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INTERCOM

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Directorate of Telecommunications

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HERE AND THERE

Communications 72—Brighton

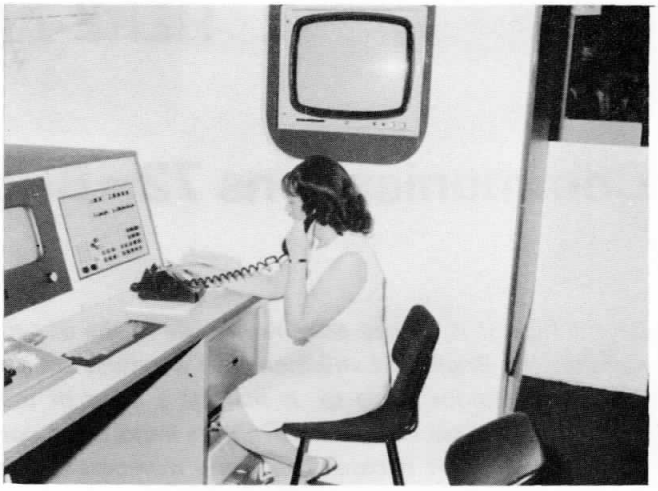
On the face of it, it may seem rather late in the day to mention the Brighton Exhibition, but we could not go into print without doing so. It may be a thing of the past, but that does not detract from its importance nor the need to report it here. Too many members of the Directorate worked hard to make it the success it was to leave it out.

Besides the exhibition itself, organised by ETV Cybernetics Ltd, there was an invaluable three-day conference organised by Electronics Weekly and Wireless World. The whole show was supported by the Electronic Engineering Association, the Ministry of Defence and the Home Office. The Chairman of the Electronics Council, Admiral of the Fleet the Earl Mountbatten, launched it. The exhibition demonstrated the growth and potential of communications. Some 90 exhibitors showed their wares to an international gathering.

The Director and Mrs Nicol speaking to Peter Twidale, Senior Wireless Technician, CCE, Harrow.

Richard Saunders, John Stokes and Eddie Wilson, all Senior Wireless Technicians at CCE Harrow, seen here at Brighton waiting for the rush.

A typical police information room console on display at the Home Office stand, Brighton.



Muriel Munro of CCE at the controls where she had a busy day. One of the many who worked so hard for the Directorate at Brighton.

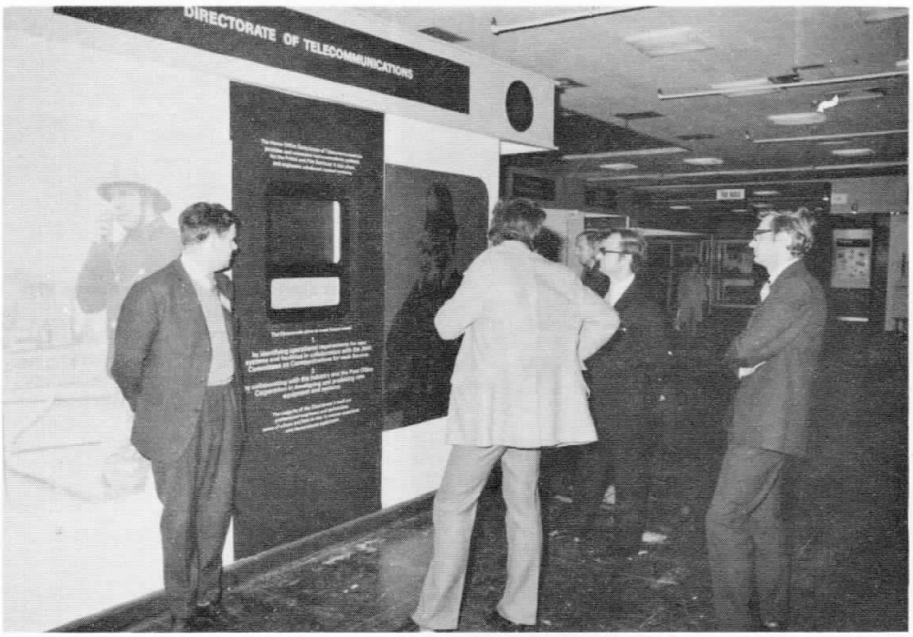
Every exhibition has, from the outset, an atmosphere all of its own and it could be said that, to a large extent, it fails or succeeds for the individual spectator as soon as he sets foot on the exhibition ground. In an age accustomed to mammoth trade shows, at which success is measured largely by size and the numbers of millions entering through the turnstiles, this was not a large exhibition. But all who needed to be at Brighton were there—the object of the exercise was happily attained.

It is our pleasant editorial job to give credit where credit is due. The whole atmosphere of the occasion was good, the conference and talks were lively and stimulating, the exhibition simple and effective. Visitors from overseas were impressed. They saw that this country is not behind in contemporary equipment and that the telecommunications industry is fully aware of future possibilities.

It gives us particular pleasure to be able, perhaps not to blow our own trumpet, for personally we had nothing to do with it, but to sound a fanfare in favour of our colleagues who did so much to make the Home Office stand the success it was.

The Directorate of Telecommunications was served well by the Home Office public relations officers and the Central Office of Information. To mention no names, some of the public relations men, with our own people alongside them, beavered away for months before those three days to make them a success. Our stand was compact, well-designed, informative and full of interest —a fact that was amply shown by the continuous stream of visitors to it. It was so well staffed that no visitor with

The International Aeradio Limited Stand at Brighton. This firm has been working on the Data Network Control System for the Police National Computer. Our project officer, Robin Hughes, was too shy to pose.



Members of the Directorate staff on the Home Office stand, inspecting the back-projected, quick-changing slides with audio-commentary, so excellently produced by the Central Office of Information in collaboration with Home Office public relations officers.

A bird's-eye view of the Home Office stand designed so excellently by the Central Office of Information. The whole set-up showed what the Office, the Home Office public relations men and our own staff can do when they have the time and the facilities.

The hardships suffered by the Directorate staff at Brighton vividly illustrated. Alan Smith, Senior Wireless Technician, Harrow; Alan Copperwaite and Steve Kettle of Headquarters.

Stan Calkin and Jim Luxton in the process of answering endless questions. There were many lost voices at the end of the session. In the background is Ray Stoodley, Officer in Charge, CCE, Harrow.

Communications 72. The Home Office stand at the Metropole, Brighton.

a query went away without a good and unhurried discussion with one or more of our own people. Often the press was so great that one had to queue to have one's curiosity satisfied.

Mention must be made of the ever-changing colour pictures of the work of the Directorate that greeted one immediately on entering the main hall. The illustrations were beautifully produced and the subjects covered gave an outsider a vivid and accurate picture of the services rendered by the Directorate.

The stand and the performance of all those concerned with its success showed plainly what the Home Office and the Central Office of Information can do when they are given the time and facilities. The Director demonstrated his firm determination that the ever-increasing importance of telecommunications and the work being done by the Home Office in that field shall be recognised by his energetic planning of our participation and his enlivening presence at Brighton.

A T Martin

On 27 November last year we held a sherry party at Headquarters to say goodbye to Tommy Martin. In the evening there was a farewell dinner at the Strand Palace, a goodly gathering enlivened by Trevor Leak on the piano.

It is surely impossible for any of us to remember the Directorate without Tom. Even when I first joined the branch back in 1949, it seemed that he had been in it forever. He was then, as he is now, a man of wry humour and caustic wit, most of it delivered through the stem of his pipe, which almost never left his mouth. May it go on record that I have had more laughs with Tom than any other man I've known?

Before joining the Home Office he was a technical representative for a number of radio firms in the Midlands, followed by a short spell in the Air Ministry.

In 1939 he assisted in establishing the first radio scheme for Birmingham City Police. During the war he worked for the radio security service attached to the Royal Corps of Signals. In 1942 he joined the Home Office as station engineer at Romsley and was promoted Regional Wireless Engineer the same year. Later he went on to Marley Hill to set up the new regional wireless depot there and in 1946 returned to Romsley where he reigned until his retirement.

Mr A T Martin and the Deputy Director, Engineering, Mr Yirrell, at headquarters. Clutched in Tom's right hand is the autograph book containing the names of his many well-wishers. In his left is his present.

Not surprisingly, his main hobby is radio and he has, in fact, been a ham since 1932 (call sign G2LB), which takes us back a bit.

Tom knows that he leaves us, after so many years of fine service, with all our best wishes and that we shall miss him sadly.

DOUBLE SIDEBAND DIMINISHED CARRIER

Since our last issue the work done on behalf of the Directorate by Professor Gosling and his team at the University College, Swansea, culminated in an extensive series of trials with an experimental three-station radio scheme in the Swansea/Bridgend area of South Wales. The three fixed stations were in fact located at Swansea University College, Bridgend Home Office Wireless Depot and Werfa, and the bulk of the work was carried out around circuits in the vicinity of Stormy Down and Pyle.

This site was chosen because, over a circuit of four miles or so, it provided three quite different environments—urban, rural and a section of four-lane highway permitting the higher speeds necessary for testing Doppler effects. Reduction of Werfa transmitter power by 10 dB relative to Swansea and Bridgend produced the worst type of 'equi-signal' situation throughout the area. The fixed installations were arranged to provide options of AM, FM and DSBDC, at variable transmitter frequency separation. Local manual mode selection was employed. Control and modulation of the remote stations were effected from Swansea via fixed radio links.

The trials produced many interesting and important results, but clearly showed that a practical DSBDC system had been developed which appeared to have some advantages for multi-station radio mobile networks. It was decided therefore to take the opportunity afforded by the Conference on Radio Receiving Systems sponsored by the Institution of Electronic and Radio Engineers and held at Swansea during July last year to invite representatives of the mobile radio industry and other interested parties to visit the trial ground and participate in demonstration of the trials systems.

Consequent attendance at the site was heavy and thanks in no small measure to generous assistance from the Chief Constable of South Wales and his officers who,

among other things provided the use of their Special Operations vehicle, the occasion was generally deemed a great success. The Forward Planning team of Wyn Crompton, Bruce Thomson and Tony Hulme received and briefed the visitors, ably assisted by Bert Green and his team from Bridgend, whilst Richard Saunders of CCE performed the wearisome but essential task of providing the basic modulation. (Acknowledgement must be made of the assistance received from the Bridgend Depot throughout the whole series of these trials, often outside their line of duty but always wholehearted. Also, of the long hours of hard work put in by the university team of Peter Petrovic, Bob Holbeche, Fabian Khan and Philip Regan.)

On 24 October, 1972 a colloquium was held by the Institution of Electrical Engineers at their Savoy Place headquarters entirely devoted to the Home Office/ Swansea University work on DSBDC and the results of the field trials described. Attendance was very high and indicated the great interest being taken in our work by all sections of the mobile radio field.

A surprising discovery during the South Wales trials was the quality of performance achieved with three simultaneous AM transmissions, when the carrier frequencies were stabilised to very near synchronism, ie to within one hertz or so of each other. These stabilities at 100 MHz were not practicable some years ago, of course, when work was previously carried out on this sort of arrangement, and today's mobile receivers are vastly different from those in use then. Now such stabilisation poses no great problem on fixed equipments and it seems possible that a means has been found of effecting some improvement to existing schemes with reasonably short time-scales and costs.

Trials of both quasi-synchronous AM and DSBDC in practical operational schemes are now proposed which will be under the direction of Mr Crompton in his current engineering post. Further research into modulation systems is under consideration by the Forward Planning Section.

LONDON REGION

C H Wilson

Cliff Wilson is a Senior Wireless Technician and is a founder-member of the team which has worked so hard to establish the new organisation. As few present members of the Directorate are old enough to have witnessed the establishment and organisation of a new region, it seems appropriate that we should publish a first-hand account of such an exercise.

On 1 January 1972, a new Home Office Wireless Region came into being—London Region.

After some 30 years of having 10 regions, each with a regional wireless depot responsible for the installation and maintenance of radio schemes for Home Office customer services, an eleventh depot has been established at the Directorate's Central Communications Establishment, Harrow.

The new region is comprised of the headquarters at Harrow and two outstations—one at Welwyn Garden City, Hertfordshire (formerly an outstation of the Home Office Wireless Depot, Cheveley) and the second at the Directorate Headquarters, Rochester Row, and a further one designed at Sidcup, Kent. The second, which has existed since the mid-1940s, was commonly known as Room 6, as that was the original location of the workshop in the main building of the Home Office, Whitehall. The staff and duties have been absorbed by, and have become the responsibility of, London Region.

In may appear odd that, until now, no wireless depot has existed in the metropolis, but the fact is that until recently Home Office commitments in the area have been limited and demands on the Directorate were met by adjacent depots. However, over the past few years commitments have increased to the extent that it has been found necessary to establish it as a region in its own right.

COMMITMENTS

By far the largest commitment in terms of equipment is the London Fire Brigade, which was created in its present form as the result of local government reform in London. It consists of the amalgamation of the brigades of Middlesex County and London, several former borough brigades and portions of Essex, Surrey, and Herts fire brigades, each one of which had its own radio scheme, which were maintained either by technicians employed by the brigades or by commercial contractors. Since the amalgamation, a vast amount of reorganisation and rationalisation has been brought about by close liaison between London Fire Brigade and Directorate of

Larry Birch, Regional Wireless Engineer, London.

Telecommunications staffs, with most of the initial technical effort and equipment being prepared by the staff of the installation section of the Central Communications Establishment.

The London Fire Brigade radio scheme, the layout of which can be seen on Map 2, is the most extensive and complex fire brigade scheme ever installed and maintained by the Home Office. It consists of five VHF channels situated at four hilltop sites. Channels 1-4 are controlled by one of four control rooms and Channel 5 from the central operations room. The four area control rooms are connected by landline to the central radio link room situated at Brigade Headquarters, Lambeth.

Whilst the fixed station equipment was being installed and commissioned, approximately 500 fire appliances had to be fitted with new Home Office multi-channel mobile radios. This programme of mobile installations, which was started before the formation of London Region, was begun by teams of technicians from the Home Office Wireless Depots of Cheveley, Cranbook and Hannington, and the London Fire Brigade Radio Department. But, since January 1972, staff from the new depot has been involved in this intensive conversion.

The standard equipment being installed in all London Fire Brigade appliances, STC 681 Mk II—10 channel AM set, has been radically modified to meet the brigade requirements. The control box, which has a completely new facia and a simple uncluttered layout with a minimum of controls, has proved to be extremely popular with the brigade operators. The new layout was devised by the Home Office Central Communications Establishment Evaluation and Development Section.

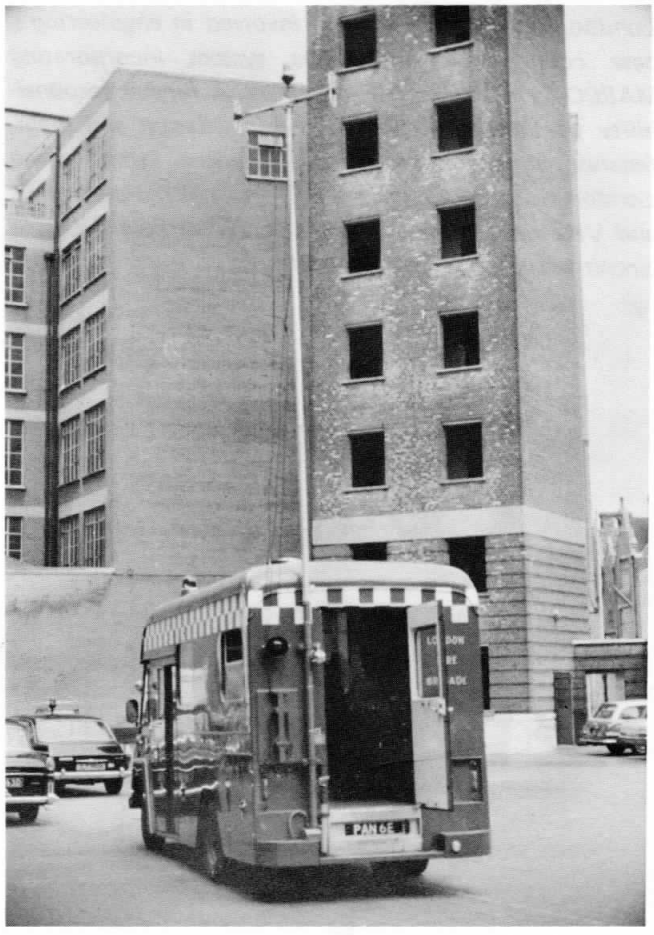
London Region is also busy on trial communications projects for the London Fire Brigade. A mobile command vehicle has been fitted with a UHF/VHF mobile repeater unit to enable UHF personal radio sets to be used on a fireground and the signals from them to be relayed to brigade headquarters, if required. To increase UHF cover, a 30ft pneumatic mast has been fitted to the rear of the vehicle.

Another brigade communications project in which staff have been involved has been the provision of reliable radio communications from a helicopter, carrying fire crew, to a ground control officer. The main problem here was to overcome the noise of the helicopter.

HELICOPTER

Three-way communication was provided in the following manner. The airborne observation officer used a portable 'Westminster' transmitter/receiver which was modified to enable the use of a noise-cancelling microphone. The audio output from the receiver was via a matching transformer and jack plug into the aircraft intercom system, thus permitting the officer to use the the normal headset and also enabling the pilot to monitor air to ground conversation.

The firefighting crew, wearing breathing apparatus, were airlifted from the ground to a smoke-filled high building. Their radio equipment consisted of a Courier VHF packset with noise-cancelling microphone and extended receiver earpiece connected to the breathing mask.



