU.

Where a TXD is co-located with its OMU, it may be more effective for some of the 'on-site man-machine interface (MMI)' activities to be done in the OMU.

When a fault occurs at a TXD and the EMTO is not in attendance, the OMU initiates diagnostic action. After initial attention, if a site visit is needed, the OMU contacts and advises the EMTO to attend the TXD concerned. On arrival at the TXD, the EMTO assumes responsibility for fault clearance.

The OMU is the centre for fault records and documentation for the OMUA. It has facilities for carrying out in-depth analysis of problems and faults. As such, the OMU provides technical support to EMTOs when required.

In addition to the support facilities provided at the OMU, LCS Headquarters have established a Maintenance Support Agency (MSA). The MSA is available 24 hours a day and acts as the primary interface between the District and the design, development and support resources within the British Telecom and the manufacturers.

The OMU is the communication point for all matters affecting the integrity of the network as a whole – at all times – and for all other matters concerning individual TXDs when the EMTO is not in attendance.

It is hoped that the policy and organisation outlined in this article will meet service objectives while giving due regard to the problems peculiar to TXD and the needs of staff employed on maintenance duties.

(01-432 9027)

TXE4: Performance update

by **Peter Jones** and **Deryck Rogers**
LES4.3.1

In *Maintenance News 22*, Peter Jones discussed performance indicators and the performance improvements sought for TXE4. Now he and Deryck Rogers report on the improvements that have been achieved, and examine the scope for greater achievements.

Our slice of the cake

At the time of writing, there were 338 TXE4(RD)s and 27 TXE4As in service, with a capacity of 3.7 million Exchange Connexions (ECs). TXE4s make up 6% of all exchanges and serve 18% of all ECs. By 1990, a third of all our customers will be served by about 570 TXE4s. The system is also changing; we have hybrid exchanges that are a mixture of TXE4A and TXE4(RD) control equipment, and facility changes brought about by enhancements. These factors should ensure that TXE4s will be around for a considerable time.

Present Performance

There are many ways of assessing exchange performance, the latest of which is Telcare (see 'New TIP's' in this issue).

But TXE4 performance is judged by other indicators, such as:

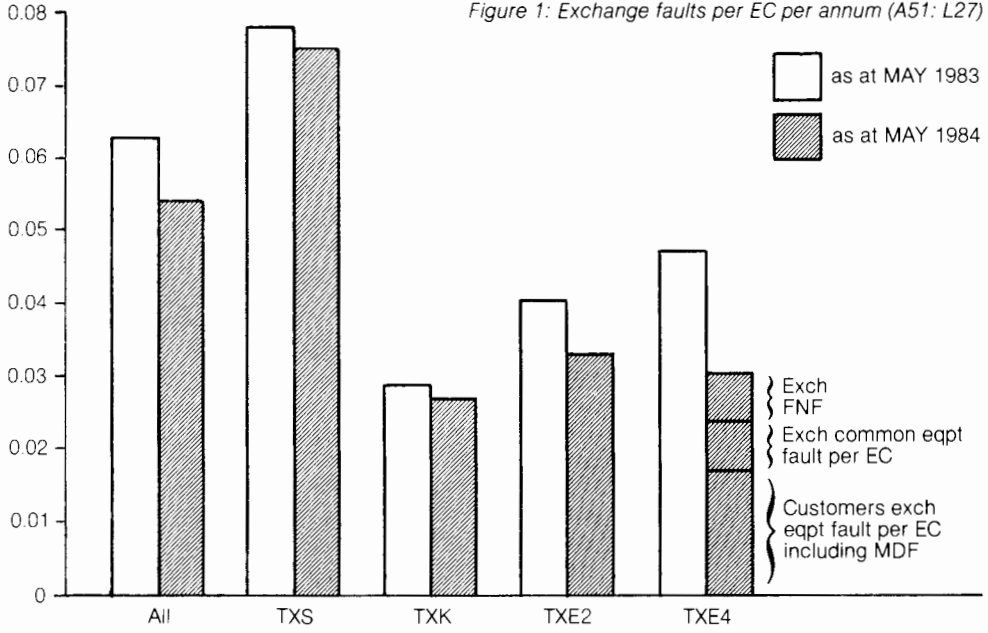
- A51 Results: Line 27 Customer Reported faults per EC per annum. This statistic was known as Line 28 until recently.
- MAC: MS1 Own Exchange Plant Defects
- Mean Time Between Major Service Failures (MTBF – average time between Major Service Failures per exchange).

□ A51:

Figure 1 shows that we have made considerable progress in improving the exchange fault rate, TXE4 now being second only to Crossbar. But we know that customer complaints are directly related to calling rate and, if that is taken into account, TXE4 would show the best performance. Even so, there is still room for improvement as can be seen from the distribution of A51 results shown in Figure 2. Those exchanges that are in the right-hand tail are not achieving anything like the performance that the system is capable of, even when calling rates are taken into account. So where can we get further improvements? Most of the faults are associated with customers' exchange equipment which includes the rather unglamorous MDF. For various reasons, work carried out on the MDF fails to enjoy the high quality of workmanship enjoyed by the rest of the exchange. Dry joints are still our biggest problem. They not only give rise to poor A51 results but also generate noise faults that often go unreported, but are reflected in Telcare results.

Another aspect of A51 performance is that of Faults not Found (FNFs). We have found that exchanges with few FNFs also enjoy good co-operation with their Repair Service →

Figure 1: Exchange faults per EC per annum (A51: L27)



Control (RSC). This leads to correctly diagnosed faults that reduce the number of FNFs and, consequently, reduces the amount of maintenance time wasted looking for faults that are not there.

□ MAC

The MAC results (MS1 PD) for June 1984 are shown in figure 3. They show that TXE4 is now the clear front runner in MAC performance, and is well on course for its target of 0.15% by March 1985. The results mean that, on average, TXE4s have less than two MS1 PD faults per month so every fault counts. If we are to maintain and improve our lead, it is vital to eliminate 'own-goal' faults such as forgetting to release an access circuit after tracing a MAC-held call. Figure 4 shows the distribution of TXE4 MAC MS1 PD results for May 1984. It can be seen that over a quarter of all TXE4s had no MAC failures for that month. It can also be seen that there are still some TXE4s that are out of line with the rest. Their poor performance is usually associated with poor quality extension work and lack of attention to 'A' relays and coin-and-fee check equipment (CFCs). This is often aggravated by poor documentation of faults and inadequate records.

Additional maintenance information on MAC performance can be gleaned from Evening Session results. These are more important than Day Session results for those exchanges that have their busy hour during the evening.