Mobile control vehicle with pneumatic mast extended to enable intercommunication between personal radios and UHF to VHF equipments.

The ground control officer's normal fire helmet was equipped with a modified S G Brown industrial headset and close contact acoustic tube microphone. The headset and microphone were connected to a 'Courier' VHF packset.

The officer concerned in the exercise said that the very loud aircraft noise did not to any great extent break into radio communications.

Tests have also been conducted on equipment to enable firemen wearing breathing apparatus to transmit and receive signals while in smoke-filled buildings.

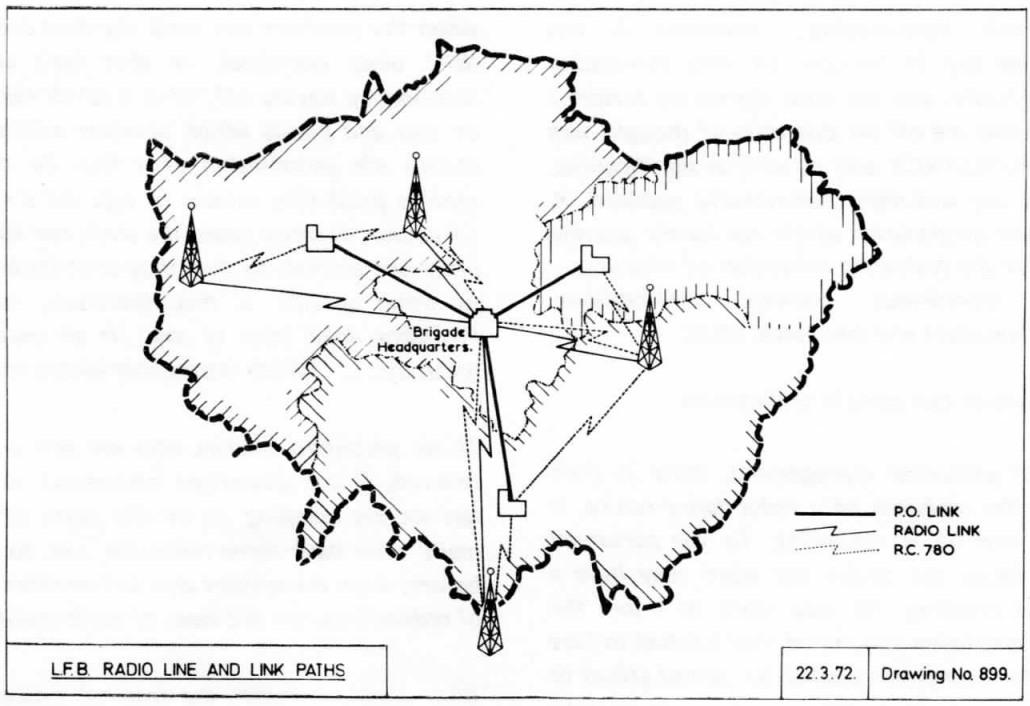
Apart from being responsible for the radio communications of Europe's largest fire brigade, London Region also caters for the communications requirements of Hertfordshire County Police, a commitment which was inherited from the Regional Depot at Cheveley on 1 May 1972. Day-to-day maintenance of this county police scheme, which consists of a force control room, two main stations and a two-channel spaced carrier system, is carried out by staff from the out-station at Welwyn Garden City.

This scheme incorporates a Pye 4000 system which allows integrated control of the main VHF channels and the divisional UHF systems. Traffic patrol cars are fitted with STC 681 Mk 11 or Pye Whitehall sets. Panda cars also carry VHF equipment in addition to UHF sets. London Region are currently involved in engineering a new county-wide pocketfone system incorporating MASCOT and VHF/UHF repeaters. A further responsibility of London Region is the installation and maintenance of communications equipment in the seven London prisons. All have UHF personal radio systems, and VHF radio links to the Metropolitan Police. Closed circuit television is in certain prisons.

Deputy Assistant Chief Officer A E Nicholls of Greater London Fire Brigade, wearing modified Courier Packset and headset, acting as ground control officer.

An Alouette helicopter in use by Greater London Fire Brigade.

Operator's console in mobile control vehicle showing VHF/UHF repeater control unit and AM681 control unit.



Although London Region has no responsibility for the Metropolitan Police or the City of London Police, it provides a service to the Regional Crime Squad which covers Greater London and the Home Counties. This unit is equipped with STC 101 multi-channel and Pye Whitehall sets.

The newest customer of London Region is the Police National Computer at Hendon, and the technicians of this depot are probably the first of many to be involved with the servicing of VDUs. At present all VDUs are still under guarantee and therefore all faulty units are replaced on a one-for-one basis by the manufacturer, but after December 1972 all servicing will be done by the regional staff.

It can be seen that London Region is an amalgam of new and established units, and the same can be said of staff. Each workshop has one or two experienced senior wireless technicians or wireless technicians, but the majority of technicians are at the beginning of their careers with the Home Office. Much time is being spent on familiarisation and training courses so that they can gain the efficiency necessary to tackle all problems which may arise in existing or future types of communications equipment in Home Office use.

OF SHIPS AND SHOES AND SEALING-WAX

Oliver Meynell

The immortal Lewis Carroll had one of his characters say: 'When I use a word it means just what I choose it to mean, neither more nor less.'

The interminable reports of legal wrangling to which we are daily subjected by the communications media only strengthen my conviction of the wisdom underlying that apparent absurdity. But, to me, such disputes are one of the less attractive sides of what can otherwise be a fascinating subject—the meanings attributed by different people and in different contexts to the plainest of plain words.

Whilst my knowledge of our own language is deplorably shallow, any competence in other languages is wholly superficial. Nevertheless, I am able to appreciate that, in some of them at least, ambiguities of meaning are also quite common.

Did I say common? Well, we all know what that means, don't we? We might perhaps say that it is common knowledge. No? Perhaps not. But when you next visit the seaside those hordes of sea birds wheeling around are most unlikely to be common gulls; and we all know that common sense (in others) is among the rarest of virtues.

Enough of this time-wasting . . . revenons á nos moutons, *as we say in Europe. (A very interesting expression incidently, but we must digress no further.) What really started me off on this train of thought was the word REDUNDANCY and its various significances, some of which are well-nigh diametrically opposed. A couple of decent dictionaries which are handy provide for this adjective the following collection of meanings—overflowing, superfluous, copious, over-copious, excessive, full, luxuriant and pleonastic (eh?).*

Let's consider one or two sample applications.

In the field of personnel management, there is little ambiguity. To the recipient of a redundancy notice, it means simply that he is unwanted. To the personnel manager who issues the notice the word may have a rather different meaning. He may want to retain the services of the employee concerned, but has had to face the fact that, for economic reasons, he cannot afford to do so. There is no practical difference, however, and the poor chap still gets his cards.

The employee mentioned might be an engineer, in which case his connotation of the word 'redundancy' will be precisely the same as that of any other 'unit of personnel' in similar circumstances. In the engineer's sphere of work, however, from the beastly term of fear and hatred with its implications of uselessness, redundancy is transformed into a veritable prince of a word—a quality which is desirable, valuable and sometimes essential.

In many facets of engineering redundancy takes the form of safety factors and margins. Structural members are made larger than is strictly necessary, higher grade materials are used and electrical components are operated well within their ratings—all good practice and forms of redundancy.

Such applications of redundancy have the admirable objective of obviating, or at least reducing to low proportions, the possibilities of catastrophic failures. (Although when carried to excess they lead to the almost equally destructive 'belt, braces and string' syndrome.) In telecommunications, there are still more specific considerations, and particularly good examples are found in the field of data transmission, where redundancy in an information channel is utilised to improve the accuracy of transmission. In some of these situations, the engineer would be in no doubt that some redundancy was essential.

'There is no new thing under the sun', the prophet said and, of course, the redundancy ploy is employed by Mother Nature in numerous ways. The prophet also told us to consider the ways of the ant—so let us do that for a moment.

When an army of soldier ants on the march comes to a stream, the leaders pile into it until the point is reached when the survivors can cross dry-foot over the bodies of their dead comrades. If that isn't an example of redundancy paying off, what is it? Or take the examples of tree and plants which produce millions of seeds to ensure the germination of a few. Or the insects and reptiles producing masses of eggs for a similar purpose. Of course, in many cases, the seeds and eggs are eaten by birds and animals so that they contribute to the survival of other species. Is this, therefore, redundancy? As Professor Joad used to say: 'It all depends what you mean by . . . ' Which is probably where we came in.

Those persistent readers who are still with me will be relieved, if not downright astounded, to know that at last we are creeping up on the point of this article. It really does have some relevance, too, to what has gone before, since the subject also derives from considerations of redundancy—in this case, of white paint.

With such an input, the internal processors of many readers will undoubtedly respond with word-associations of CRANWELL, CATTERICK, VERNON etc—birthplaces of such historic mottoes as 'If it moves, salute it. If it doesn't move, put a fence round it and paint it white'; and other pithy and specific phrases. For once, however, the machines have blundered, the reference in this case being not to the military training establishments of hallowed memory, but to white lines on roads.

It was during a longish ride home recently along one of our more pleasant stretches of motorway that I remembered a recently read newspaper report referring to a decline in the use of cat's-eyes, and the subsequent train of thought drew my attention to the white line markings stretching in both directions as far as the eye could see. Idle speculation about the vast quantities of paint and manpower required for this purpose was followed by thoughts of cost-effectiveness, and these eventually and inexorably led to the recognition of our old friend 'redundancy'. For, although the use of all this white paint may not be superfluous, it is certainly copious, full and luxuriant, and thus qualifies by definition.

All good engineers being economy-orientated, the recognition of redundancy naturally led me to consideration of other possible uses for these road markings, and the thought occurred that here was an almost ideal basis for a rural vehicle-location system.

Consider the facts. Almost every road of significance in the country carries such markings. The majority of the markings comprise broken white lines. What an ideal medium for positional coding! Information could readily be conveyed by element lengths, spacings and codings; and it would be a simple matter to provide unique and easily read identity for, say, each 1km square of the National Grid.

'How are these identities to be read?' readers may be asking. The answer is by the use of simple optical devices so mounted on vehicles that the range of vision would include one white line. Depending upon the coding system employed, it might be necessary to relate the received information to the speed of the vehicle, in which case the latter also could readily be obtained to the necessary accuracy by optical methods, activated by light reflections from the road surface.

By the means so far outlined, information on a vehicle's location would become available in the vehicle and could be displayed either on an alpha-numeric indicator using grid references or by more sophisticated methods using maps and other devices. If, as is often the case, the information is required at some control or base location, it can be transmitted by digital data over a radio channel using one of the standard methods.

Think of the advantages of such a system. The major technical disadvantages of existing and proposed location systems—inaccuracies due to multipath and other propagational idiosyncrasies, variation of accuracy with vehicles' positions within a system, cumulative errors etc—disappear 'at a stroke'. The required standard of accuracy can simply be designed into a system. There is no need for a large and costly network of fixed stations. The vehicle equipments can be simple and quite cheap; the low power levels and digital processing circuitry involved would be admirably suited to integrated circuit techniques.

It might appear that problems would arise from such things as sections of roads under repair, road junctions and other irregularities. There is no timing problem, however, and in practice the system would pick up the next section of proper marking when it came along and would automatically lock on again. There would be small breaks in the positional information, but a centralised system processor could retain the last good position—which would seldom be far out.

Some readers will be wondering also what would happen at night when the markings are not illuminated. It is believed that this is unlikely to prove a real problem because there is probably enough scattered light normally from the vehicle's own lamps to provide an adequate input to the system and, in any case, it would be a relatively simple matter to arrange auxiliary illumination if required.

Clearly, a system of this nature would best be organised on a national basis. Then, given the basic system, all sorts of side benefits could accrue. Suppose, for example, that anything like 'road-pricing' became government policy. A dreadful thought, but a possibility. All that would be needed would be a simple integrator attachment to the vehicle equipment. If required, the system could be made to cater for different areas being charged at different rates.

Technologically, the concept seems viable, requiring a certain amount of development, but mainly being a matter of co-ordination. We agreed earlier that a national system would be preferable. Smaller systems would be practicable eg, on a county basis, in which case they could be used by all local authority services; and facilities could also be rented to other customers. Obviously, however, a large system is more attractive both operationally and financially, and the thought appeals of a national agency for the purpose, perhaps calling itself the National Location of Cars Organisation (NAT-LOCO).

A paper in the last issue of INTERCOM had a title to the effect 'How Did We Get Here And Where Do We Go From Here'. At this moment, I must admit to similar feelings. As usual Carroll has an opposite piece of advice to offer—'Begin at the beginning', the King said, 'and go on till you come to the end: then stop'. I promise to stop very soon now. I've given you the idea and there is clearly the opportunity of a lifetime for some young man who will take it up and work out a few details. (The adjective has been included, I hasten to add, not because of any doubt regarding the competence of older men, but from some experience of the timescales involved in integration and co-ordination exercises.)

To readers who object to the 'few details', I would point out that a famous Prime Minister of recent times is on record as describing a cataclysmic governmental upheaval as being 'a little local difficulty', so my acknowledged slight understatement has a very eminent precedent.

No royalties will be demanded by the author, but donations to the Engineers' Benevolent Fund (Redundancy A/C) will be gratefully acknowledged.

A final word to those readers with oak trees and similar grossly redundant systems in their gardens. 'Have you considered buying a pig?' That would eat the acorns etc, produce bacon and fertilise the garden at the same time. Such efficiency! Of course, it would also root up the vegetables and stink the place out, thereby creating certain secondary problems. But they become an 'environmental' matter, which might be a good subject for another paper!

Oliver Meynell is the nom-de-plume of a Directorate engineer. Crossword devotees may penetrate the thin disguise and the Editor will be pleased to receive from country readers views as to his identity. These should be submitted on postcards, please, with no more than 20 words of explanation for the choice. The sender of the first correct solution received by the Editor will be rewarded by a suitable small momento—a photograph of Horseferry House by moonlight, a complimentary ticket to the next Radio Components Show, or an immediate posting, depending upon the explanation provided.

COMPUTERS AND FIRE BRIGADE COMMUNICATIONS

P P H Smith

Paul Smith, CEng, MIEE, is a Chief Wireless Engineer in Forward Planning and Research of the Deputy Directorate.

FOREWORD

The following article is the substance of a discussion paper recently presented to the Joint Committee on Fire Brigade Communications. Its object is to emphasise the kind of approach necessary when considering the possible application of computer-based systems in the field of Fire Service mobilising communications, against the criteria of operational efficiency and economic viability. Although dealing specifically with the Fire Service case much of the article is of general application. There may be other views on a few points of detail but, as already stated, the paper was produced as a basis for discussion, and it should be read in that light. If it draws attention to the principles which must apply in the consideration of automatic systems it will serve a very useful purpose.

We shall not be concerned in this article with computers as such or how they work, but rather with how they may be used to improve the efficiency of communications and allied services, and thus the efficiency of a brigade. It follows that we shall be concerned also with their limitations. Computer salesmen can be extremely optimistic and persuasive, though they seldom possess much technical knowledge. Computer manufacturers do not as a rule allow their engineers to talk directly to customers, a fact that tends to deprive the potential user of expert advice when he is planning to purchase. However, if he has clearly defined his requirements and is prepared to take the technical advice freely available to him from the Home Office and the Central Computer Agency, the potential user is most likely to obtain the best value for money.

Computers are now a 'tool of the trade' in communications engineering in much the same way that telephones, key and lamp units, teleprinters and radio equipment are. They are good at performing routine repetitive tasks at very high speed and doing exactly what they are told, no more. They cannot think or replace the skilled Fire Officer or control room operator, nor can they yet act upon the spoken word. It is as well, too, to remember that they are only as accurate as the input data or information fed into them by the human operator and as the program of instructions according to which they are to process the information. Nor should it be forgotten that these programs are dependent upon the human programmers.

So, it will be seen that computers are not necessarily the answer to all our prayers and whether they will be of use to a particular brigade or not depends largely upon the actual operational requirements. The need for a clear statement of these is, of course, of paramount importance and cannot be emphasised too often.

The application of computers to Fire Brigade communications cannot be considered in isolation from other aspects of Fire Brigade operations. Fire Service operational requirements for mobilisation and communications must be considered as a whole, not just the 'technical' parts such as lines, radios and other associated machinery, the dividing line between operations and communications is indistinct, the two fields are very much dependent one upon the other.

THE GENERAL COMMUNICATIONS PROBLEM

The operational communications requirement for mobilisation and subsequent back-up is composed of three main sections:

(1) 'pure' communications;
(2) information retrieval:
(3) message composition and distribution.

'Pure' communications consist of the rapid and accurate transmission of instructions or orders and information to and from various parts of the brigade. This part of the requirement must define the 'where', and the standards of reliability on which the communications network is to be engineered.