□ Major Service Failures (MSF)

The MTBF of TXE4 has improved from 14 months – early last year – to 30 months at present. However, it can be seen from Figure 5 that we still have a long way to go. The 50 year MTBF of TXS (strowger exchanges) is really the MTBF of the power supply, power distribution and tone generators. It is very difficult to isolate a TXS other than 'failing' that equipment, because of its distributed control. TXE4 can be more directly compared with TXE2 and TXK1/3 because they are all common control systems. If MSFs caused by Working Party faults in TXE4 could be eliminated, we would have an MTBF of nearly 20 years. This can only be achieved by:

- carefully following procedures, such as never removing a unit marked with a red triangle unless the necessary procedures have been followed
- doing work on sensitive parts of the exchange during light traffic periods
- taking particular care when doing System Security Checks (formerly known as Dormant Fault Checks)
- caring about the quality of the work done in

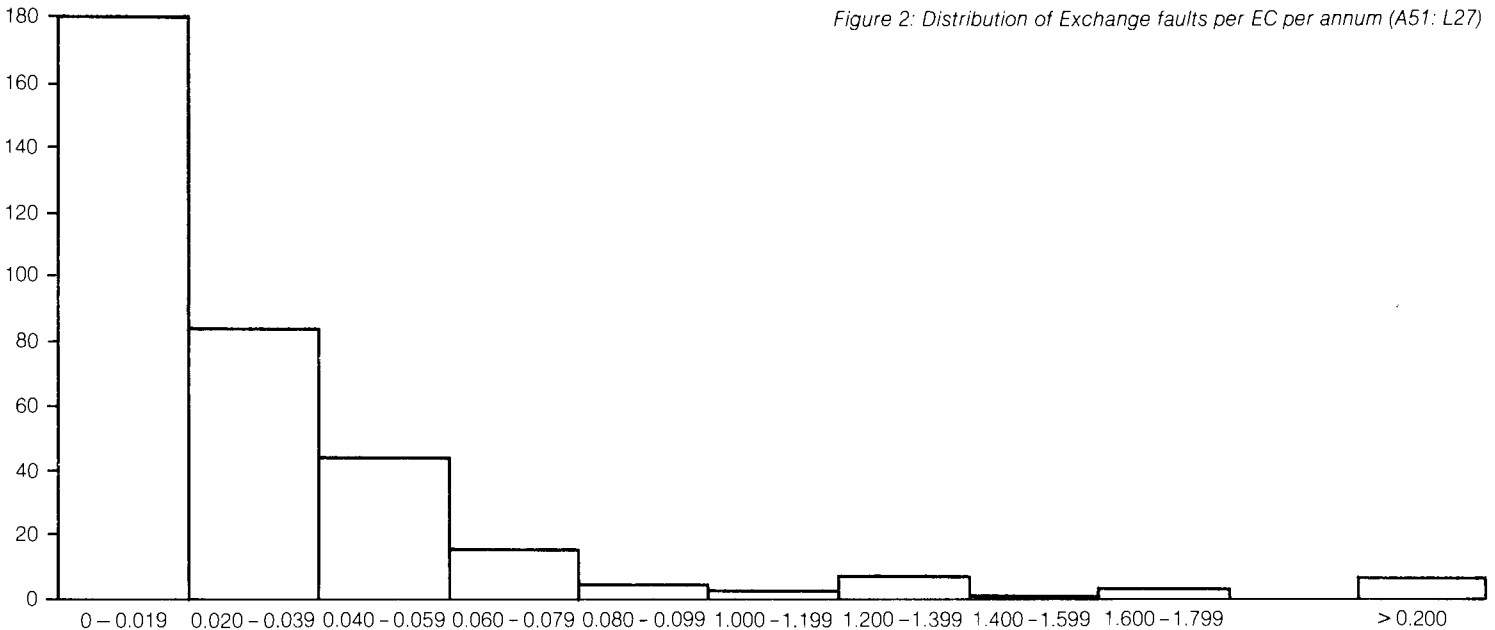


Figure 2: Distribution of Exchange faults per EC per annum (A51: L27)

your exchange – insulating your wrapping tools would also help.

It is interesting to note that the improved design of TXE4A has resulted in only one Design Deficiency being identified that causes FNFs, as opposed to 27 in TXE4(RD). Even so, both systems have the same MTBF. In other words, almost all of the MSFs that have occurred in TXE4A were caused by working parties.

The future

□Future targets

The national TXE4 targets for the three main indicators are: –

- A51 – 0.025 (by end of March 1985).
- MAC MS1 Own Exchange Plant Defects – 0.15% (by end of March 1985).
- MSF – MTBF fo 5 years (during 1984).

Most exchanges have already achieved or bettered the above targets. With the emphasis now on Quality, the above targets, along with other performance indicators, will be embraced by Area (District) Quality Plans, taking into account local circumstances. Other facets of maintenance will be included in the Quality Plans including the accuracy of records and the importance of correctly recording fault information as mentioned earlier.

□Major role

TXE4 has a major role to play in providing service for our customers in the future.

Nationally, TXE4 is providing a better service than any other major system but some TXE4s still have room for improvement.

Major service failures by careless action are our greatest weakness.

We cannot afford to be complacent if we are to maintain and improve our present performance.

(01-432 2457)

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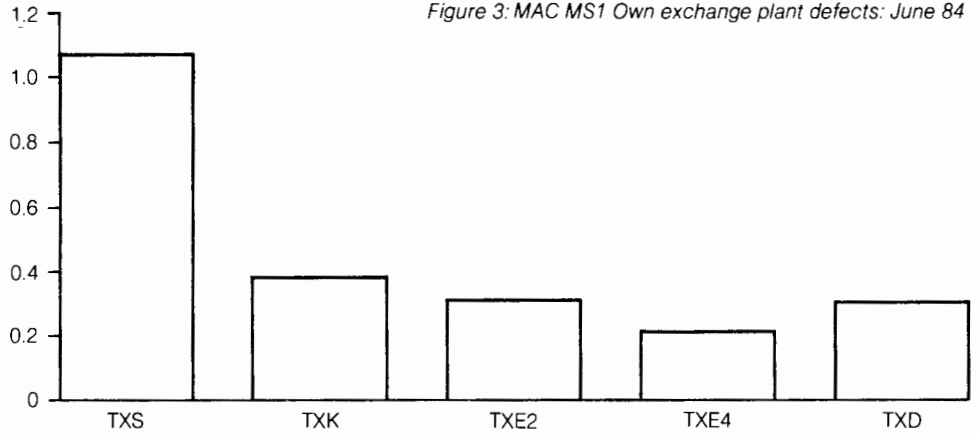


Figure 3: MAC MS1 Own exchange plant defects: June 84

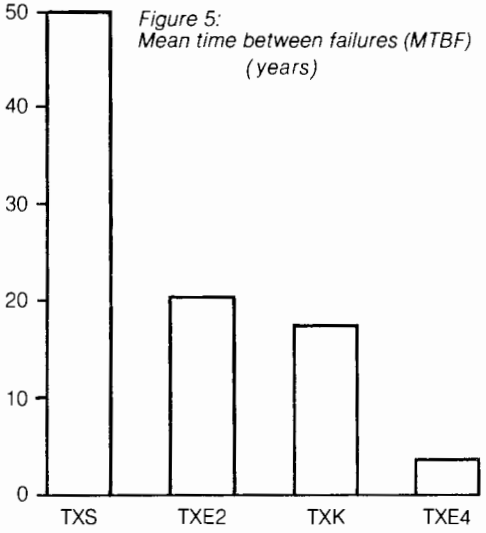


Figure 5: Mean time between failures (MTBF) (years)