Information retrieval covers:

(1) determination of the normal first attendance stations and appliances;
(2) modifications of this as necessary by reference to the status or 'availability' of stations and appliances;
(3) determination of subsequent back-up and support

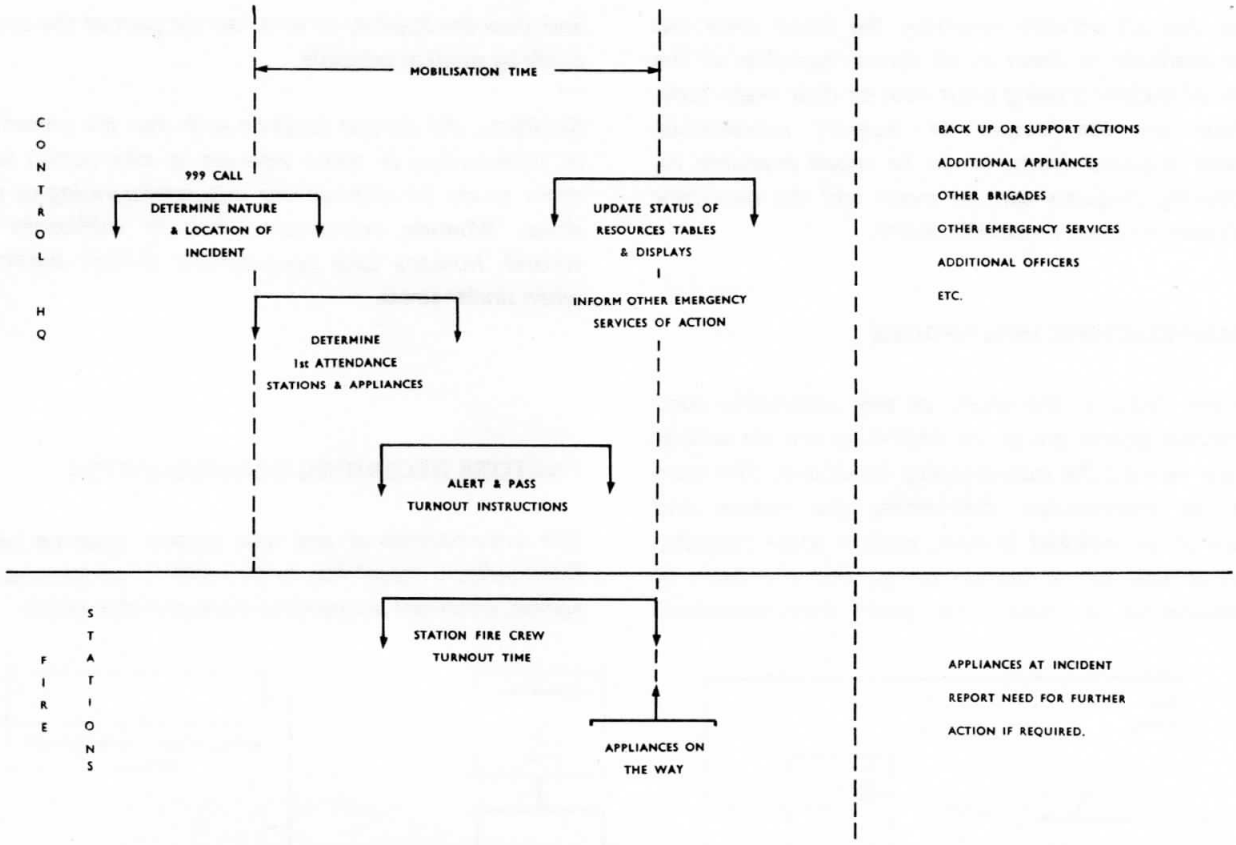


Fig. 1. Simplified illustration of sequence of events in mobilisation to show that the main object of this aspect of Fire Brigade operations is to ensure that fire crews are in possession of all the necessary information and instructions *before* they are themselves ready to roll.

action determined by information fed back from the scene of the incident;

(4) provision of information concerning special risks connected with premises and materials.

Message composition and distribution covers the gathering together of the information and instructions in the right order or format, addressing it prior to sending it to the required destinations. Format is very important, for the message must not only be transmitted in the shortest possible time, but must contain only the essential information in a form which will enable the recipient to act upon it with the minimum delay and least possible misunderstanding.

INFORMATION RETRIEVAL

Information retrieval is the first link in the mobilisation chain of events after the nature and address of the incident are known. These determine the content and distribution of the callout message. Computers are ideally suited for this task as they are able to search, rapidly, large data banks or information files. They can select the necessary callout instructions in fractions of a second, always provided that the search factors are fine enough to produce only one set of instructions, for more than one set would involve further choice by the operator. (All Fire Service communications officers will be familiar with the problem of finding the right 'High Street' or 'Willow Crescent/Avenue/Road/Lane/Grove in a large area comprising several towns, using a manual card index system.)

Having found the right 'card' or first attendance instructions much more rapidly than is possible manually, a computer can, effectively at the same time, check on the status of stations and appliances, compose the message, address it and start transmission to the required destinations. The variable part of the message (the location of the incident and its nature, together with any useful supplementary information) may be passed by voice of the operator or may be printed by a mechanical device at the receiving stations as required. A computer is also capable of noting acknowledgements, alerting the control operator if any are not received within a given time.

UPDATING OF INFORMATION

All changes in the pattern of resources of the brigade, station, appliance and officer availability, can be used by the computer to modify its response to incidents, automatically, once the changes have been fed into it. Changes in status resulting from the computer-controlled callout could update availability tables without operator-action being necessary.

The task of keeping all status displays, etc up to date can be made very much easier. Each change fed in once only

ensures that all officers requiring the latest state can have it available to them at all times regardless of the number of incidents being dealt with or their magnitude. Decisions on the nature of support movements, assistance required from, or to be made available to, neighbouring brigades can be made and the necessary instructions initiated more efficiently.

THE MAN-MACHINE INTERFACES

The weak links in the chain of any automatic communications system are at the beginning and the end, at what are termed the man-machine interfaces. The main source of information concerning the nature and location of an incident is now, and for some considerable time will be, a human being, and the form of communication is voice. The basic communications problem is the transfer of that information from its human source, ie the originator of the emergency call, to other human beings somewhere else, so that they may arrive at the scene of the incident in the minimum time, in sufficient numbers and with sufficient equipment.

If computers or any other automatic means of communication are to be used, the information which determines all subsequent action (ie nature and location) must be fed into the system accurately and in sufficient detail to ensure that the right set of callout instructions are determined. The input must be in the machine's language, as voice input to computer is not yet available and will probably not be an economic possibility for many years, if ever. The input device must therefore be some form of keyboard or similar equipment, implying the need for a skilled operator, but its design must be such that the degree of skill required is the minimum, and thus the liability to error on the part of the operator made as small as possible.

Similarly, the output must be such that the presentation of instructions to those who are to take action enables them to do so without any misunderstanding or undue delay. Whereas computers work in millionths of a second, humans take considerably longer, particularly when under stress.

FACTORS REQUIRING CONSIDERATION

The introduction of any new system must be justified financially; a 'case' has to be made in which cost is set against potential savings and increased efficiency.

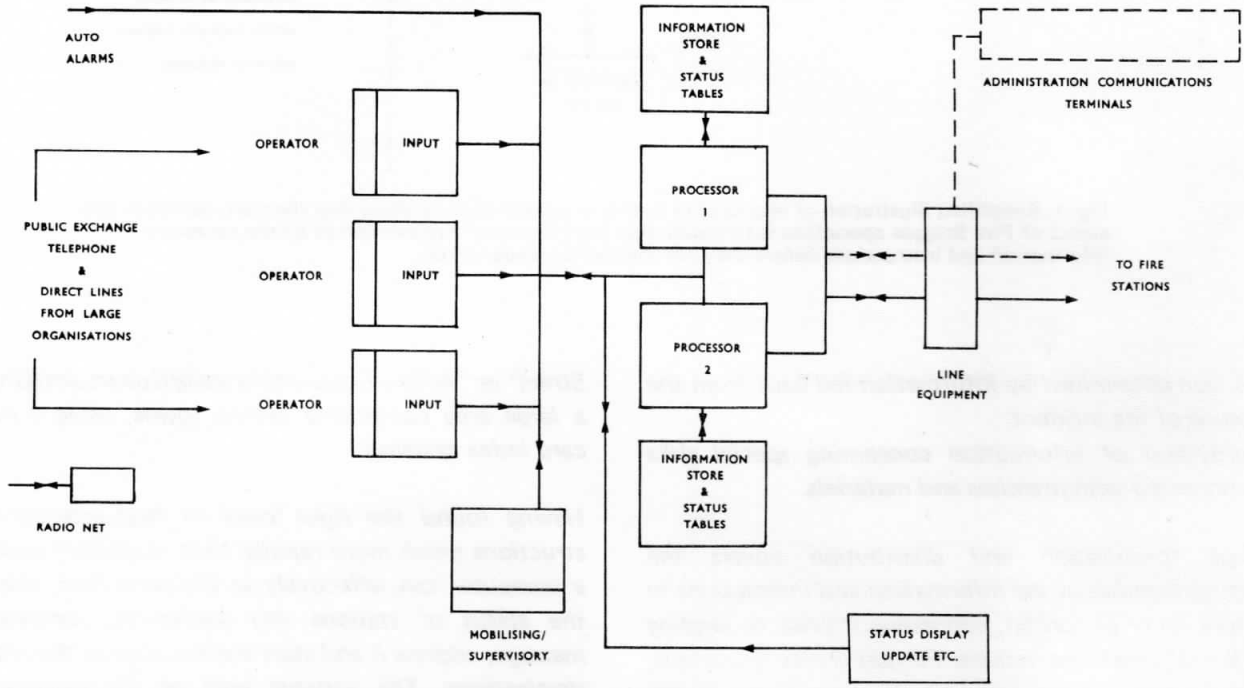


Fig. 2. Possible organisation of a computer system for mobilisation and administration, using duplicated automatic changeover processors. Should the second processor fail while the first is under repair, the system is completely out of action.

The costing must take account of the capital sums for equipment, programs and building work and also of running maintaining and accommodating the system. Any savings in cost of operators and other support staff necessary in a manual system can be shown as true savings, but there is always an increase in manpower for maintenance of the equipment itself (hardware) and for maintenance of the programs (software), both of which are continuing commitments. These commitments may be met by contract or by direct labour, but either way the cost must be allowed for.

Increased efficiency is practically impossible to quantify in terms of cost, its justification depends on powers of persuasion and argument! An estimate of the likely reduction of losses of property due to a reduction of response time can probably be made, but one cannot put a price on saving lives.

For an operational system, reliability is the most important requirement. This will involve a high degree of, if not complete, duplication of items making up the central part, individual failure of which would put the system out of action. To rely on a manual system as a fallback may be financially attractive at first sight, but it should be noted that the only way of maintaining an efficient manual system, and the necessary skills of the operators, is to use it. Implementation of an automatic system requiring fewer operators means that, after a comparatively short time, operators are neither available in sufficient numbers nor do they have the necessary skills to provide the standard of service which is required by means of a manual system. The manual data bank (card index), must also be kept up to date, requiring considerable staff effort and this will reduce the 'savings' allegedly resulting from the introduction of the automatic system.

One should beware of suggestions from representatives of commercial firms that an existing computer, designed or provided for other purposes, could meet an operational need for which, in the eyes of a competent engineer, it was not originally intended. Although, it must be admitted, some of these suggestions are at times feasible, it should be realised there is always the strong possibility that the cost of additional programming is likely to exceed that of a separate computer. This will be more apparent in the future, for the cost of programming, which is highly labour-intensive, is increasing continually, while progress in the technology of computer manufacture is tending to bring down the cost of the equipment all the time. In general, the simpler the programs and equipment, the higher is the standard of reliability.

COMPUTERS IN COMMUNICATIONS FOR ADMINISTRATION

So far we have considered operational communications, but there is always a requirement for the transfer of information from and to various parts of a brigade for the purpose of administration.

Various methods are at present available for this, such as telephone, teleprinter, facsimile, the postal service, despatch rider and van.

Automatic telephone exchanges, both private and public, are computers of a simple kind. They can do only one thing— provide a connection between two telephones when requested to do so by one of them. Even here, the man/machine interface is the weakest link. The required number must be dialled accurately and 'setting up' of the call is a comparatively long process compared with the immediate responses of the two speakers once the call has been established.

The use of the telephone for other than urgent operational matters will always be with us, giving as it does, human-to-human communications in the conversational mode, which is only slightly less easy than face-to-face speech.

The transfer of printed matter, however, is an area in which good use can be made of automatic data transmission equipment and the use of the postal service and couriers will doubtless decline in the future.

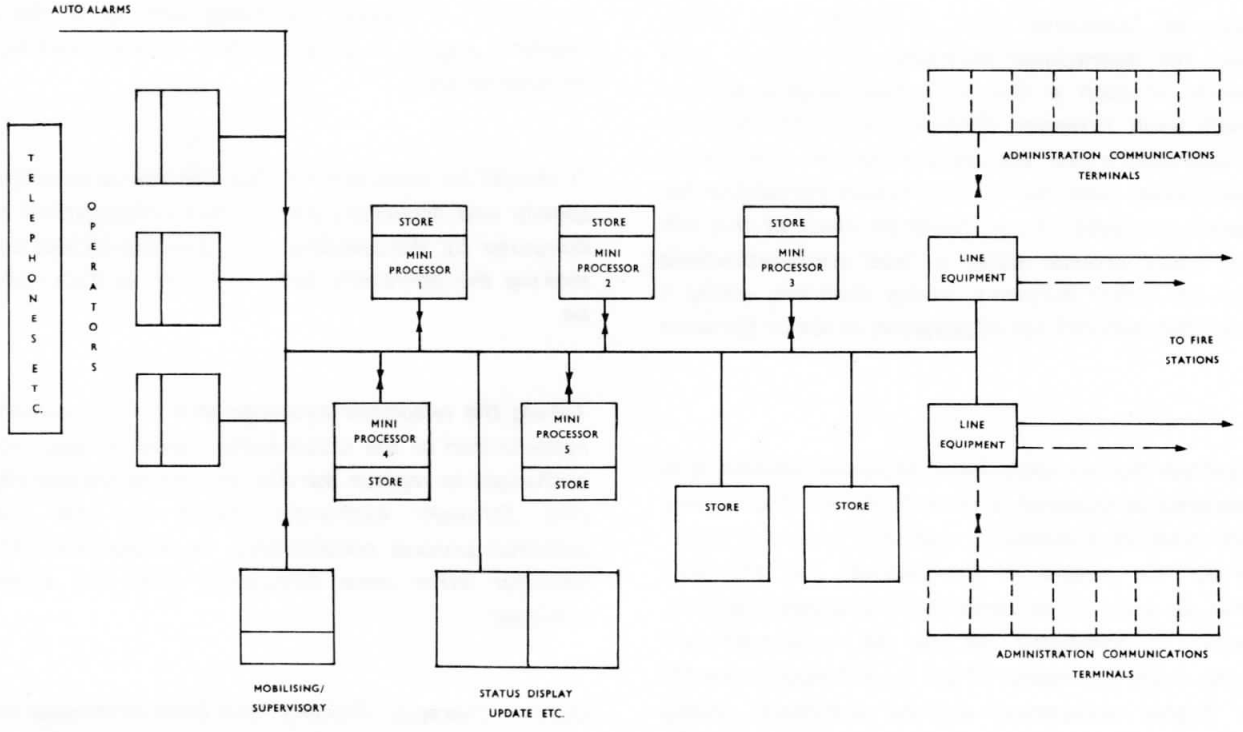


Fig. 3. Example of possible organisation of a computer system for mobilising and administration communications which provides reliability by the use of 'distributed' processing power. The first load is handled by, say, four mini processors, the failure of one of which has no effect on the system as the fifth replaces it. A further processor failure only increases the response time by a small amount. A total of five processors failing simultaneously is necessary to put the system totally out of action. At the intermediate numbers of simultaneous failure, the response time can be improved by giving priority to the operational user at the expense of administration.

MAKING THE BEST USE OF AVAILABLE COMMUNICATIONS CHANNELS

If we now consider the possibilities of using computer-based communications systems for both operational and administrative data and/or other types of traffic (perhaps we should pause here while operational dead bodies are removed!) we may find that the effective utilisation of the communications facilities may be improved and consequently achieve a reduction in cost. This will be possible only if the operational users' requirement for the response time of the communications system is met. *Which means that the same service must be given to the operational user as he would receive if he were the exclusive user and therefore have the facility to communicate with any terminal, at any time, immediately, when required.*

The use of computer-based switches to handle data and telegraph message traffic enables this requirement to be met. Programming a computer to give over-riding priority to operational traffic is simply achieved and the use of what are known as 'store and forward' techniques means that other traffic is only subject to delays during the passages of the operational traffic and, of course, any peak hour queuing which one would have on any administrative communications system, manual or automatic. This use of computers, in the 'pure' communications role, has the most attractive possibilities of any applications for cost reduction. This is because the communications facilities, ie channels, can be utilised more efficiently.

Consider an 'exclusive' line, a private wire circuit provided for operational purposes. The use or time occupancy of such a line in a Fire Brigade will be extremely small. However, the line is rented for 24 hours a day, 365 days a year, and its cost has been justified by the operational need for its continuous availability for emergency purposes. If use could be made of this idle time, it could provide either a 'free' communications channel for other purposes, saving channels, giving a more reliable network for all purposes at about the same cost.

To be certain that an operational 'exclusive' channel is in fact available as required, it must be tested. The interval between tests in a manually operated system is determined by the nature of the channel and the staff available. In a computer-based communications system, a channel in combined use can be monitored continuously, both by means of its more frequent use for traffic (higher occupancy) and by automatic testing under computer control during idle periods. Any deterioration or fault can be reported to the operator for remedial action immediately rather than await discovery in an emergency situation.

POSSIBILITIES FOR THE FUTURE

The use of printing machines operated by the seven-unit code internationally used for computer and data communications has interest because the character set available includes upper and lower case letters, the normal punctuation marks, tabulation and back space so that the production and transmission of printed messages is as indistinguishable as possible from an ordinary letter produced by an office typewriter. A letter from and to any part of the brigade could therefore be delivered in minutes. Circulars, orders and any other instructions might be distributed to any number or all offices, reducing typing and reproduction staff effort. The cost per message (or letter) would certainly not be more than if it were sent by post, and repeat copies could be made available without additional typing or copying machinery. Such a computer-based message distribution system could well form part of the overall operational communications as the programs would be almost identical with those written for its prime purpose.

Programming and design of a computer system to search lists of addresses, attendance instructions, stations and appliance status, officer availability, back-up capability, incident progress and to keep them all up to date is practicable now. In addition, the computer could automatically select stations to be alerted with necessary appliances, handle administrative messages and present to the mobilising officer's position, the current status of any of the above on demand.

As noted previously, the weak link is in the man/machine interface. This problem is being tackled in a number of ways.

It should be remembered that the aim is to enable the speedy and accurate input of data (information) to the computer by the operator. This aim can be met only by making the operator's task as simple as it can possibly be.

Taking the telephone exchange as a simple example, the introduction of the touch button 'dialling' and crossbar exchanges to replace the dial impulse trains and step-by-step Strowger exchanges speeds the call number selection process considerably. It is also less liable to operator error once familiarity with the system is achieved.

Optical Character Readers have been developed for use where the source of information is already printed, such as bank or Giro cheques, clock cards and other such forms, but they are not yet an economic proposition for handwritten or normal type-printed characters.

Where the terminal is a visual display, consisting of a television-type tube and keyboard of some kind, a computer can be programmed to provide a number of choices, one of which is to be selected. At present, this selection is mostly carried out by keying numbers or other characters in via the keyboard. A recent development is the 'light pen' which the operator merely touches on the tube face to indicate his choice and the computer then takes action or provides further, more refined, choices until the final course of action is indicated.

The input of information to a computer-based system from automatic unattended alarms presents no real problem other than of technical compatability which may mean that the specifications for such systems must in future include a defined standard form for their output signals. Similarly, appliance status and location could be input directly to the computer without manual handling where provision is made to pass this automatically via radio to the control. Specifications for all such automatic systems directly connected to a computer would also have to call for a much higher standard of reliability and protection from false alarms than obtains at present.

It would be advantageous if the telephone exchange equipment, on activation by a 999 call, automatically printed out in the control room the telephone number of the calling instrument and the address. This is a plausible proposition now, but the cost of providing this countrywide is, and will be prohibitive for many years, though no doubt it will be practicable eventually.

THE NEED FOR A SENSE OF PROPORTION

Any plan which specifies a computer-based system is going to involve high costs, both capital and continuing. The really worthwhile benefits can only come from completely integrated and carefully specified systems. Application of computers to parts of the system is not likely to bring about any significant improvement in efficiency or show financial advantages.

The objects and requirements for a system must be clearly stated in terms of WHERE, WHEN, TO WHOM, WHAT, but not HOW. This will mean that some operational research has to be undertaken, covering all aspects of the brigade operations, format of messages, type of mnemonic codes used, amount of information, operating procedures and so on. To get the best performance from any system, be it manual or automatic, this type of study is necessary anyway, only when this has been done and the results applied to the manual system can fair comparisons, and a reasonable forecast of the advantages to be obtained by the installation of a computer, be made, ie it may be possible to achieve one's aims and objects solely by streamlining a manual system.

It is very important to remember that in an operational organisation a simple reliable system is always preferable to a complicated 'glossy' status symbol, which may have a slightly better performance when it works but, by the laws of cussedness, is not working when needed in emergencies.

Personnel and 'job satisfaction' are equally important. Referring to what was said earlier, the only way to maintain skills is to use them. In the Fire Brigade environment, these skills are only used for a very small proportion of the working shift, and the onset of emergencies is, happily, random and not continuous. Taking the load off the human operator by means of machinery, unless it provides a significant improvement in operational and management efficiency must be considered very critically vis-a-vis the effects on the morale of staff concerned.

Finally, to emphasise the need for an overall system approach, very expensive and fast-acting computers need reliable and efficient communications networks to match. Unless the information contained in a computer and its processing power can be made available, as and when required, to those who need them—the time and money spent will be completely wasted.

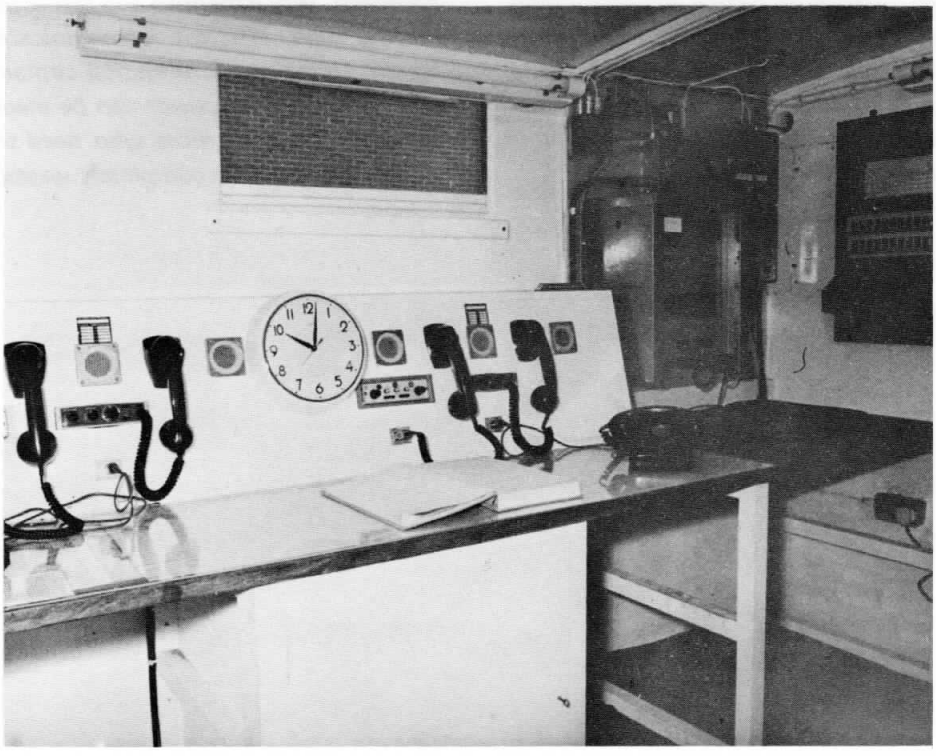
SOUTH WALES POLICE INCIDENT VEHICLE

Bert Green, Regional Wireless Engineer, Bridgend, writes to us: 'We have recently completed the radio installation system of a rather magnificent looking vehicle—the property of South Wales Police, and I was so impressed that I think it may be of interest to you at INTERCOM. The communications equipment installed in this vehicle is listed as follows:

2 VHF 10 channel; all channels operational. Mobile equipments: STC 681/MK2.

2 UHF 6 channel; all channels operational. Base station equipments: Pye W15U.

24 UHF Pocketfone equipments Pye PF1. Aerials are installed for mobile operation or extended mast systems when the vehicle is stationary.'



The South Wales Constabulary inform us that the unit is made up of tractor and trailer with an overall length of 44ft 6in x 8ft wide. The trailer is 29ft long and the interior is divided into three sections, each having a width of nearly 8ft.

The foremost section of nearly 9 ft length is used for communications. It has two complete consoles, each with a VHF three-channel control, multi-channel UHF control and a Panda adaptor unit for monitoring. Two telephones are provided for and a Telex can be installed when needed.

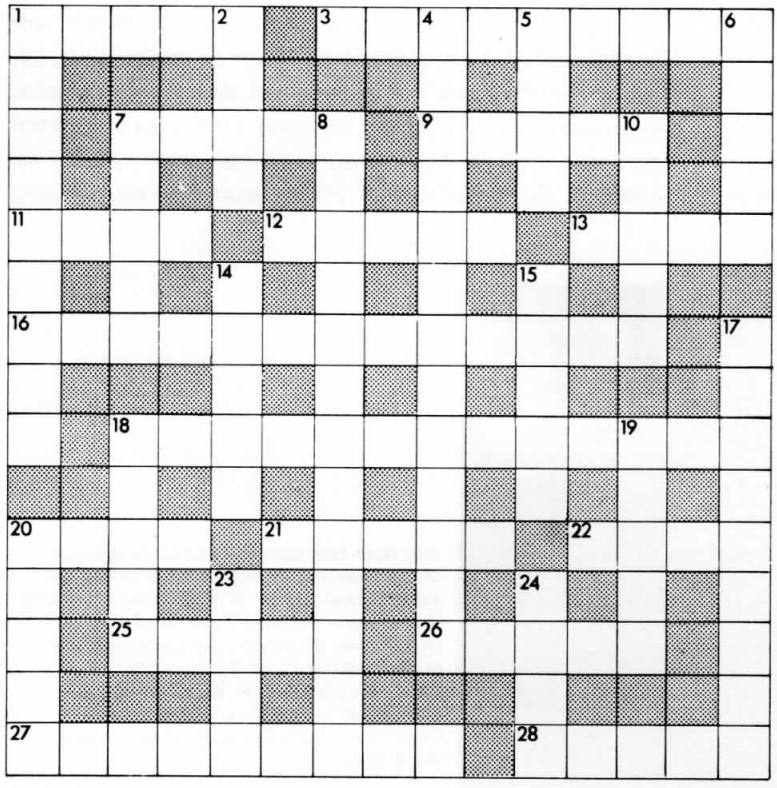
The middle section is a room of about 11½ ft long, complete with table and seating accommodation which can be used as an office or for conferences.

The rear section is nearly 8 ft long and is used for the provision and serving of light refreshments. It has an independent overhead water supply, sink unit, gas cooker and cupboard space.

The trailer has a mains and secondary power supply provided by a portable generator. There are two lighting systems, both mains and 12 volt. Heating is provided by gas fires and the whole trailer is carpeted.

CROSSWORD

WARNING—Look out for technical traps!



ACROSS

1, 3, 27 All those modulations! (5, 9, 9)
7 Mixed trips in Soho? (5)
9 Schoolboy's punishment, MPT's delight. (5)
11 Handy prefix for hands not needed. (4)
12 Palindromic in dbm. (5)
13 Go and return? (4)
16 As for poet, both in this. (1, 4, 2, 6)
18 Inquisition by blonde. (1, 4, 8)
20 One noise makes noisy source. (4)
21 Vegetable, we hear, by weight. (5)
22 Over the base. (4)
25 Eliminate. (5)
26 Roman eleven in Roman this. (5)
27 (See 1 Across.)
28 End of the link. (5)

DOWN

1 By 6 Down we do it (9)
2 What we do for what we get. (4)
4 A young man's fancy makes his . . . (5, 8)
5 Endless noise makes particles charged. (4)
6 Ever present, but there undone. (5)
7 Upset, upset and open shop. (3, 2)
8 Poor Alfred with his pan had to make this. (4, 3, 6)
10 Good man takes a song to get up—or down. (5)
14 From stale source acquire outcome. (5)
15 Cold and hot with a point to point is Diana's sport! (5)
17 Girl cross, with something rude attached. (9)
18 Plate, but not a dish. (5)
19 This measure is socially acceptable even to a radio set. (5)
20 Support, sometimes gilded. (5)
23 Impure country? (4)
24 Pieces—of information? (4)

The solution to this crossword puzzle will be found on page 56.

CONTROL ROOM – BOURNEMOUTH

E Marchant

Ted Marchant is Transport and Communications Officer to the Dorset and Bournemouth Constabulary. He studied engineering in Bournemouth and Guildford and at the Mid-Warwickshire College of Technology. For several years he worked on design and development for British Leyland.

The official opening of the Eastern Area Control Room at Bournemouth on 22 July 1972 by Sir John McKay, CBE, QPM, Her Majesty's Chief Inspector of Constabulary, saw a further phase in a development which was started some eight years ago by the recently retired Assistant Chief Constable, Mr H A Green.

The control room was designed to provide the communications and control equipment for a total police command system with data transmission and management information.

In January of 1972, the force was reorganised and the number of divisions reduced from four to two; the Eastern Division covers the residential conurbation of Bournemouth, Poole and Wimborne, whilst the Western Division is mainly rural. The Eastern Area can be compared with a city of half a million population.

Prior to the reorganisation, the Eastern Division had three separate UHF controls; VHF was controlled from the now extinct Force Control at Dorchester. As from January 1972, each area was planned to have its own control room capable of controlling all UHF and VHF schemes in its respective area plus overall Force Control if necessary.

To meet the operational requirements of the Eastern Division, it was planned to design a complete communications complex including control room, collators' office, command/viewing room and teleprinter room. This complex had to be housed in the existing Eastern Area Headquarters at Bournemouth which consisted mainly of office accommodation with the exception of a large parade room. It was this room with three adjacent offices which was finally selected and work on conversion started in June 1971.

The control room has eight consoles which are positioned on a computer-type floor on three levels. On the lower level are the three radio operators' consoles, each operator controlling his own UHF area plus VHF communications. The consoles are normally manned by civilians. On either side of the controller on the elevated

The then Her Majesty's Chief Inspector of Constabulary, England and Wales, Sir John McKay CBE, QPM, officially opening the Eastern Division Control of the Dorset and Bournemouth Constabulary at Bournemouth on 22 June 1972. With him are Colonel Weld, the Lord Lieutenant of the County and Chairman of the Police Authority, and the author.

rear row are two incident consoles manned by police personnel. The controller is of chief inspector rank.

The room is air-conditioned and has walls and ceiling acoustic-tiled to give a pleasant working environment. Lighting panels are recessed into the acoustic-tiled ceiling with individual switching.

The command/viewing room and collators' office are separated from the control room by glass panels which give an uninterrupted view into the control room.

RADIO EQUIPMENT

Each console is equipped with a 20-channel Pye Mascot, the control panel is inset into the console face and supported by a fabricated frame.

The channel allocation is seven UHF, two VHF, two inter-Force and two fixed mobiles.

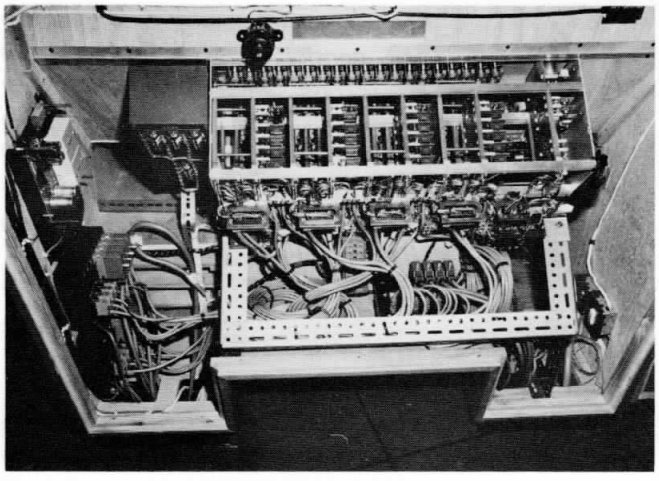


Fig. 1. Bournemouth Control Room—the interior of a console showing the Pye Mascot installation. The consoles were designed to give maximum accessibility of equipment for ease of maintenance.

To reduce the noise level within the control room, handset working is used on all consoles, the headsets are the standard GPO type which receive radio transmissions in one earpiece and telephone in the other. The transmit switch is foot operated.

The Mascot has given increased operator control on the UHF schemes due to each base-station being terminated on individual switches. The Bournemouth channel, for example, has three base-stations which means that, depending on location, three separate transmissions on the same channel can take place at the same time.

At the time of writing this article, the new VHF Pye ASSORT equipment has not been installed, delivery is scheduled for October and until this is operational, the two divisions are sharing a single channel.

TELEPHONE EQUIPMENT

GPO, Air-Ministry-type, push-button panels are used in preference to standard key and lamp units. These units are used widely in aircraft control rooms and have advantages over the conventional 'key and lamp' units, not only in the considerably reduced size of the unit, but for servicing, by removing the two retaining screws, individual panels can be unplugged and replaced with a minimum of inconvenience to the operator. These units are shown in Fig. 2. Four of these units can be fitted in the space normally taken by two key and lamp units.

This is the first installation of AD equipment for police use and, whilst the aircraft industry are permitted to use push-button dialling, this was not initially approved for

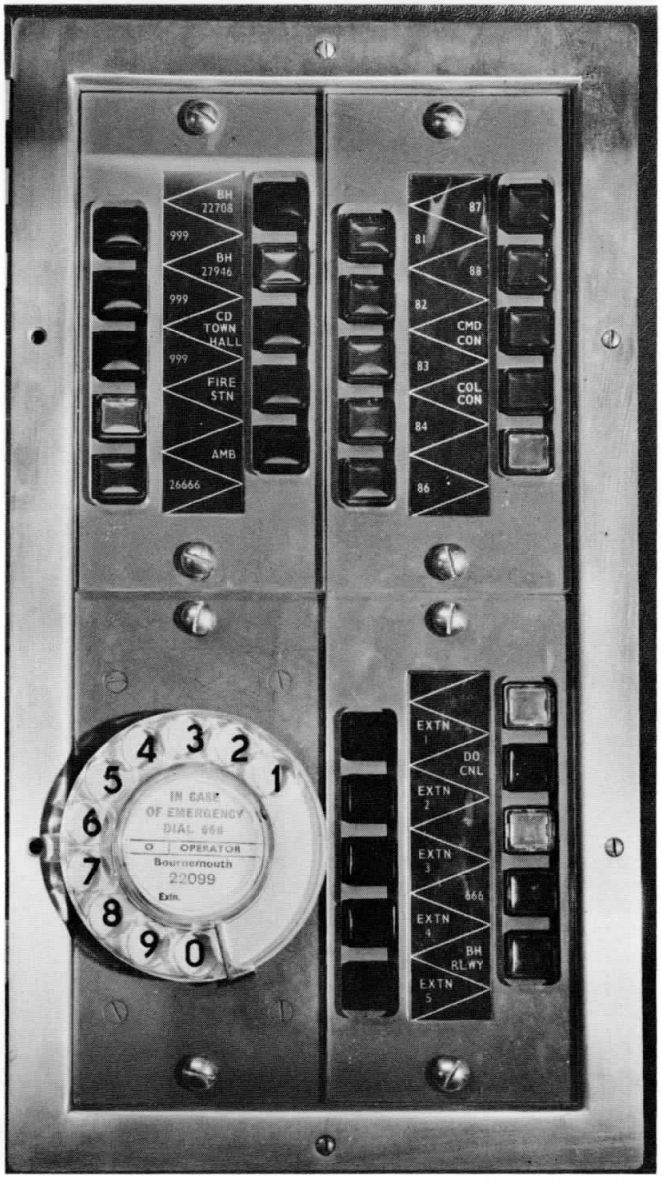


Fig. 2. The Air Ministry push-button telephone keyboard. The buttons are the same as those used on the Pye Mascot.