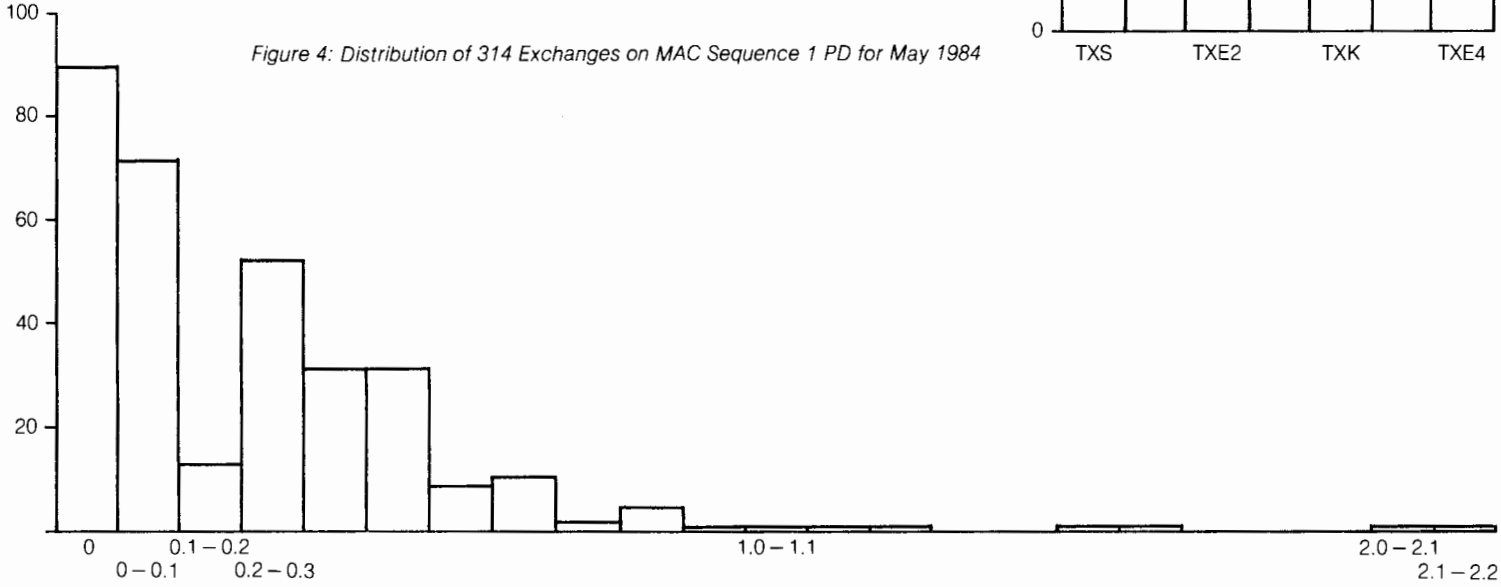


Figure 4: Distribution of 314 Exchanges on MAC Sequence 1 PD for May 1984

National network co-ordination centre review 1968-1984

by **Jim Gipp** NN/TSO2.3.3

NCCs were set up in 1968 with a general brief to monitor the performance of the whole telephony network by collecting data about major service failures. They are also responsible for controlling the removal of plant from service for planned work, in such a way that service loss is minimised by the use of the Service Protection network (SPN). Also they keep watch on the performance of HF links and trunks rented by the television authorities.

When it opened, the National NCC comprised of 2 engineers and 1 CA. It had grown to 8 engineers and 5 clerical staff by 1978. Now, with the introduction of microcomputing facilities, it has 6 engineers and 3 clerical staff.

Network growth

Over the period, we have seen the main network grow from less than 150,000 circuits to about 420,000 circuits. To accommodate these there were about 330 coaxial and microwave radio links in 1968, whereas there are now some 1650.

Equipment improvements

At the start of our existence, all transmission systems employed frequency division multiplexing (FDM) and virtually all were valve operated. Valve systems have not gone from the coaxial network and new growth is with digital systems.

Also during the period, although there has been little change in the total number of exchanges, then they were all Strowger, whereas now there are 63% TXS, 10% TXK and 27% TXE.

FDM Performance

In 1968 the failure rate on main links was more than 4 faults per 1000km per annum, with an average outage per failure of about 3 hours. These figures have improved to 1.5, and ¾ hour respectively. The reduced failure rate has been brought about by the introduction of transistorised transmission equipment and the use of the more rugged smaller bore coaxial cables having continuous dielectric. The reduced fault outage time results from the use of the Service Protection Network.

National NCC output

NCCs, in addition to being involved in the day-to-day operational control of the network, produce regular reports on network performance. National NCC produce regular statistics tailored to meet the needs of various committees, and weekly summaries of major service failures. The statistics have been used to indicate trends in performance and to estimate required network performance parameters for new systems, in particular the growing digital network. The summaries draw managements' attention to the sort of failures occurring in the network, so that appropriate remedial action can be taken.

Over the years these summaries have contributed to an increased awareness on the part of maintenance engineers.

Network records

Our greatest difficulty has always been the maintenance of accurate records of the make-up of the HF network in terms of plant and broadband use. These have improved with the introduction of computers, and for the digital network a system has been developed using Telecom Gold's Dialcom computers. This has enabled all NCCs, and some major repeater stations, to have access to common records. These are used when setting-up make-good routes, and identify private circuit customers affected by network abnormalities so they can be informed. In spite of these improvements we are, of course, still dependent on getting accurate and timely information about network changes.

Failure reports

During 1983 the NNCC received over 4000 reports of major service failures and miscellaneous events. Of these, some 800 →

related to HF link failures which, in turn, contributed to the loss of 2200 hypergroups. 1000 reports were received from exchanges which suffered restricted service or isolation. Failures to television links reported to the NNCC totalled 820, and 875 programme circuit failures were also notified.

Included in the total of reports received were about 800 relating to miscellaneous events which are not normally classified for statistical purposes.

Planned Work authorisation (Form A60)
In the course of 1983, the planned work duty processed and authorised over 2400 planned works. These included authorisation to cover remedial work on trunk cables to ensure that the performance of the coaxial pairs would be up to standard for digital transmission. The protracted nature of this work placed an even heavier burden on the Service Protection Network (SPN) facilities.

Also contained in the total 2400 planned works were 400 jobs which required plant to be released from service for periods in excess of one minute, and hence necessitated the issue of a Form A60. In addition, the early part of this year also saw the introduction of procedures to deal with the digital network and in particular the 'X-stream' services.

As well as this, the duty has a continuing commitment to produce and maintain contingency plans to cover catastrophic fault situations, such as a complete failure of submarine cables to the Channel Islands.