Fig. 3. A Coded Tone Generator installed in a traffic vehicle.

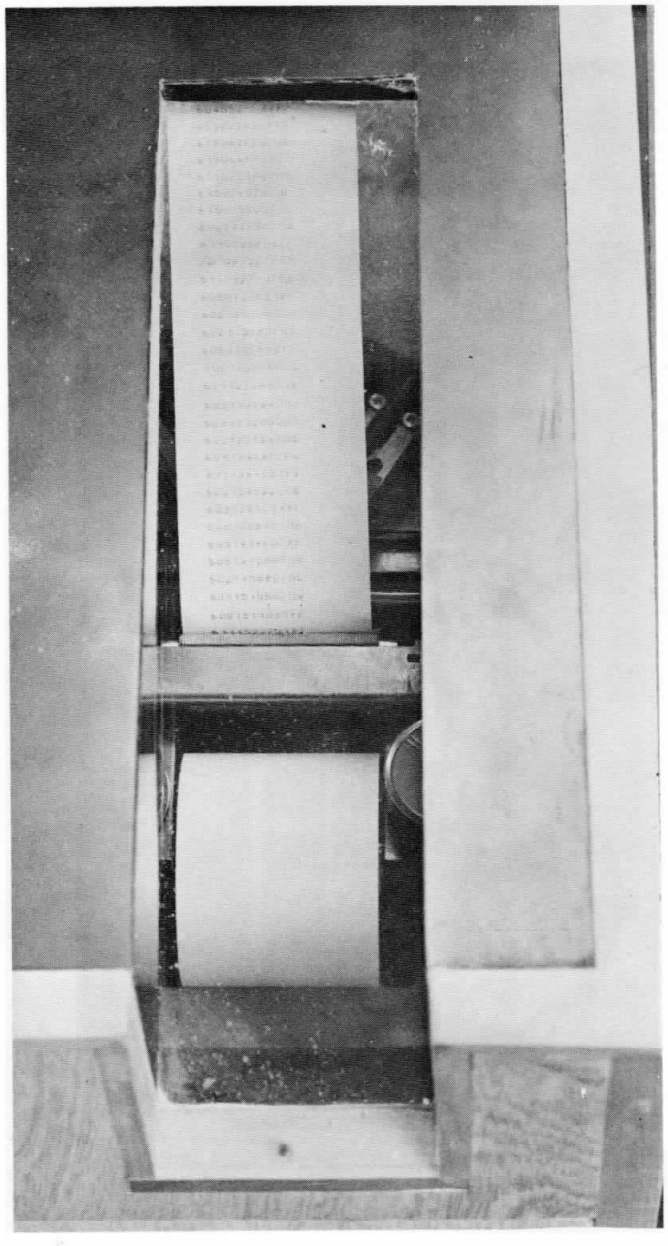


Fig. 4. The printers, which are installed in the radio operators' consoles, record all transmissions into the store complete with time injection.

working on external extensions. Approval has now been given and push-button panels are being fitted in the same position as the dial unit panel. The facilities terminating on the panel are those normally encountered in police control rooms. They consist of both internal and external extensions, private wires and emergency circuits. One panel is used exclusively for inter-console communication. Monitoring, operator re-call and 'buzzer-off' buttons are fitted in the jack-plug panel in the right-hand console leg. When the 'buzzer-off' button is used, a red warning light is activated.

DATA TRANSMISSION

The use of data transmission for updating a vehicle's state and location was first used by the Dorset and Bournemouth Constabulary in 1970; the equipment installed in Bournemouth is a further development of the well-proven installation in the Dorchester control room.

Each vehicle is fitted with the 'Coded Tone Generator' (Fig. 3), a unit that is capable of sending 999 call signs, 99 states of duty and over 4,000 locations. The call sign can be changed easily by plugging in the required digits which are engraved on binary plugs.

The CTG illustrated has the format 612 K13CE. This shows that vehicle 612 is in Map K (which is Bournemouth) on duty 13 in area CE. By pressing the TX button, this format is encoded and despatched, the transmission time is under one second. If the air is engaged, the CTG will 'queue' until the air is free, which means that a driver arriving at an incident can press the TX button and leave the car. The button is illuminated on pressing and, as soon as the transmission is received, a signal back to the car extinguishes the light. On returning to his car, the driver knows that the message

has been received. An emergency button is also fitted. By pressing this, the CTG will automatically over-ride other transmissions, notifying that the vehicle is in an emergency state.

In the control room, the full transmission plus the time is printed by the printers installed in each radio operator's console (Fig. 4). At the same instant a 'Date K' punch-tape machine installed in the equipment room is activated and the transmission punched on tape for processing at a later date on the county council computer. The information obtained is used for management information and is a very important part of the command control system. The total management information is far too comprehensive to discuss in this article, but is fully covered in the Dorset and Bournemouth Constabulary book 'TIME FOR UPDATING'.

The information from the car is held in the core store for retrieval. In the Dorchester system when the store was interrogated, the information appeared on an alpha/numeric display. Whilst this was satisfactory, it was restrictive in that only one unit could be displayed at a time. It is obviously desirable when interrogating an area to see total availability at a glance. Further development work was carried out and 10in Shibaden video monitors were purchased for each console. The cost of these units was a fraction of the cost of computer VDU terminals.

By selecting either a complete map or an area of a map the total deployment of mobiles and foot patrols are displayed, including whether they are using VHF or UHF (Fig. 5). Individual call signs can also be interrogated.

Visual display units identical to those used on the control consoles will be installed in section stations to

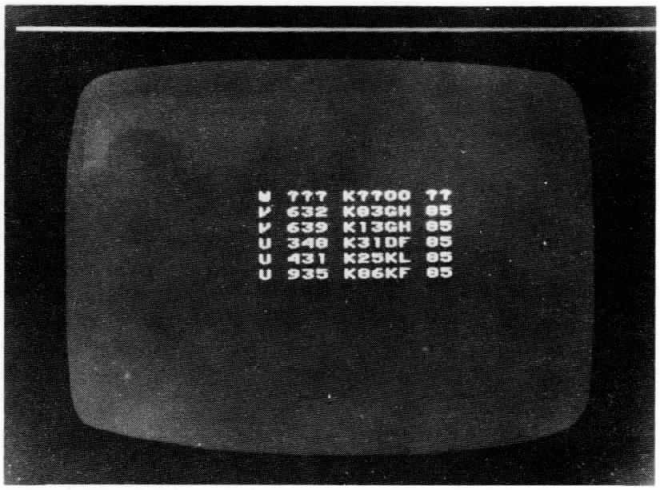


Fig. 5. A VDU, showing availability and deployment in Map K. The first letter signifies whether the mobile or foot patrol is using VHF or UHF. The last two digits (in this case 05) give the total deployment in this area.

enable supervisory officers to interrogate the store to ascertain current commitments. The VDUs will be linked to the store by Post Office Datel 600 lines.

In front of each operator is an update/interrogate panel; to interrogate the store only two buttons have to be pressed. UHF transmissions are received in speech and are fed into the store in the same format as VHF data transmissions. On pressing the input button, the automatic cycle of operations as in VHF data transmission takes place. When the transmissions are received by the decoder, it also illuminates a blue light in the main display map to show the presence of a mobile, or a green light for a man on foot in that particular area, dependent on the duty received.

The 10 operators' consoles are numbered 81-90 inclusive to enable any vehicle to have selective calling to

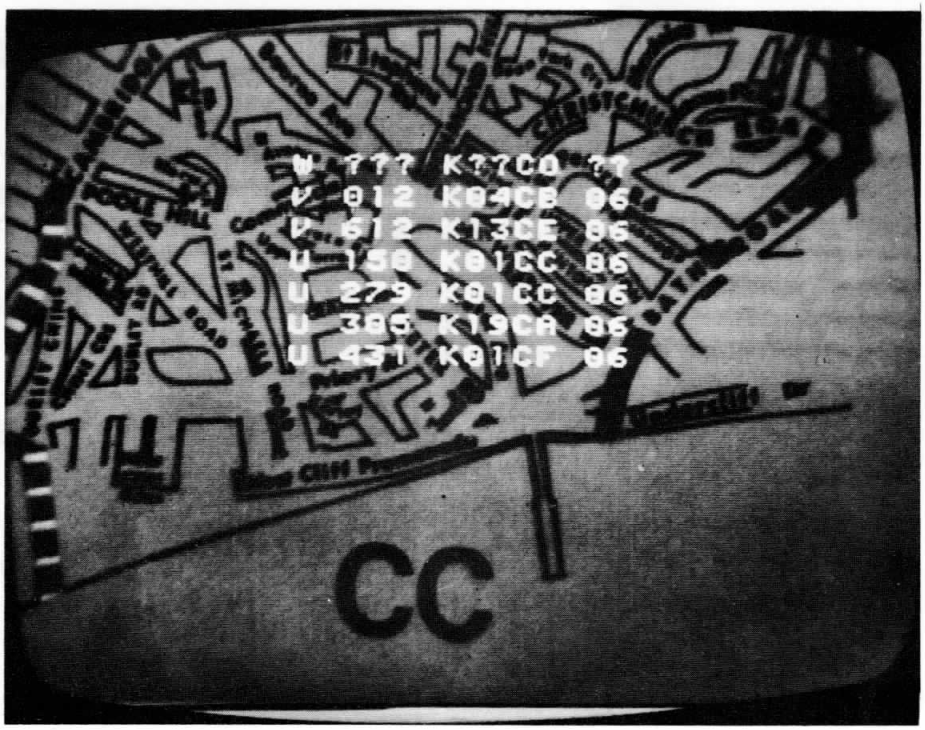


Fig. 6. A close-up of a VDU screen showing deployment and availability for an area superimposed on a street map selected for the Autocue CCTV unit.

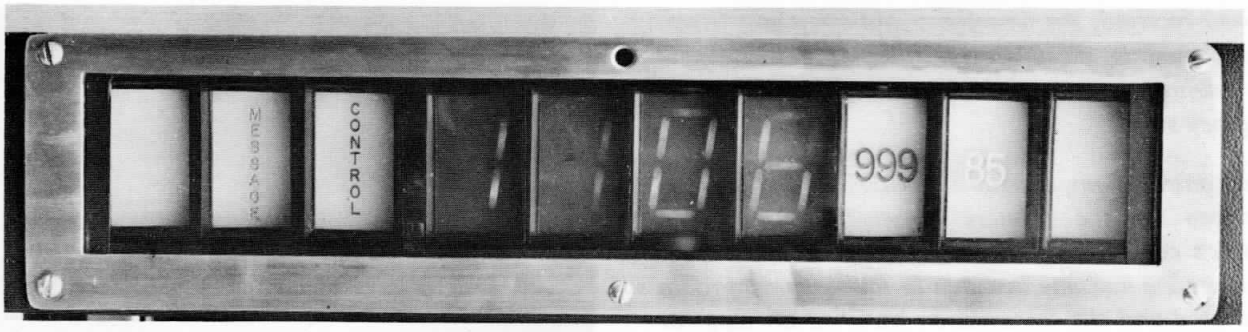


Fig. 7. The display panel fitted at eye level in the consoles shows 'real time' and signal lamps.

individual consoles. If an officer in a vehicle selects 90 on his duty code and presses the TX button, the selected console signal light will be illuminated, indicating that a mobile is calling. Other features of the system include automatic updating of road-blocks and print-outs of response times.

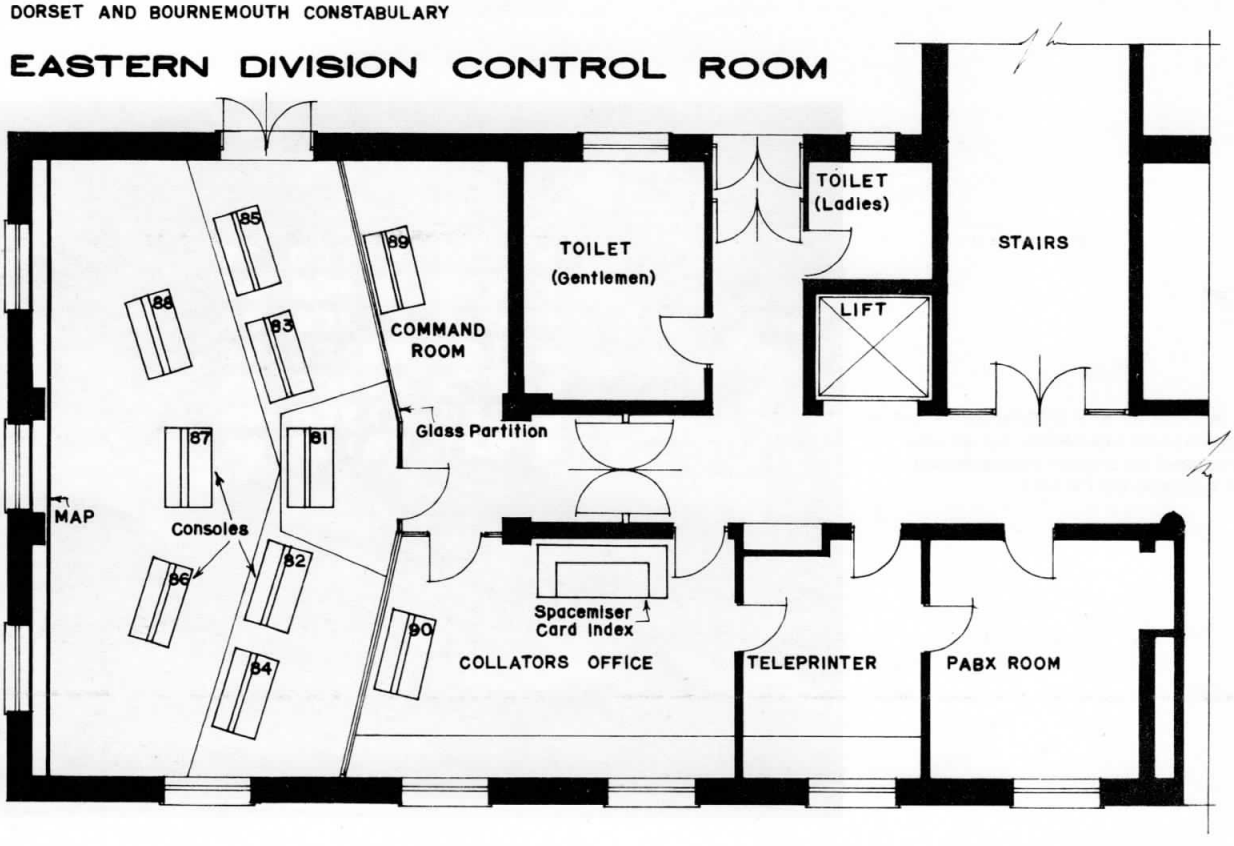
The core store is installed in the equipment room directly below the control room and is capable of storing the information on 1,000 vehicles and 1,000 men.

A unique feature of the total system is that all data, either from coded tone generators or manual input, both for the Western and Eastern Divisions is stored in the one core store at Bournemouth. This enables either control room to interrogate the deployment and availability of mobiles and manpower in their own or the adjacent division. This is particularly useful when overall force control is necessary from one control room or when there is an incident on a divisional boundary.

Further developments which will be incorporated into the system are the provision of printers in cars, printers which will be of the same type as those fitted in the consoles and which will print 'plain language' messages. The existing console 'interrogate/update' keyboards will be used for transmitting messages and the operator will have a selective calling facility.

Successful tests have also been carried out using personal radios to transmit data, and this could be introduced operationally in the not-too-distant future.

The company responsible for developing and installing the data transmissions equipment was Digital Systems Ltd of Farlington, Portsmouth. From the inception of this development, the Home Office Directorate of Telecommunications has supplied not only technical advice, but the necessary wireless equipment to ensure that the command/control system was a success.



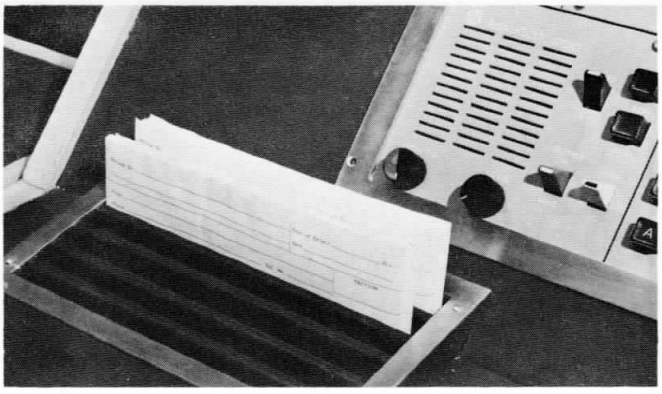


Fig. 8. All pending 'calls for service' messages are held in the message rack until the incident is completed.