The future
There are two major features that should be mentioned. One is the introduction of the automatically switched digital SPN (ASDSPN) which will operate at the 120/140 Mbit/s level. This will be computer operated and will include a telemetering system which will inform NCCs of route failures and the current configuration of the network. The system will produce an historic record of operations and this will be used for statistical analysis.

The other feature is likely to bring together the NCC and network traffic management functions under one roof in a Network Management Centre.
(01-257 2241)

Cellular radio

Telecom Securicor Cellular Radio Ltd (TSCR), a subsidiary of British Telecom, has recently been launched. Here is an outline extracted from "The Review" of the market situation, together with an explanation of how cellular radio works.

Soon we will see the introduction to Britain of a new telecom technology which should boost BT's business.

But much will depend on whether the race for customers is won by TSCR, the joint British Telecom-Securicor cellular radio company, rather than private sector rivals Racal Millicom.

Both groups have been given a licence to operate and will compete for the same customers throughout the UK. Both have been told by the Government to offer a service to over 90 per cent of the country by the end of 1989.

The fight will be fierce. TSCR (in which BT owns a majority of the shares) will use British Telecom engineers to plan, design, install, commission and maintain the system of base stations, transmitters, receivers and switches. Much of the equipment will be installed in BT premises.

BT will also act as one of the system's retailers – selling and installing handsets and billing its customers.

Large numbers of BT staff are already active in a number of areas of work.

As Racal and TSCR are competing for

exactly the same customers, the amount of extra work coming BTs way depends on who is the more successful company.

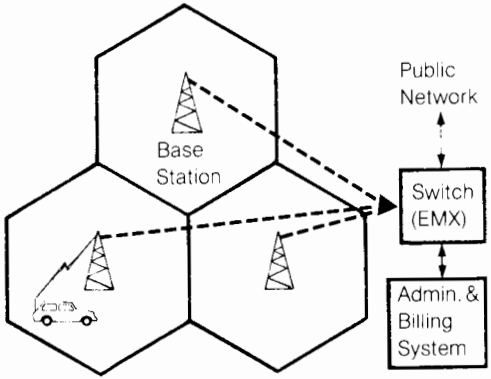
Cellular radio, the latest telecom technology, is expected to create entirely new business, and will not rival the BT network.

It offers business people a new technology which enables them to be in touch wherever they are.

As well as handsets in cars, truly portable telephones will be available, for the first time. The service will be a great improvement on present car radio telephones.

The equipment for the network is being supplied by Motorola, which, although an American company (the UK's cellular radio technology is based on an American system) does have a large base at Basingstoke, where, increasingly, equipment for the system will be manufactured.

BT's licence requires a coverage of 90 per cent of the UK by the end of 1989.



How it works

Britain is divided up into 'cells' varying in size from 2 miles across to some 30 miles across according to local terrain and likely customer numbers.

In each cell there will be a transmitter/receiver.

Customers travelling around Britain will simply dial the number they want on their mobile handset.

The handset sends out a signal that hits the nearest transmitter/receiver.

This transmitter/receiver will change as the customer moves through different area 'cells'. But the customer will be unaware of any change.

The transmitter/receivers connect with the BT network.

Calls are logged on a central computer for accounting purposes.

With acknowledgements to The Review/April 1984.

Blinded by the light

by **Dave Haskell** BTWM/TEM 3.2.1

All too often the stable door is closed after the horse has bolted! Sadly this has frequently been the case in the provision of effective voltage surge protection for External Overhead and Underground Plant.

Due to the sporadic and unpredictable nature of electrical storms, the extent of damage that can occur from direct and indirect lightning strikes tends to be minimised in a lot of minds. In the past luck, rather than good judgement, has saved the day on numerous occasions. However, the advent of voltage sensitive electronic switching systems means that consideration has to be given to effective protection – otherwise the business will pay heavily in terms of loss of service, damage, and renewal costs. Above all there is the safety risk, which clearly cannot be overlooked.

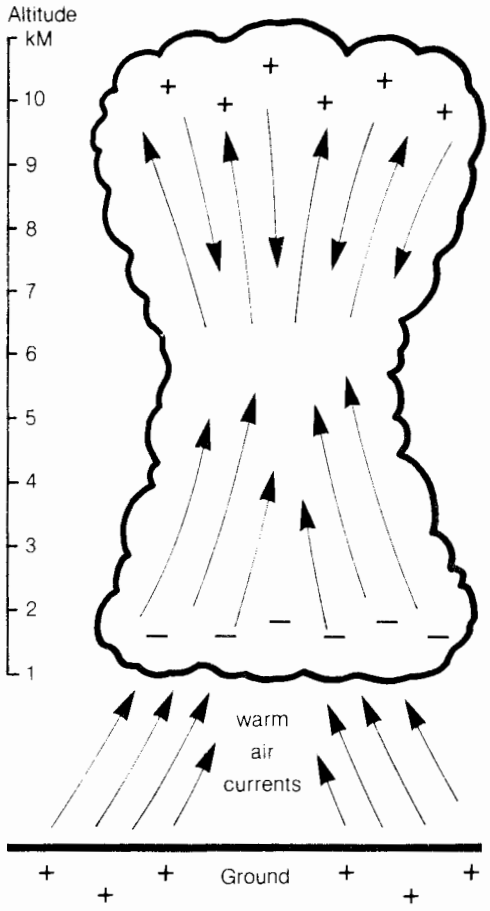
Examine your own records and you will be sure to find many instances where damage has occurred to plant due to ineffective protection. If so, read on!

Donner und Blitzen

A typical cumulonimbus storm cloud – as shown in figure 1 – is created by a rapid upsurge of warm, moist, air to great heights.

Strong air movements take place with winds reaching altitudes of 10,000 metres, and cooling of the elevated air masses leads to heavy condensation. The storm clouds →

Figure 1:
Formation of a typical cumulonimbus storm cloud



reach heights at which temperatures are below 0 degrees Celsius, resulting in precipitation in the form of ice crystals or super-cooled droplets. Usually both forms are present and the alternation between ice and water droplets produces a high electrical potential. The negative and positive charges are separated owing to the different speeds at which ice and water fall, so the clouds act as generators. When the air becomes overcharged, a lightning discharge is produced. The resulting sudden increase in pressure in the path heated by the lightning, leads to a shock wave heard as thunder.

The electrical potential of a strike can reach 100 million volts and the current can be up to 200,000 amperes, although an average value is nearer to 25,000 amps.

The energy involved in each lightning flash is about 100 kilowatt hours, enough to supply the average household with electricity for a week or more.

Fortunately, the number of actual strikes is very small small in proportion to the total number of lightning flashes, since many occur as discharges from cloud to cloud. If a fire is caused it is usually the result of lightning with a long discharge duration. Very brief flashes are termed cold strikes since – although temperatures of 10,000 degrees Celsius are reached – they are too short-lived to ignite the material involved.

Because of the high voltages involved in a lightning strike, it does not require a direct strike to harm telecommunications plant. A nearby ground strike can induce very high voltages, resulting in considerable damage not only to nearby plant but, because of the conductivity of our cable network, also over a very large area.

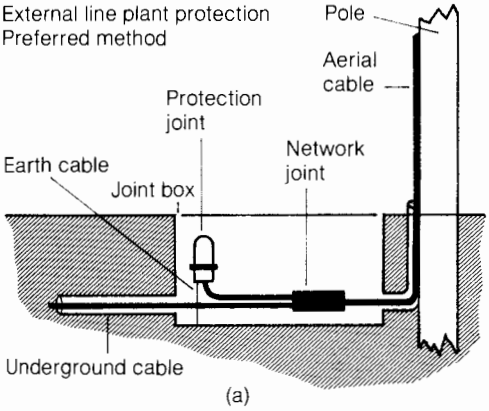
Gas discharge tubes

The devices in use for protection of the External Plant Network are commonly known as Gas Discharge Tubes and the Vocabulary of Engineering Stores defines them as Protectors. A gas discharge tube consists of two electrodes in a small evacuated envelope into which a small quantity of rare gas has been introduced. It 'fires' at about 210 volts and has a switching time in the order of microseconds. At the striking voltage a discharge is established and the device conducts. When this voltage disappears the gas discharge tube ceases conducting and restores to normal.

Devices in use at present are mainly protectors 5A, 14A, 17A and 18A.

Protectors 5A are used to provide protection at primary connection points (PCP's), customers' premises and at Radio and TV Stations. It is a plug-in device and one is required for each leg of the pair. Protectors 14A are three-pin plug-in devices, the centre pin being the earth connection and the outer pins line connections. Their main function is to provide protection on main distribution frames (MDF's).

Protectors 17A and 18A are basically an encapsulated Protector 14A with three



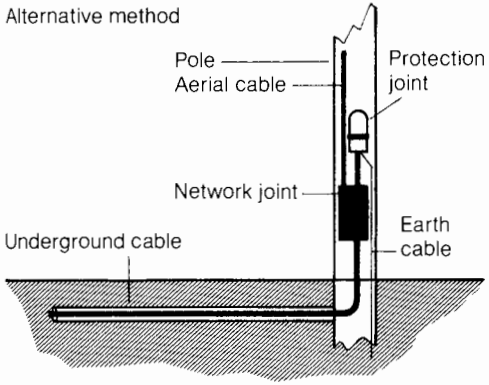


Figure 2

terminating wires. The two short red wires are the line connections and the long green wire is the earth connection. This device is predominantly used for providing protection in underground and aerial cable joints.

Only one Protector 14A, 17A or 18A is used per pair of wires.

Lightning protection joints

BTWM have pursued the development of the cap-ended Sleeve 31A and 32A as a lightning protection joint using protectors of the 17A type. Figure 2 details their recommended use. Sleeves 31A and 32A can provide protection for up to 50 and 100 pairs respectively.

To ensure that a good quality joint is achieved, BTWM supply a kit containing all the necessary items to produce a protected joint. They are known as 'kits closure lightning protection 17A', (KCLP17A). Currently, over 5000 kits have been supplied to the field without any reports of failure so far – in fact, the feedback has been very encouraging.

Aerial cable and dropwire protection

In the External Plant Network the aim is to protect BT plant, personnel and customers at extremes of the network. The exposed overhead cable can be sacrificed, so long as the 'E' and 'D'-sides of the network are protected. Damage can be minimised on long aerial cable routes by 'fragmentation' – that is, by providing protection at intermediate points along the route. Obviously, the number of additional protection points will depend on the length of the route and the probability of lightning on the length of the route and the probability of lightning strikes. See figure 3.

Should the aerial cable route contain a number of High Grade circuits – and loss of service cannot be tolerated – it is suggested that gas discharge tube protection is provided at the ends of the exposed section, and a steel catenary wire suspended about 4 inches above the aerial cable for the length of the route. The catenary wire will be bonded to the earth at the protection points and earthed at, say, every 4 or 5 poles along the route.

The catenary wire will then act as a lightning conductor

TV and radio station protection

At radio stations the requirement is to safeguard BT plant, personnel and customers both within and outside the rise-of-earth-potential area. This is currently being achieved by employing the 'equalisation method' rather than the 'isolation method' of protection, see figure 4.

Radio stations, by their nature, are **extremely** prone to electrical discharges from the atmosphere – much more so than external plant overhead cables, so have to be treated accordingly.

If protection at radio stations is not carried out correctly, situations hazardous to BT plant, personnel and customers can arise. It →

Figure 3:
Example of aerial cable and dropwire lightning protection.

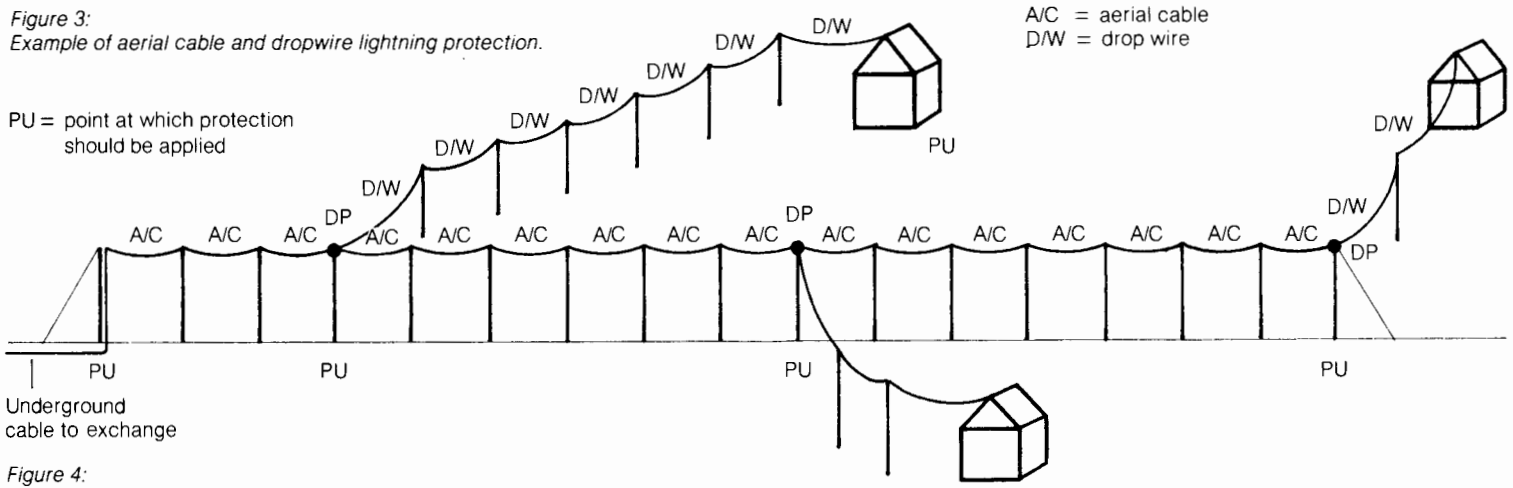
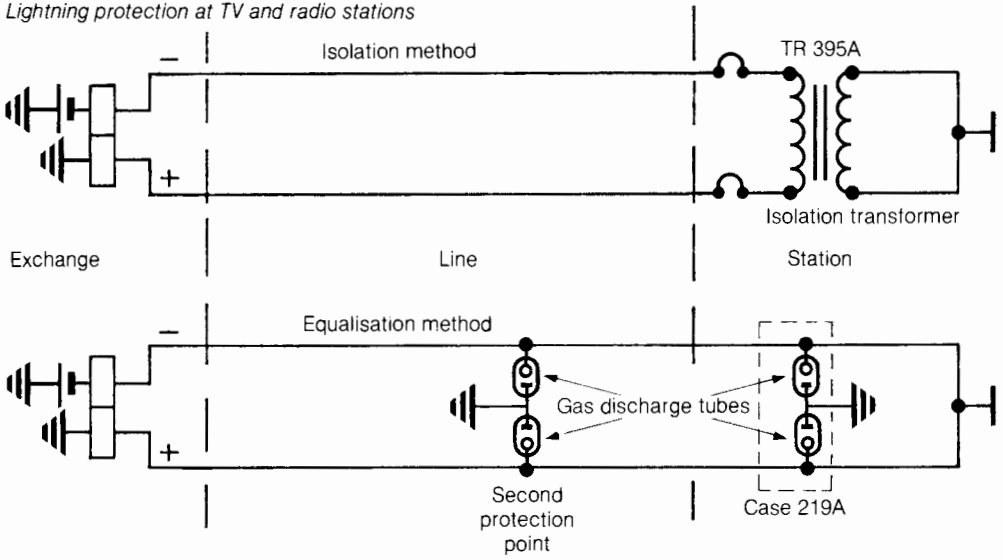