MESSAGE CARRIER SYSTEM

To reduce the amount of movement within the control room, a Lamson message carrier system has been installed. This is of the vacuum-tube type, and all tubes have been concealed below the computer floor, while the terminals have been housed in the cabinets on which the VDUs are mounted.

The tube routeing is between the teleprinter, collators' and control rooms consoles.

CONSOLE DESIGN

To ensure that the consoles are ergonomically correct, models were maufactured and various keyboard layouts assessed.

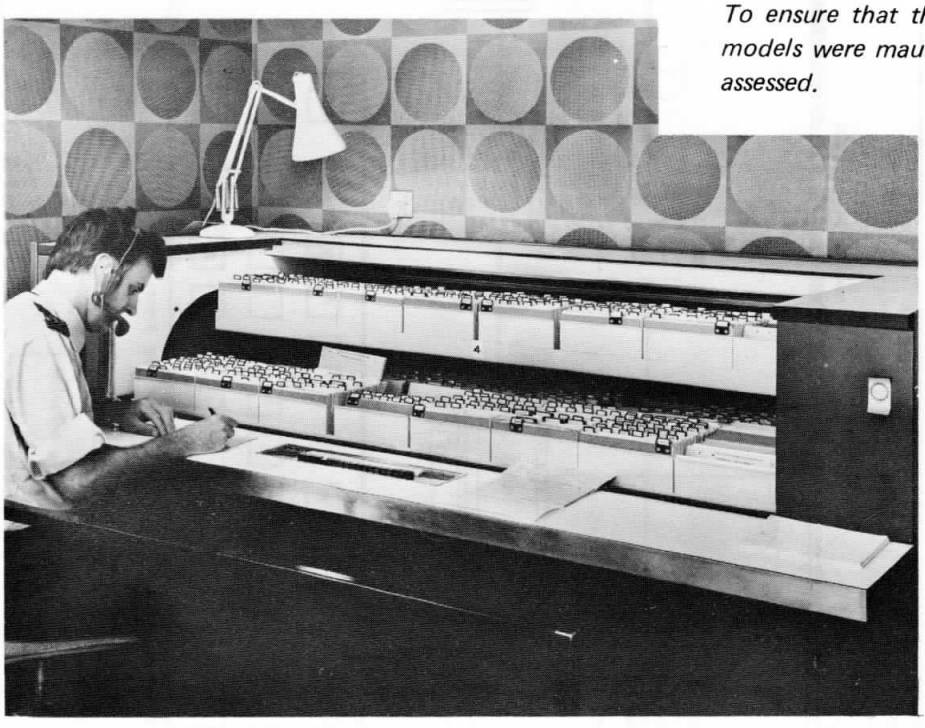
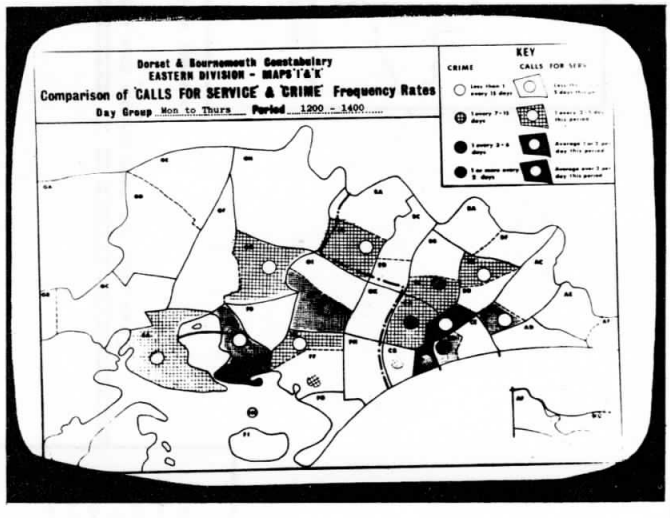


Fig. 9. The electronically operated Spacemiser card index system in the collator's office, capable of storing 140,000 information cards.

'AUTOCUE'

A late innovation to the system was the 'Autocue' random access closed circuit television unit. This enables any map, illustration or instruction to be produced on any of the control room VDUs at the 'press of a button'. The Autocue unit can be supplied in multiples of 16. At Bournemouth, the capacity will be 96 with the electronics designed to give automatic 'hunting'. The unit comprises a fixed television camera focused on rotating drums which hold 32 12in x 10in frames. Maps of each area are slid into the frames (Fig. 11.), each console has its own selection buttons and if, for example, area CC is required, the CC button is pressed and a detailed street map appears on the VDU. If the availability of manpower in the area is required at the same instant, the core store can be interrogated and the availability is superimposed on the map. (Fig. 6.)

In the Bournemouth complex, the main Autocue unit is housed in the equipment room.



Information obtained from the computer print-out is used by the controller to deploy personnel effectively. Maps showing crime frequency rates and calls for service are held in the Autocue unit and can be settled by the operator.

Dorset and Bournemouth Constabulary

COMMAND & CONTROL SYSTEM

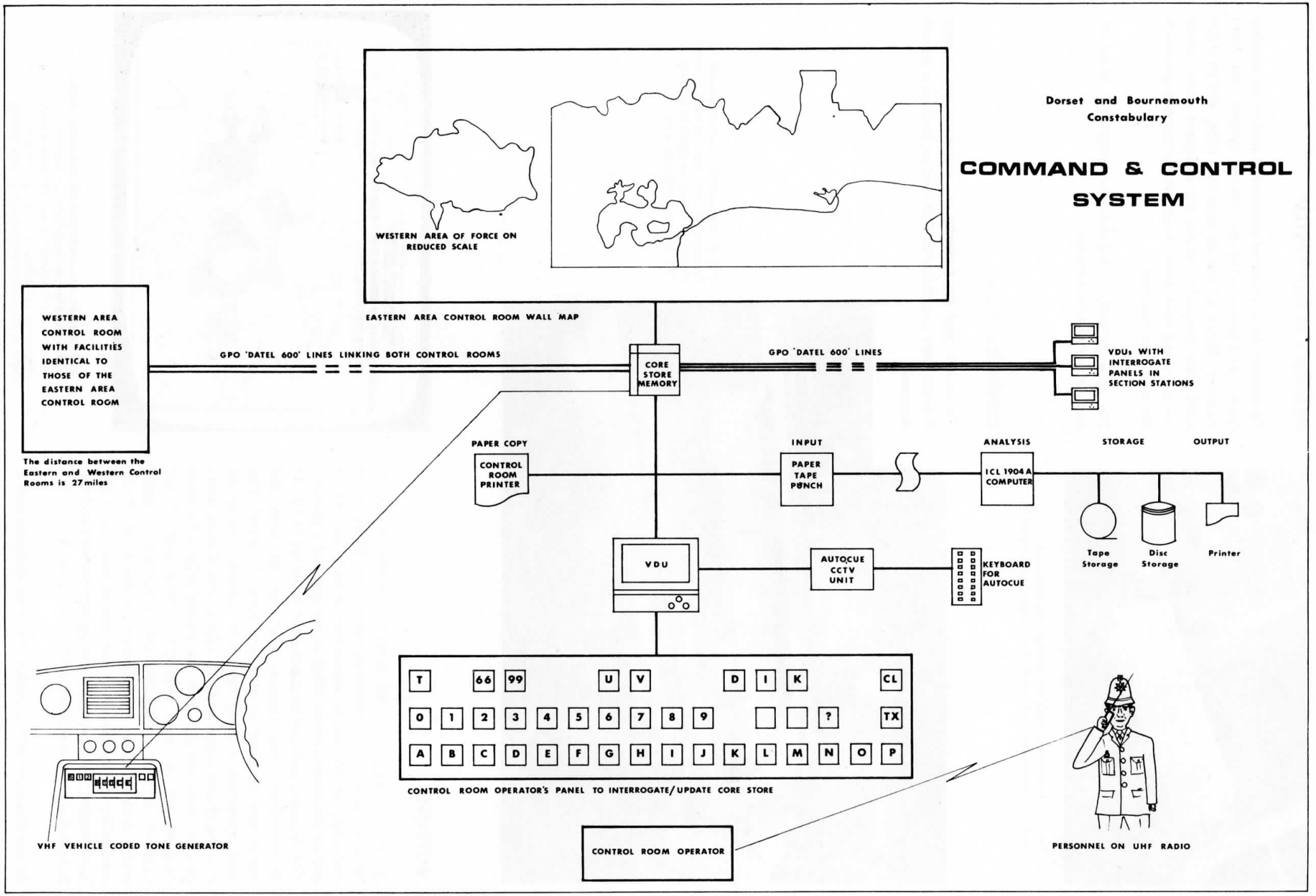
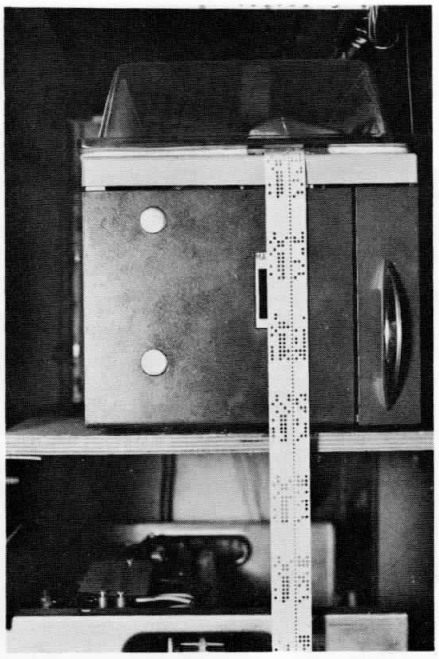
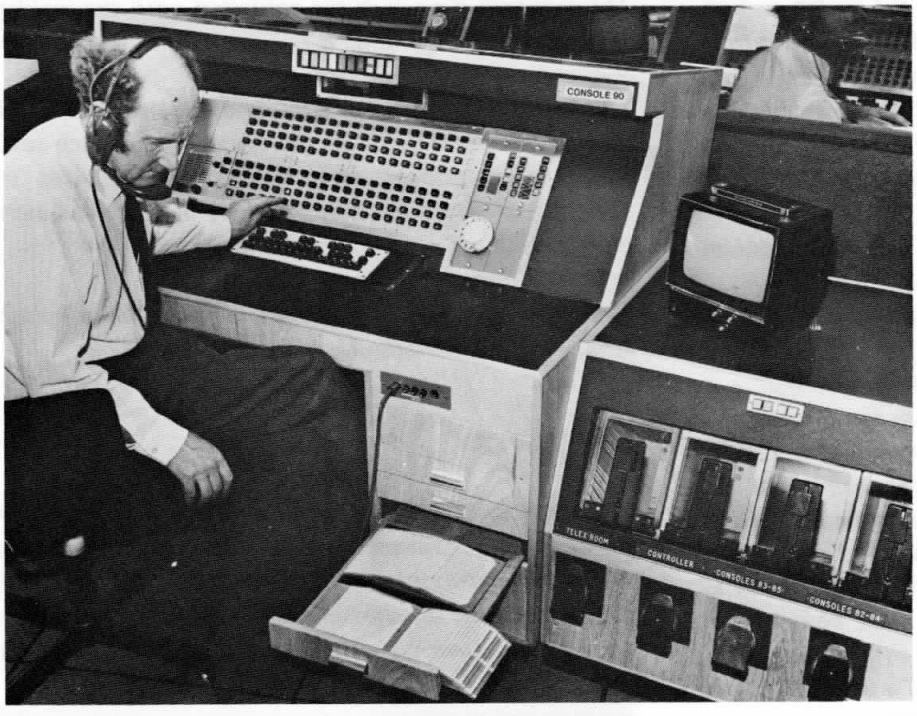


Fig. 10. The teleprinter 15 broadcast system. The keyboard for selecting the four out-stations is shown in the centre.



The computer punch tape which records with time all data transmitted to the store for subsequent management information.



The collator's console, showing the street index cards. On the right of the console are the Lamson message terminals.

The Eastern Division wall map showing all streets on an enlarged scale, each area of the map fitted with panel lights which automatically show the presence of mobiles or foot patrols.

The controller's console with the VDU, showing availability superimposed over the map area. The Eastern Division street map can be seen with the Western Division shown in reduced scale on the left.

The Pye Masçot equipment dictated the centre section of the console and, to keep the telephone controls within reasonable reach, the standard Post Office key and lamp units were not acceptable. The depth of these units also created problems and it was decided to use the Post Office AD unit which measures 6in x 3in x 2in.

To avoid a multiplicity of signal lamps, a separate display panel was designed and installed at eye level. This panel is shown in Fig. 7. and indicates the following:

(1) The four centre digits give the real time.

(2) CONTROL. This lamp is linked to the Controller's console and is used for supervision purposes, ie if the radio operator is broadcasting an instruction and the controller monitoring, and wants the instruction altered, he selects the control lamp to attract the operator's attention. The operator can then speak to the controller over the intercom link before completing the broadcast.

(3) MESSAGE. This illuminates when a message arrives in the console vacuum-tube terminal.

(4) 999. This illuminates and pulsates when a 999 call is received and is terminated only when the call is answered.

(5) CONSOLE No, eg 85. This is the console number and illuminates when selective calling from the car is used.

In front of the operator on each console is an alpha/numeric display panel which will, when a commercial burglar alarm is activated, give the number of the alarm and the area in which it is installed; combined with a remote resetting switch, this will enable the 200 or so commercial alarms terminating at Bournemouth to be installed in the basement equipment room.

A slotted container has been incorporated into the top of the console to hold message pads for calls for service. The messages remain in the container until the incident has been concluded. (Fig. 8.)

The right-hand leg of the console contains drawers with a complete street index of the Eastern Area, each street has the operational area index which enables the operator to select the map showing the required street on his VDU.

The 'Hood' of the console contains fluorescent lighting strips which illuminate the complete console face.

MAP DISPLAY

The wall map was manufactured by the Dorset and Bournemouth Constabulary and displays the deployment of uncommitted foot and mobile resources. Throughout the division and in the adjoining territory of the Western Division; green lights indicate a foot patrol

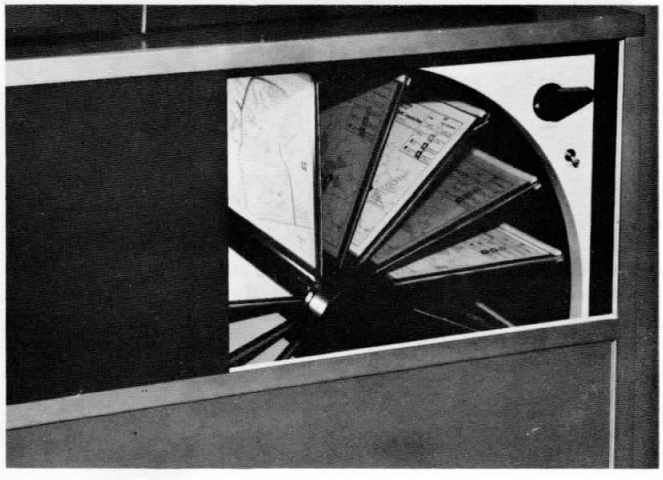


Fig. 11. Street maps, major incident instructions and management information are held in the Autocue closed-circuit television unit, operators can select the required frame, which will appear on his VDU. Maximum time from select to screen is 13 seconds.

and blue lights mobile units. Resources en route to, or in position at, checkpoints, are shown by pulsating red lights and quiescent lights respectively. (Fig. 13).

COLLATORS' OFFICE

The collators' office is an integral part of the command control complex and has its own radio console with identical facilities to the control room consoles.

Provision has been made for the installation of the National Police Computer VDU adjacent to the console, so that all enquiries on persons, vehicles, etc, whether local or national, will be channelled through the appropriate staff.

For local information, a 'Spacemiser' card index system is used. This unit holds 140,000 record cards which are electronically selected. (Fig. 9.)

TELEPRINTER ROOM

The teleprinter network for the Eastern Area is a Post Office trials installation. Teleprinter 15 units are used at Bournemouth with broadcast and individual select facilities to four teleprinter 15 units installed in out-stations.

The selection switchboard is shown in Fig. 10.

The second teleprinter shown is linked direct with Force Headquarters who are responsible for inter-force communication.

POLICE COMMUNICATIONS—THE PERSONAL TOUCH

N Morley

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The following is a paper presented to the Conference of the Joint Radio Committee of the National Power Industries held at York in September 1972. To many readers, the majority of its contents will already be familiar, but it is thought that the younger members of the Directorate and perhaps some operational readers may welcome a broader view of the personal radio field than that obtained in their particular situations. Subsequent discussion at the conference was lively, and it is a pity that some parts of it were not recorded for reproduction here also.

INTRODUCTION

The theme of this conference is Getting Your Man *and it seems to me that, of the various facets of police communications, what we call 'police personal radio' was most appropriate to the theme. This paper is therefore devoted to that subject. Although much of it will doubtless be irrelevant to your particular operational requirements, I thought that a brief review of the evolution of personal radio in the police environment might be of interest.*

There have been very few technological innovations which have had significant effects upon police operational methods. The wide-scale introduction of VHF mobile radio in the post-war years was one example, of course. And in earlier days I suppose that various changes in means of transport might qualify, although they were evolutionary rather than revolutionary. But there is no doubt at all about the place of personal radio in this category. Within a year or two of its provision in substantial quantity, entirely new methods of policing had been devised and introduced, to make better use of the advantages obtaining from the close contact now possible between policemen 'on the ground' and their operational controllers. And I think that this is probably the true criterion of an innovation's value. Many devices are useful adjuncts or aids, but when the facility provided is designed into operational practice, it becomes an essential component and, whilst this is very gratifying, it also places enormous responsibility upon all of us who are concerned with its provision and maintenance.