Figure 4:
Lightning protection at TV and radio stations



is imperative then, that the correct principle is employed coupled with a high standard of workmanship.

With the 'equalisation method', protectors are provided at the station and at a point along the station feeder cable defined as the 'second protection point'. When lightning strikes, the potential of the ground around the mast rises by several thousand volts compared to the ground potential at the distant exchange. This voltage places extreme stresses on BT equipment and the cable feeding the site. To overcome this, protectors are connected to every cable conductor. At the instant of a lightning strike

the protectors allow the station ground potential to appear on the cable conductors in an attempt to equalise the potential.

This is where the 'second protection point' is **vitally** important – not only in correct positioning away from the mast, but also in the quality of the workmanship – since it is at this point that the surge on the cable has to be 'dumped'. If the 'second protection point' is incorrectly situated, or suffers from inferior workmanship, the surge will pass along the cable into main cable network with disastrous and possibly fatal results!

Provision of earth electrodes

The provision of a good Earth cannot be over emphasised. It is a waste of money providing protective devices only to provide an ineffective Earth.

Where lightning protection devices have been fitted and shown to be inefficient, it is nearly always because little or no attention has been given to the provision of a good Earth.

It should be noted that the value of the Earth required for external plant overhead cables is 40 ohms or less, and 20 ohms or less for the 'second protection point' at radio stations.

It is for this reason that the latest instructions on the lightning protection of external overhead plant and radio stations, now have a table of requirements to produce an Earth of the above resistance values in soils of different volume resistivities, using copper tape, earth spikes and rods.

It must be pointed out, though, that the only meaningful evaluation of an earth electrode is by means of an electrical test, so this procedure is recommended in all cases.

Future trends

In an effort to contain costs and improve on productivity a new kit (kits closure lightning protection 18A) is being developed. The matrix board of the new kit will – for the same overall dimensions – have double the capacity as that of the KCLP17A. Also, the new matrix board will have an in-built earthing strip, thereby reducing the parts contained in the kit and make for easier and quicker connection of the protectors.

Finally, good lightning protection not only safeguards plant and personnel – it is also cost effective. With kits now under £10 the cost is recovered the first time a fault is prevented.

As the title of this article suggests, don't be Blinded by the Light, but open your eyes to the savings possible – in lives and cash – by good protection.

(0222 391433)

Letter

Our Merlin correspondent, who informed us about corrosion of line jack units in MN24, draws our attention to something new . . .

Trunking for Box Connections 300

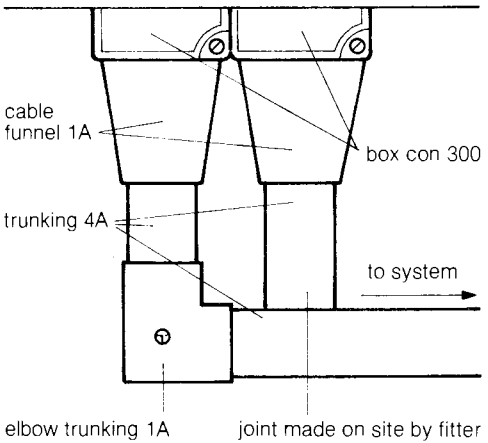
For several years the installation of a Box Connection 300 meant the installation of several feet of visible and unsightly cable.

A new trunking system has just been introduced for use with the Box Connection and Merlin system boxes.

It comprises of the following three components:

Item	Item Code	use
Cable funnel 1A	07 2274	Replaces an end panel in a Box Connection 300 and provides a neat interface to the Trunking 4A
Trunking 4A	07 2272	2inch × 4inch plastic trunking with clip-on lid supplied in 2m lengths
Elbow 1A	07 2273	Elbow 1A 90 degree plastic elbow for use with Trunking 4A

→



The system boxes for Merlin's Regent (Box Connection 350) and Herald S5102 (Box Connection 335 and 336) are being issued with Cable Funnels 1A already attached, enabling direct connection to the trunking.

So the next time you visit a site why not neaten it up with a bit of trunking?

R Coates, BT Merlin/SE 2.1.3, (0394 693467).

National Networks: trunk services-maintenance

by **Peter McKenzie** NN/TSO2.3.6

At the end of June 1984 National Networks Trunk Services employed nearly 9350 staff, 61 per cent of them in the largest Division: TS02 – the Maintenance division. But what is the role of this Division and what is the size of the Network maintained by them? Before answering these questions perhaps we should ask, why National Networks?

The reasons

National Networks (NN) was created in the Spring of 1982. The BT Board's reasons for splitting the then Inland Division into NN and Local Communications Services (LCS), as independent profit accountable businesses, were based on two driving forces, one external and one internal.

□ The external forces included –

- the emerging competition – the licensing of Mercury being only the tip of the iceberg
- customers' expectations – as customers become more reliant on telecommunications they place increasing demands on their telecommunications suppliers to improve, and add to, the services provided
- technology – technology now provides the capacity to deliver the new services customers require.

□ The internal forces included –

- the fact that to meet the external forces, if run in the old traditional monolithic form, BT could not meet the demands being made upon it as a Business,
- to take and implement decisions faster, it was realised that smaller, more manageable, units were needed, based on the new market segments.

The Structure

To meet its responsibilities, NN has been set up as two separate profit centres – Trunk Services (TS) and Specialised Services (SS). TS has business responsibility for the STD services, SS has responsibility for a wide range of services including Telex, Packet Switching and long distance private circuits.

The size

TS Division became fully operational in April 1983 at District Office level. During the following year District Office staff, and District Managers Trunk Service (DMTSs), planned and managed the orderly transfer of some 7600 Area staff into the TS Divisions.

As at the end of June 1984 the distribution of staff was as follows:

Trunk Services Division	Reference	Staff Nos
Operations	TS01	650
Maintenance	TS02	5738
Systems Engineering	TSP1	132
Transmission & Switching Planning	TSP2	284
Transmission Works	TSP3	1106
Switching Works	TSP4	1176
Finance	TSF	83
Commercial	TSCM	19
Personnel	TSPM	80
Computing Strategy	TSCS	79
TOTAL		9347

With a relatively small staff – 3.9 per cent of BT's total workforce – Trunk Services is organised vertically; that is, all Planning and Works is integrated into one structure from Head Office to District level – and similarly for Operations and Maintenance. The purpose of this is to create an organisation more responsive to take on the major technical and commercial tasks of the next few years – particularly that of changing the trunk network from analogue to digital technology. The vertical structure also ensures that lines of communication are short and information can pass rapidly through the Division.

In terms of assets NN owns trunk transmission down to Group Switching Centres (GSCs) or Digital Principal Local Exchanges (DPLEs) and trunk switching down to and including GSCs or Digital Main Switching Units (DMSUs).

The trunk network currently consists of more than 417,000 trunk circuits controlled from 435 Trunk Maintenance Control Centres (TMCCs). There are 444 group, transit and sector switching units, served by well over 600 repeater stations and 195 radio stations. These represent an asset base with a value exceeding £1.4 billion. It is also a network which is growing and absorbing new technology. While the existing analogue network will continue to function until the late 1980s, a digital network will grow alongside.

More digital transmission systems are already in service and the initial Digital Main Switching Units (DMSUs) are coming into service. Eventually there will be 60 large, fully interconnected, DMSUs capable of providing enhanced STD services and allowing the introduction of new competitive services.

Good marketing and selling alone does not sell new services unless they themselves are effective and backed up by an efficient maintenance team. This maintenance team also includes LCS staff.

The Maintenance Division

The vast majority of the Regional and Area staff transferred to NN/TS are now in the Maintenance Division (TS02).

The overall responsibility of TS02 is to determine and implement such policy as is necessary to ensure the economic maintenance – and progressive improvement – of the standard of service, provided by the transmission and switching plant in the trunk network.

In the transmission field this includes the maintenance of all analogue and digital line and radio equipment, together with associated cables, used for both trunk and special services in the trunk network.

In the switching field it covers the maintenance of all space and time-division equipment and systems used for switching of trunk traffic, including access to international routes.

From Head Office to District level the policy is one of involvement, and the work of the Division can be broadly summarised as:

- pre service work – assisting designers and planners at specification stage about the maintenance facilities and documentation required for new services and equipment,
- acceptance into service – liaison with installation staff to ensure the supply of facilities necessary for the efficient operation and maintenance of new systems, test equipment and spares,
- operation, maintenance and technical support – recommending methods of operation and maintenance to achieve, efficiently, the required standards and establishing procedures to monitor results. Organising repair arrangements and providing technical support as required,
- second line development – developing solutions to problems encountered in service.

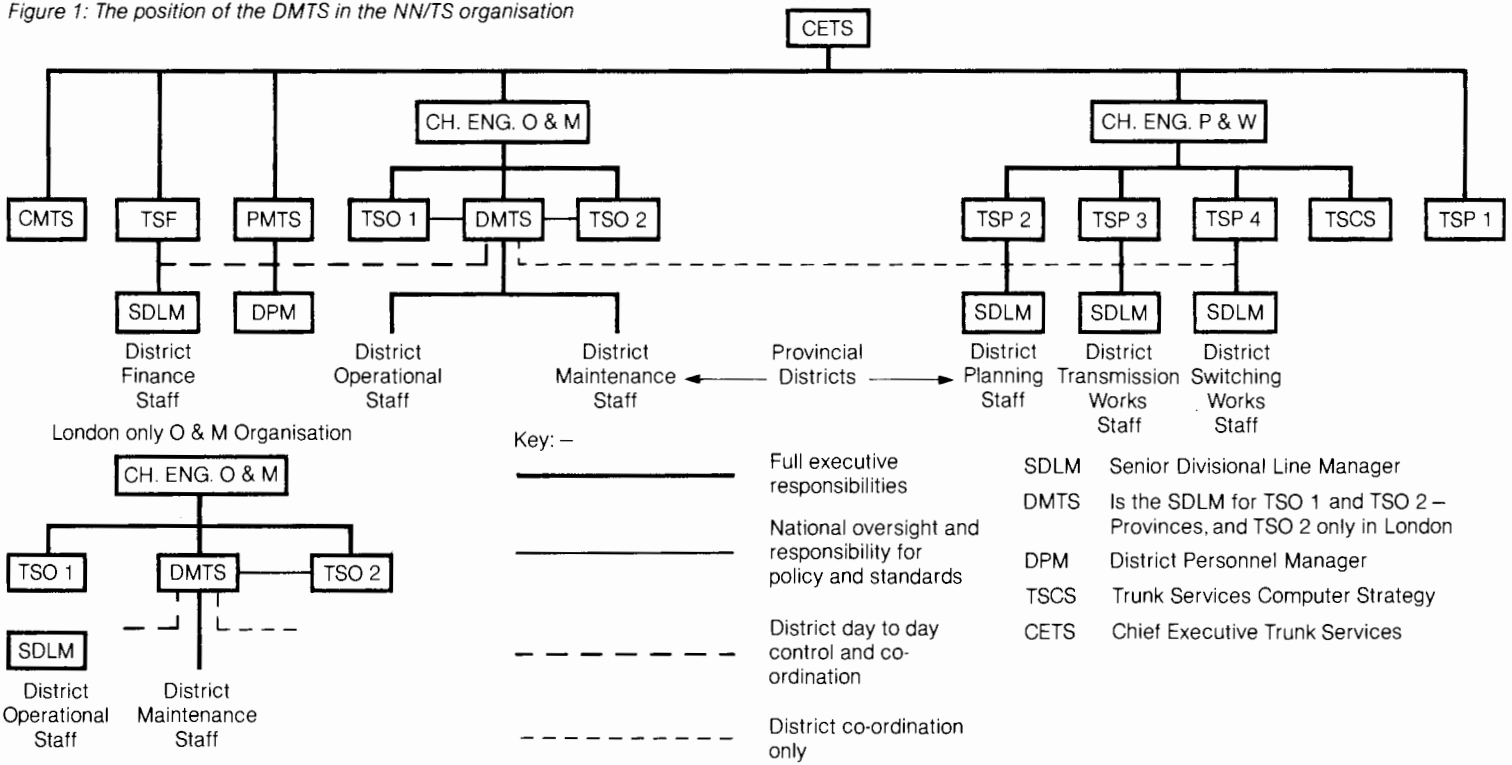
The role of the DMTS

Within TS02, the day-to-day maintenance of TS plant throughout the country is managed by the DMTSs whose current geographic responsibilities are roughly in line with the previous Regional boundaries.