Police chiefs are unanimous in their assessment of the value of personal radio in helping to counteract manning difficulties by enabling more efficient use of limited resources. In the very early days when models of pocket sets were first being tested, one chief constable predicted that before long a beat policeman would no more go on duty without his personal radio than he would go without his boots. That would be pushing devotion to duty a little far, but the point the chief was making, that his personal radio would be regarded as an essential part of a policeman's equipment, has undoubtedly been proven correct.

As a slight diversion, which nevertheless underlines the points already made, it is interesting to note the virtual disappearance of two previously vital items of police equipment, namely, police whistles and police call-boxes. Ten years ago, this would have been unthinkable, but now even that old reactionary Sergeant Dixon has had to accept these changes—brought about by the use of personal radio.

BACKGROUND INFORMATION

To understand the ways in which personal radio is employed by the police it is necessary to know a little about police organisation and their main (vehicular) mobile radio systems.

Taking the structure first—a typical county police force might be divided territorially into, say, six divisions, each under the command of a chief superintendent. The divisions in turn are often further divided into two or three sub-divisions. The status of the sub-divisions varies considerably with the nature of the force, and the officers in charge range from superintendents to inspectors. Divisional headquarters are often large establishments, and are invariably manned on a 24-hour basis, whereas sub-divisional headquarters in less populated areas may be closed for part of the night.

A typical radio arrangement would be for the county to be covered by a common radio channel, controlled from Force HQ, but with facilities for emergency control

from the divisional headquarters. The channel will be two-frequency with duplex fixed equipment, permitting the emergency control mentioned to be affected on a 'talk-through' basis by small fixed equipments tuned as mobiles.

Landline communications relevant to the present subject generally include a force PABX system, embracing force, divisional, and sometimes sub-divisional headquarters, and also operational private wire circuits between these locations. From Force Headquarters, control is normally exercised over all traffic patrol cars and motorcycles, dog-vans, special operations vehicles, etc. Control of personal radio schemes, ie of foot patrols and personnel using panda cars, is normally down at sub-divisional and/or divisional level.

BASIC PERSONAL RADIO SCHEMES

Most people here will be aware that the personal set currently most widely used by the Police Service in the United Kingdom is the UHF Pye Pocketfone. There is a notable exception in the Metropolitan Police District, which currently uses high-band VHF Storno equipment. There are also in use large numbers of sets of other manufacture, but the largest quantity of a single type of equipment is undoubtedly of the two-unit Pocketfone PF1, of which the police of England and Wales alone have well over 20,000 in service. I shall be touching on the matters of personal equipments and frequency bands later, but in the meantime references to UHF personal sets and systems will imply use of the PF1 system.

When personal radio became of really proven viability six or seven years ago, there was much pressure to get as much equipment into the field as quickly as possible, particularly to alleviate manning shortages as mentioned earlier. The policy adopted was to determine priority of issue on the basis of crime rates. Naturally, therefore, the first programmes of installation were in densely populated urban areas, followed by later programmes covering suburban and rural areas.

In dense urban areas it is most important, of course, at either VHF or UHF, to have a good base-station aerial position. At UHF in particular, although line-of-sight is unnecessary and multipath is remarkably effective, a dominant aerial installation is of vital importance. It follows that the best locations for such systems in urban areas are often tops of high-rise blocks of office buildings or flats. In the first urgent rush to get basic systems into operation as quickly as possible, it was not always practicable to get the necessary agreements for the use of such sites, or the essential landlines for control purposes. Consequently many of the early installations were on a less than optimum basis, employing tubular masts erected on the most suitable police or local authority buildings. A typical early system might thus have comprised a single transmitter/receiver combination controlled over either a local cable or a short private wire circuit from a sub-divisional or divisional police headquarters, by means of a simple self-contained control unit. There was often a second control unit in the CID office or at some point in the same building. The facilities provided were on/off, transmit/receive, and talk-through switching, plus intercom between controls.

The initial ad hoc *installations were re-engineered to better criteria as time, effort and availability of line circuits permitted, the principle adopted being to select the best possible positions for the base-station installations and provide line circuits to the stipulated operational control or controls. In many cases, control was required from both sub-divisional and divisional headquarters. Another important feature which was introduced as soon as the availability of suitable equipments permitted, was a duplicated base-station installation with remote changeover facilities. This was essential as personal radio quickly evolved from the 'useful adjunct' to the 'essential item' phase, as discussed earlier.*

The provision of a satisfactory single aerial array installation being sufficiently difficult, we followed the general policy of using a high-grade duplexer for each transmitter/receiver combination and switching the aerial to the appropriate combination with the main/standby switching function.

EXTENSION OF BASIC TRENDS

The area of coverage of a typical UHF personal radio scheme with a single fixed station is 1-3 miles radius in a dense urban area and 3-8 miles radius in suburban and rural areas. Within those areas, however, there may well be small patches with poor or no cover, due to local depressions or exceptionally heavy screening. From the cover aspect, therefore, improvements to basic schemes require some means of extending the areas of cover, and a solution to the 'black spot' problem.

In divisions in dense urban areas there are a lot of policemen involved, and it is reasonable from all points of view to provide overlapping systems on different frequency channels. These may well be on the basis of a separate channel per sub-division. Less-populated large areas are covered by multiple base-stations on a common channel. In schemes of this nature the fixed receiver outputs are generally fed into some sort of selective combining arrangement which also provides lamp indication of the preferred transmitter station for replying to incoming calls. There is a limitation on 'talk-through' with these systems, since a personal radio transmission may well only trigger one of the base-stations, whereas the called party may be covered by another transmitter. However, the 'talk-through' facility is probably most used in small schemes, when control points are temporarily unmanned. Another problem arises in

multi-base-station schemes when it is required to make broadcast transmissions from all stations. This is a well-known problem, of course, but it is less troublesome in personal radio than in vehicular systems because the mobile receivers concerned are often either stationary or slow moving, and FM capture effect is more effective. We have done and are still doing some research on quasi-synchronous transmissions in the personal radio field.

For the filling of 'black spots', or the extension of cover in particular important directions, we use on-frequency relays (OFRs). These are installed near the fringes of cover from the main base-station with high-gain Yagi aerials directed on the base-station, and lower-gain forward aerials (eg corner reflector types or similar). You will probably remember the launching of this device in 1967. As introduced then it was interesting but of little or no value to us because it was semi-directional. We considered that to be of practical value, an OFR would need to operate in both directions, simultaneously, using common transmit/receiver aerial systems. Discussion with the firm led to an agreement that they would go ahead with the development of a duplex equipment on the basis of a small pilot production order. But it took a couple of years of further concentrated joint effort with experimental installations to produce a satisfactory solution. Since then, however, a considerable number of OFRs have been installed and are giving very good service.

I said earlier that in rural areas the range obtained from a typical personal radio base-station (eg 8-10 watts transmitter power in the 450-470 MHz band, with 5 dB vertical gain omni-directional aerial array) might be 3-8 miles, depending upon local conditions. Taking 5 miles as average this means that every 80 square miles of countryside requires its own base-station. In the more populous parts of the country an area of that size will probably include one or two largish centres of population, villages or small towns, and in such circumstances, the provision of base-stations with their remote control facilities, standby power, etc is generally justified. But consider the sparsely populated regions—the majority of Wales, parts of the North and the West Country.

One police force in one of these regions has a total strength of little over 800 and covers an area of 4,200 sq miles. Clearly, in the wilder parts of that force's area, personal radio cover by conventional methods would be a matter of base-stations per policeman, and completely uneconomic. Of course, in such parts policemen do not normally patrol on foot, nor is the Unit Beat System applicable, but there is nevertheless a considerable requirement for personal radio.

Although the main police cover may be provided by patrol cars fitted with force mobile radio, their crews will spend quite a lot of time out of the cars and sometimes at considerable distance from them—attending to incidents, visiting farms, etc. It is important that in such circumstances the crews retain communication, and to cover situations of this nature we use mobile repeaters. Briefly, these comprise a combination of a VHF mobile set, and a UHF mobile set tuned as a base-station, which can be switched so that incoming calls on VHF are retransmitted on UHF, and vice versa. A crew leaving their car could switch their car set to the relay mode and take with them a standard personal radio and they would thus remain in contact with their control.

The OFR and the mobile repeater discussed so far are important developments providing valuable tools in the engineering of personal radio schemes to meet unusual operational requirements, but there is little doubt that the most important progress has been made in the area of control systems. The provision of modern flexible control systems at force control and divisional headquarters has added enormously to the operational value of personal radio.

Mention should here be made briefly of some of the facilities provided in typical systems. At divisional HQ up to three operating positions may be installed, each similarly provided for the control, typically, of eight communications channels. These may comprise three UHF personal radio channels, access to two main VHF mobile channels, the operational landline to Force control, and two local control extensions. The facilities include monitoring and selection to transmit on any combination of channels, inter-channel connection, main/standby switching on UHF remote base-stations, talk-through switching, etc. Treating the landline connection to force HQ and local extensions similarly to the radio channels gives complete flexibility, including the facility for Force Control to be given direct control of any UHF personal radio channel(s). Additionally, in an emergency a UHF channel can be switched through to a main VHF channel, giving Force Control VHF/UHF relaying facilities.

At Force Control a similar type of system will be installed with perhaps 10 similar control positions, catering for up to 20 communications channels (which will include the operational landlines from divisional HQs.) The combination of such systems at Force and divisional HQs gives a very great measure of flexibility, as I am sure you will appreciate. A programme of installation of such communications control systems is well advanced at Force HQs, and has started at divisional HQs.

An entirely different aspect of personal radio applications which perhaps nevertheless comes under the general heading of 'Extensions to basic systems', and is worth a brief mention, is the use of personal radio in aircraft. Police use of aircraft is generally limited to low-altitude, off-route flying on searches and the like,

and the normal situation is that a police observer flies as passenger in a light aircraft or helicopter loaned or hired for the occasion. In such circumstances the only practical means of communication between the observer and ground elements is personal radio, and this works very well. It is, of course, necessary to ensure that its operation has no effect upon any aircraft equipment, but the types of sets which have been used, VHF and UHF, with perhaps 100 milliwatts radiated power, are unlikely to pose any problems of that nature. Provided with suitable microphone/telephone arrangements they have proved quite effective in this role.

SPECIAL EQUIPMENTS USED IN THE DEPARTMENT OF PERSONAL RADIO SYSTEMS

I have described earlier the development of the on-frequency repeater, and the specification of the consequential proprietary equipment is probably well known. I have mentioned also mobile VHF/UHF repeater and the way in which it is used by the police. A few more details of the latter equipment may be of interest.

Our first mobile repeaters were made by Central Communications Establishment at Harrow, for use in an operational policing experiment in rural Devon. The VHF set used was the Pye Vanguard. This was modified by converting the original electronic muting to relay muting which could be used for the repeater switching function. Although the Vanguard was a simplex equipment it was found necessary to use a duplex set on the UHF side. This was because of the 'channel engaged' or 'pip-tone' signal, which is transmitted on our two-frequency schemes to indicate to all mobiles that an incoming call is being received. A simplex UHF set would be held on Transmit by the 'pip-tone' transmission and two-way communication thereby inhibited. For the UHF element, therefore, Pye proved a duplex variant of their Westminster (5 watt) mobile range. There were a few interface problems levels and switching functions, but these were overcome and a workable arrangement reached. A few similar installations were manufactured to meet urgent requirements. Based upon our experience a specification was written against which the equipment in current use was developed. The home-made system had the disadvantages that the VHF Vanguard equipment was not 'all solid-state', and therefore had a greater current drain than was desirable; also, of course, there was a multiplicity of control units, etc. The current Pye VHF/UHF mobile repeater utilises standard Whitehall VHF and Westminster UHF sets with a single control/interface unit, providing a flexible arrangement which can be used:

(1) as a normal Force mobile on VHF;
(2) as a personal radio control station on UHF;
(3) as a 'talk-through' personal radio base-station on UHF; and
(4) as a full, two-way VHF/UHF repeater.)

Modes (1) and (3), ie normal VHF mobile and UHF talk-through, are available simultaneously.

The use of standard sets not only enormously simplifies maintenance aspects, but also means that the major part of the total installation can be bought under bulk purchasing procedures, thereby reducing its cost.

I have discussed at some length the make-up of the police static personal radio nets and the VHF/UHF mobile repeater used for some rural purposes. There is another very important area of operational requirements which could be called 'special operations'. This really amounts to a need for the ability to provide temporary personal radio cover in a variety of circumstances, sometimes predictable but often not. In the predictable category comes such applications as crowd control at football grounds and traffic control at big show grounds. The unpredictable requirements arise from criminal activities, searches and disasters of all kinds. For the majority of these requirements in both categories, a similar basic arrangement is used, that is a duplex mobile transmitter/receiver which is used as base-station for controlling standard personal radio sets. For the football ground type of application a typical arrangement is to have a permanent aerial installation to which the transportable set is connected when required. When a mains supply is available a mains power unit is used, otherwise batteries. The same type of equipment is used as for the UHF half of the mobile repeater. All solid-state, its battery consumption is minimal (200 mA on receive, 1.5A on transmit.) For the major unpredictable application the police generally use a special operations vehicle which acts as a base for the senior personnel and as a communications centre. Such vehicles may be fitted either with a duplex mobile set as described or with a standard fixed equipment, or both. Force VHF radio will also be fitted, and very often other communications facilities. Pneumatic aerial masts will probably be available. For smaller unpredictable operations the duplex mobile is used as a transportable for a temporary base-station, or the mobile VHF/UHF repeater. These can be used temporarily with magnetic-based aerials on vehicle roofs until better aerial systems can be erected. For limited area operations a vehicle aerial will often be quite adequate. (I should have mentioned earlier that both sets used in the mobile repeater are multi-channel equipments so that appropriate channels can be selected for particular applications.)

An ancillary item of equipment which hardly rates the adjective 'special', but which nevertheless merits an honourable mention here, is the Pocketfone Vehicle Adaptor. Most of you will probably know this item, comprising a small unit for mounting in panda cars into which the Pocketfone receiver can be dropped when a 'Unit Beat Policing' officer is in his car. The unit enables the coupling of a 3 dB gain vehicle aerial and an audio

output amplifier (and it also maintains the receivers battery state), thus giving greatly improved reception performance within the car.

I explained earlier how personal radio schemes are generally based upon sub-divisional and divisional controls, and most divisions will normally have several different channels in use. Many senior officers who move around their areas want to be able to communicate with the controls of all the sub-areas through which they pass, in other words they want a multi-channel facility. We have on order an interesting and very useful demountable set for this purpose—10 channel, ½ watt—which operates either as a portable or a car set. When plugged into the car the vehicle aerial, audio amplifier, and power unit are automatically coupled, providing full mobile set performance. This set will undoubtedly fill a variety of roles.

An interesting arrangement developed by Metropolitan Police in conjunction with industry is an item called FRED (Force Radio Extension Device), which is basically a uni-directional relay device. It was originally developed to retain communication with motorcyclists or traffic. It operates on the principle that an outgoing mobile transmission can normally be received on a personal radio set, but a personal transmitter is inadequate to get back into the mains receivers. FRED comprises a small receiver unit mounted on the motorcycle and coupled to the motorcycle transmitter. Thus a dismounted motorcycle with a suitable personal set will still be in full communication with his control, receiving directly and replying indirectly via the FRED receiver and the motorcycle transmitter. Metropolitan Police use a special hybrid personal radio for this purpose with VHF receiver and UHF transmitter. The UHF power requirement is very small. The arrangement has proved satisfactory for the required purpose and production quantities have been ordered. It is planned to extend its use to some cars also. Outside London we are looking into the suitability of a similar arrangement for use in such situations as motorways, where vehicles must be left on one side of the road when attending urgent matters on the other carriageway.

I explained that the FRED arrangement utilised direct reception of the mobile channel on the personal receiver. That was developed for city police, but it is, fact, as most of you will know, that the performance of present-day personal radio receivers is such that their reception is comparable to that of a full vehicle installation. In the reverse direction, however, considerable power is necessary and in typical Home Office area cover schemes anything less than 5 watts transmitter power is of very limited use. A normal 5-watt portable VHF set, probably of 10 lbs upwards, is too heavy for a man to carry continuously. A great deal of the weight of such sets is in the battery necessary to give the requisite duration under stipulated transmit/receive/standby conditions. There are circumstances in the police field, however, in which the transmission requirement is minimal, but it is extremely desirable to have direct access to a VHF mobile channel. For such requirements a lower battery capacity can be considered and we are currently out to tender for a set with alternative battery packs—the target weight for the set with the smaller pack being 4 lbs.

As you can imagine, there are a great many other special and interesting arrangements and equipments in use in the police personal radio field, but time will not permit further discussion on this aspect. I will finish on equipment aspects, therefore, with a brief word on the 'second generation' of personal sets.

We have recently conducted field trials with equipments from four manufacturers selected from those who submitted proposals in response to our invitation for so-called 'second generation' UHF personal radio. Contrary to many fears, maintenance problems with personal sets have not seriously worsened as the sets aged, and initial purchases of six years ago are still giving good service. The first production of new equipment is required to meet demands for more sets, rather than for replacement purposes. There is some demand, however, for extra facilities available with the new types of set.