DMTSs report direct to the Chief Engineer,

→ 27

Figure 1: The position of the DMTS in the NN/TS organisation



Operations and Maintenance and, in addition to their in-line responsibilities for Maintenance and Operations, they also have indirect responsibility for Planning, Works, Finance and Personnel staff in Districts whose in-line managers are located in Head Office.

Figure 1 illustrates the TS organisation and the position of the DMTS.

Agency working

While the aim of the new organisation is to be as independent as possible, there will be a need to continue to use LCS staff for maintenance work in the early years.

For some things it will be more practicable to pay others to do work for NN/TS. This 'agency work' will be covered by Agency Agreements between the DMTSs and General Managers.

The reasons for this include –

- physical – ducts carrying both NN & LCS cable, and GSCs with subscribers,
- economic – small elements of NN work that would not justify the establishment of an NN work force,
- social – staff remote from the main centres of NN activity who would not feel part of the

new organisation,
- variable work loads – patterns of work that peak for short periods only.

There will be, of course, instances where TS02 will act as agents for others, for example when TS02 staff maintain the local element of a non-dedicated GSC, or do maintenance work for BTI or, indeed, for NN/SS on an agency basis.

Corporate concern

Looking forward in the new competitive environment which now faces us, it is evident that effective maintenance activity has a major role to play in NN/TSs future. The quality of this maintenance activity is paramount, particularly at a time when our customers' perception of quality of service leaves room for improvement. Overall quality of service is a Corporate concern and it is only through maintenance staff in NN & LCS – working as a team – that the quality of maintenance activity, and hence service, will improve.

(01-432 9310)

Electronic component Fast Response Service – FRS

by **Andrew Pagan**,
Materials Department M6324

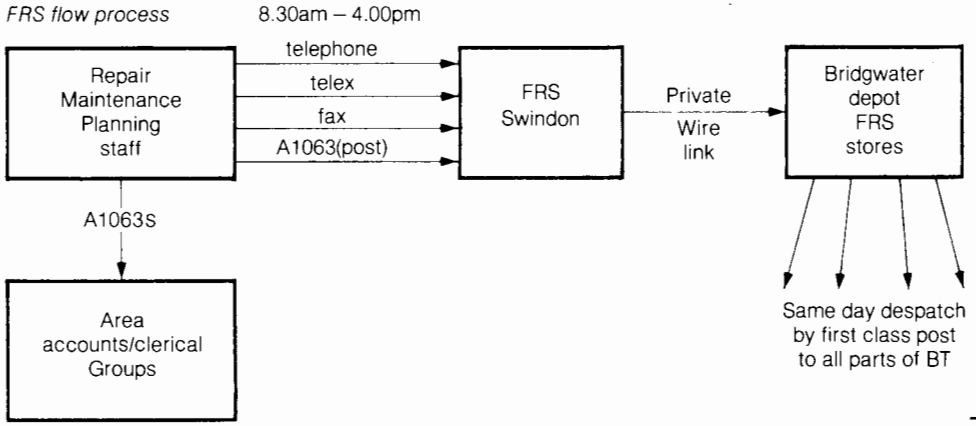
Issue 2 of the FRS catalogue was published in July and contained approximately 1300 items for general maintenance, repair, and planning, as well as for 11 specific product ranges. Further items have since been introduced for Coin Telephone 22B and Senator.

The policy of same-day despatch is working well and field staff are increasingly using the telephone ordering facility which gives immediate access to stock availability and requires no follow-up paperwork. Telex, facsimile and post for A1063 details are alternative methods of ordering. The figure shows the FRS flow process.

Comprehensive Technical support – including reliability data, ESD advice, item approval and assessment of equivalents – is available through FRS links with the Materials and Component Centre (MCC) in Birmingham and London (see following article).

The FRS catalogue and price list gives details of all product ranges stocked. If you have problems obtaining components please contact us – we may be able to source the item for you.

Catalogues and further details of the system can be obtained from Andrew Pagan on 0793 484572.



Pat Keates and Michael Bleadon of Swindon's Fast Response Service seen processing orders for electronic components.

The Materials and Components Centre (MCC)

by **Trevor Morton-Holmes** MC2.3

MCC provides the following support functions –

- Advice on selection, availability and reliability of all materials and electronic components
- Component identification, sourcing and replacements for obsolete components
- Advice on prevention of Electro-Static Discharge (ESD) and trouble shooting
- Component, equipment and system reliability data collection and analysis
- Testing, evaluation, failure analysis and reliability assessment of components and assemblies
- Testing, evaluation, analysis and advice on the use of materials
- Custody and maintenance of BT mechanical standards, dimensional metrology, dynamic testing, proof-testing and non-destructive testing
- Electrical safety testing of apparatus.

Remember, you can talk to us directly about any task or difficulty you are experiencing and we will try to help you.

Our motto is 'Help us to help you keep BT ahead'.

For further information please contact John Mottram on 021-772 2361 Extn 2529.

Stop press

Avoid cheap plugs

An article in a recent issue of 'Safety Scene' referred to the potential hazards of using 13 Amp plugs from non-approved sources. The essence of that article is included here.

The 13 Amp plug is common enough nowadays and we are probably all guilty of nipping into the local shop to buy one so that a new piece of equipment can be tried out. What we may not appreciate, is that many plugs purchased from bulk suppliers can be of indeterminate and variable specification with – it seems – little regard for electrical safety.

It is easy to catch out the unwary, too, because people believe they are buying a safe product when it is clearly embossed BS1363 – the appropriate British Standard Specification for 13 Amp plugs. Unfortunately, this number gives no guarantee of actual compliance. Purchasers should be particularly wary of plugs which have a 'V'-shaped fuse holder, and those which do not have separate compartments to prevent detached wires from touching other terminals.

The simple message is: obtain your plugs from BT stores whenever possible. If you do buy locally, select yours from a reputable manufacturer.

Any enquiries to Peter Brunton, LLS5.1.2, 01-739 3464 Ext 421.

If you have a contribution to offer to *Maintenance News* other than a letter to the editor, please forward it to your *Maintenance News* agent listed below. The Editor cannot publish anything to do with current awards suggestions, neither can he be held responsible for technical inaccuracies in authors' submitted text.

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