Undoubtedly, the ingenious concept of the 1965 Pocketfone has created problems for present-day designers of UHF personal radio sets. The two-unit format meant that it was at least a pocket set—albeit two pockets. And the transmitter design ensured optimised aerial positioning and modulation. Viewers of 'Z-cars' and similar programmes will have noticed that it is an uphill struggle to get the set held vertically, but again at UHF polarisation is not a major problem. A lot of our customers express a preference for a single unit set and for it to be body-worn rather than hand-held, but the penalties involved in such configuration are obviously considerable and offset system gains elsewhere.

In the police field the major operational advantage to be gained from the new range of equipments lies in their multi-channel capability. We asked for three channels and this provides very valuable flexibility. The methods of utilising three channels will vary. In some cases the frequencies of three adjacent personal radio schemes will be used to give flexibility of deployment (and of maintenance) within a large area; alternatively, a common reinforcement channel can be used for major operations requiring quick response. In any event I am sure the facility will be put to good use.

FREQUENCY ASPECTS

I suppose the first word under this heading must be on the choice of band—VHF/UHF. A great deal of nonsense has been uttered on this subject, mostly deriving from claims made on behalf of particular proprietary equipments. For quite a long period during the last year or two there were two regular full-page advertisements in

'The Police Journal', one which claimed that X's personal radio gave better penetration of buildings at VHF, and the other—you've guessed it—that Y's personal radio gave better penetration of buildings at UHF. This was amusing in a way, but how confusing to the layman. I am sure those two advertisements must have been responsible for some cynicism as to the credence which can be given to manufacturers' claims. Actually, of course, both claims were partially correct—given appropriate conditions both manufacturers could have justified them. A certain mystique has grown around this quality of 'penetration' in this context—quite unnecessarily. Personal radio waves still obey the appropriate physical laws—UHF gain by multiple reflection and getting through smaller apertures, VHF by lower attenuation through walls, etc and diffraction around obstacles. We satisfied ourselves at an early stage that either band could provide a viable system.

The reason why Metropolitan Police use high-band VHF is simply that they have tested and proved to their satisfaction the particular equipment they use. The majority of other forces preferred the Pocketfone. Developments over the last five or six years have not significantly affected the issue either way. One mode of operation in which there is a significant difference is person-to-person without base-station, when VHF generally gives a better range—as it also does in rural areas with natural obstructions. Actually a lot of VHF is used by other forces for many purposes, and Metropolitan Police also use some UHF, as we mentioned in connection with their motorcycle relay.

When UHF personal radio was first introduced it was on 50 kHz channelling. From the start, however, we assigned channels on a 25 kHz basis and made use of the attenuation obtained at 25 kHz off-centre to permit closer geographical spacing of schemes than would otherwise have been possible. This was necessary in the densely populated areas of the Midlands and North West because of frequency problems. The Americans have proved to their satisfaction that 25 kHz channelling gives the best overall utilisation at VHF. For personal radio at UHF I am sure the same principle should apply.

An important factor in frequency planning, of course, is a question of radiated power. At UHF the maximum transmitter output power permitted from a personal radio set is 0.5 watt. We have applied this limit rigidly to all mobile equipments and any other equipment operating in the mobile transmitter assignment section of the band. On the fixed transmitter side we limit transmitter power to 10 watts, with vertical aerial gain of 5 dB as previously mentioned. These arrangements give reasonably balanced systems, bearing in mind all the variations in personal aerial efficiencies and polar diagrams, etc, and the limits are necessary to contain the frequency problems. In any case the returns obtainable from increased power alone are very small, whereas interference problems, which may well be line-of-sight (and in any case always follow a well-known natural law), can increase dramatically.

RELATED RESEARCH AND DEVELOPMENT PROJECTS

We have in the Directorate a number of studies, development contracts and experiments in hand with some bearing on the personal radio field. These include a study contract on mobile aerial systems which is turning up some almost incredible information on personal radio radiation patterns and how they are affected by positions of sets, positions of arms, etc. We hope that this will eventually help us in optimising formats and carrying arrangements.

Many of you are aware of the work being done for us at Swansea University on double-sideband, diminished-carrier modulation systems. In the personal radio field the system has obvious attractions and we are currently looking into the possibilities of some development work in this direction.

Finally, I have no doubt that others beside ourselves are watching with great interest developments around 900 MHz. Members of the mobile radio fraternity, which continually suffers in one way or another at the hands of the broadcasters, must have gained considerable vicarious satisfaction at the recent ruling in the States that a large block of spectrum in the 900 MHz area should revert from broadcasting to mobile radio.

Miracles do happen and who knows—some of our younger colleagues could live to see the day when a similar appreciation of relative values obtain in this country also. Be that as it may, we cannot afford to neglect the possibilities of this higher frequency band.

FIREGROUND COMMUNICATION

In a paper on Police communications it is obviously quite anomalous to discuss Fire Service matters, and I only mention this subject because it involves a development in personal radio which is of interest to some members of the conference. In the Fire Service there is a long-standing requirement for a wire-less communications system to give absolutely solid cover over a limited area, no matter what the environment—underground installations, industrial complexes, etc, sometimes flooded, often with explosive or noxious atmospheres. Many ideas have been tried in the past but none has been acceptable because none has provided the essential predictability of cover. There is now considerable reason for hope that we have a solution.

About a year and a half ago we placed a small contract with a well-known research unit of one of the major industrial combines for a model 150 kHz system of a type which appeared attractive. The system did, indeed, work better than anything else we had tested, but it was not up to the stringent standard required. Laboratory work done during the development, however, once again pointed firmly to the advantage for this purpose of a higher frequency—in the low-HF region. To cut a long story short, we negotiated frequencies for tests, which were outstandingly successful. Problem situations selected by fire chiefs included the fourth basement of a London store, a Post Office underground trunk exchange, and an oil refinery, and in all cases results were completely satisfactory. The present position is that we have on order an adequate quantity of equipment for wide-scale operational trials which we hope will take place between six months and a year from now.

Obviously the Fire Service requirement is a small specialised area and not amenable to pre-plumbed systems. There are also severe frequency problems to be faced. Nevertheless, the item was thought worthy of mention as it will enable any members who may so wish to follow the progress of trials.

CONCLUSION

I set out with the firm intention of keeping this paper brief, succinct, to the point, etc, and now realise how miserably I have failed on all counts. In looking over it I was dismayed at the number of times I used words flexible and flexibility, but on reflection I decided against alterations because, however bad from a literary point of view, this redundancy does underline one of the prime requirements of police systems. Indeed, flexibility is probably the essential quality of any *system which must be capable of quick reaction to unpredictable events, and I am sure it is engineered into many of your systems too.*

I imagine the fundamental difference between our system is on the control side. Police systems generally conform to a hierarchical organisation, whereas a lot of your requirements probably relate to finding individual addressees, as the theme suggests.

In spite of this we do have a very great deal in common in the requirements of our customer services, and the equipments and techniques used to meet them, and I find, and hope you agree, that these exchanges of views and information can only be of benefit to all parties.

Mr T C Williams, CBE, QPM

In August last, the Directorate staff were stunned by the news of the sudden death of Mr Christopher Williams, Chief Constable of Sussex. Tributes to him and his work have been paid by eminent people from many different spheres, but it would be wrong for any publication concerned with police communications to be issued without mention of his special interest in that subject.

Mr Williams was, of course, a member of many official committees and working parties with which the Directorate is concerned, and his contribution to the work of those bodies has properly been widely acknowledged. Valuable though that was, however, by many of us he will be remembered best for his unfailing courtesy and help in less formal circumstances. He was always prepared to listen to other people's views and arguments on communication topics. Keenly interested in new ideas and developments, he would provide valuable considered operational opinion on prospective innovations. Any experiment or other project in Sussex would receive the utmost co-operation and one knew that reports would be constructive.

To summarise, it is true to say that, in all its activities, the Directorate could rely not only upon Mr Williams' unfailing interest, advice and encouragement, but when necessary also upon his active assistance.

We remember these things with gratitude and a very real sense of loss.

PROBLEMS OF RADIO COMMUNICATIONS IN A HIGHLAND FORCE

C W Rhoden

With this article from Inspector Charles Rhoden of the Ross and Sutherland Police Traffic Department we welcome our first contribution from a Scottish police force.

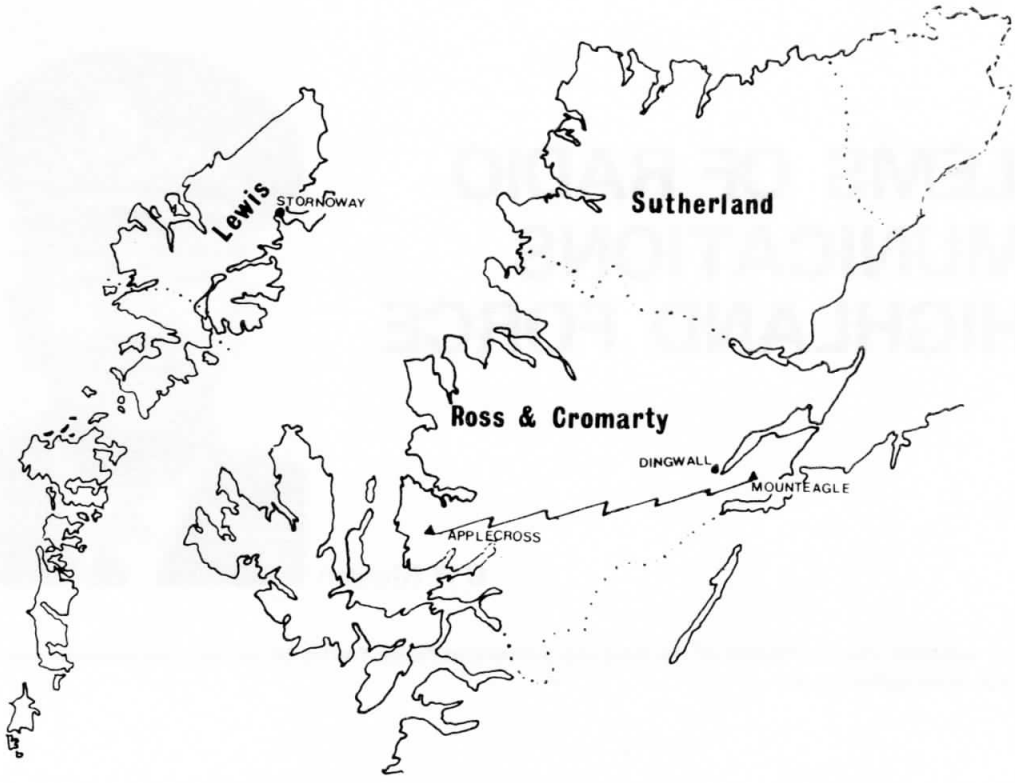
The area policed by Ross and Sutherland Constabulary comprises the counties of Sutherland and Ross and Cromarty, including the Island of Lewis. The area measures roughly 100 miles from north to south and 110 miles from west to east. It is the largest police area in Britain, covering some 3,275,162 acres. Much of the terrain is mountainous with several peaks of 3,000 feet or more and there are vast stretches of open moorland.

The problem of providing radio coverage for such an area is a formidable one. At very high frequencies, hills cast deep shadows, and since the roads mainly run in the valleys, and the coastal villages are all at the head of one sea loch or another, radio communications are very difficult, particularly when transmitter output is limited to the power used by an electric table lamp. As resources become available, however, a satisfactory network has been developed with the result that Force Headquarters is now in touch from Gairloch to Kyle of Lochalsh on the west coast of Ross and Cromarty and from Helmsdale in East Sutherland to the Butt of Lewis in the Hebrides. A brief account of what was involved in developing the radio system may be of interest.

In 1963, when the Ross and Sutherland Constabulary was established, only 10 of the force vehicles were fitted with VHF radio, and there was good radio coverage of the more heavily populated east coast area through a repeater station at Mounteagle on the Black Isle. There was no contact, however, with cars in the west coast or with the sub-divisional offices at Stornoway on the Island of Lewis.

The basic radio setup was that Force Headquarters and mobiles were in touch with each other through the VHF repeater at Mounteagle, some 500 feet above sea level. Distance and mountainous terrain prevented communications with the west and it was therefore necessary to establish a separate link to connect the two coasts. Given the Mounteagle site as one end of this link, another site had to be found on the west coast from which radio communication could be established with force vehicles on the west coast and, if possible, with the sub-divisional office at Stornoway. Several suitable sites existed, mostly on mountain tops, but none had electricity available and few were accessible in the commonly accepted meaning of the word. It was our good fortune, however, to find that the North of Scotland Hydro Electricity Board were in the process of erecting a radio station on Sgur a Chaoraghain, some 2,500 feet above the sea on the Applecross peninsula on

The tracked vehicle which transported the equipment.



the west coast of Ross and Cromarty, and they kindly offered us the use of these facilities. Incidentally, the provision of electricity for this station had entailed the laying down of four miles of electric cable. Accordingly, tests were made to prove the feasibility of a high band radio link from this site to Mounteagle and, these proving satisfactory, an agreement was drawn up to rent the facilities at Applecross, ie the electricity supply, the mast and the accommodation for our equipment.

Early in 1967, the apparatus necessary to equip two back-to-back stations was obtained. The existing 50-watt, low-band (80 to 100 MHz) equipment at Mounteagle was to be connected back-to-back with new 25-watt, high-band (150 MHz) equipment which was to provide the coast-to-coast link, and the whole arrangement was to be duplicated at Applecross. In this way the radio operator at headquarters in Dingwall, by pressing his transmit button, brought up not only the local low-band transmitter enabling him to talk to the local mobiles, but also activated the high-band link. The high-band link in turn triggered off the low-band transmitter at Applecross, thus putting the operator in touch with the mobiles on the west coast of Ross and Cromarty, and indeed on the Island of Lewis.

Unfortunately, when the equipment was installed, it was found to have some shortcomings. In particular, it was found difficult to adjust the various levels of reception due to the inadequate design of the interconnecting arrangements, and the position was further complicated by the fact that the manufacturer of the radio equipment which was then in use ceased production of radio/telephone apparatus at that time. Thanks to the ingenuity of our maintenance engineers, who designed a special piece of apparatus, the difficulties were overcome and new equipment was put into operation. The service worked quite well, and headquarters had reasonably good contact with the west. After one year's evaluation, however, it became apparent that the Applecross installation was the weakest link in the chain. The transmission path for the high-band link is over wild and mountainous country, the picturesque grandeur of which contributes nothing to the quality of the radio signal, other than attenuation and a certain amount of fading. The noise level on the link was obtrusively high, and it was realised that any substantial improvement could be achieved only by modifications at Applecross. The aerials in use at Applecross were four-element Yagis, and it was known from previous tests that they had poor gain and directivity, due to the large mass of metal in the mast. At altitudes of 2,500 feet the problem of wind and ice is severe, and the mast had been built accordingly.

The difficulty was that the long Yagis would not be self-supporting in heavy snowstorms, nor could the existing aerials in such conditions be pushed far enough in front of the mast to render negligible the effect of the heavy lattice work of the mast. It had been estimated, however, that if a purpose-made mast could be provided to support the long Yagis, an improvement of some 10dB in circuit performance could be obtained. It was hoped too, to improve the overall reliability of the Applecross installation. This site is inaccessible for long periods during the winter months, which in practice means that fault developing in the equipment can put the station out of service for weeks at a time. What was required, therefore, was the provision of standby equipment with some means of changeover in the event of failure. Accordingly, the entire radio equipment, including aerials, was duplicated so that the changeover could be effected by switching the mains alone.

Ross and Sutherland—a dramatic and forbidding picture of aerials being inspected at a height of 2,539 feet.

The switching of the mains from one equipment to the other was under the control of a separate radio circuit, using frequency selected networks. Eventually, after a long period of planning and preparation, the new equipment was ready to be installed, and in the spring of 1971, the assault of Sgur a Chaoraghain was eventually begun when the roof of the radio hut emerged from the winter snow. From timber purchased from a local sawmill, a mast was constructed in the form of a large trestle, so made up as to provide support for eight-element Yagis at two points along the booms. The structure was hauled to the mountain top with the aid of one of the tracked vehicles ('Weasels') used by the Force Mountain Rescue Team, and this vehicle was also employed to drag two large boulders to the site. The boulders were drilled, fitted with eyebolts and sunk into the ground as anchors for the mast. It will be seen from the accompanying photograph that the design of the mast owes nothing to the Eiffel Tower, the Post Office Tower or the Saltire Society, but it stands four square in the icy wilderness in mute defiance of the worst that wind or rain or ice or snow might do.

A small transmitter capable of sending two voice frequencies was set up at Stornoway—some 60 miles away. The output of the complementary control receiver at Applecross is fed into a pair of filters each of which is tuned to accept only one of the two control tones which can be transmitted from Stornoway (ie one tone for each set of equipment). This tone on passing through its filter is amplified and passed on to a two-way relay or switch, which is common to the output of both filters, and can switch on either set of equipment depending on the tone transmitted. As a safeguard against the failure of the control system, the switching relay will remain locked in the last selected position, thus ensuring that one set of equipment will remain working. The new installation has been in use now for over a year during which time the performance has been very satisfactory.

On the three occasions on which equipment faults developed, the changeover facilities were used to bring in the spare equipment, so keeping the circuit operational until such time as the maintenance engineer was able to rectify the fault. Fill-in repeater stations have been set up at Stornoway, and Tain in Ross and Cromarty; at Dornoch, Lairg and Bettyhill in Sutherland, so that substantially complete coverage of the police area has now been achieved. Perhaps in the not too distant future when the police get facilities of a radio satellite, the problems presented by mountainous terrain will be overcome, but until then they will have to rely on ingenuity along with perhaps, as in our case, not a little physical effort.

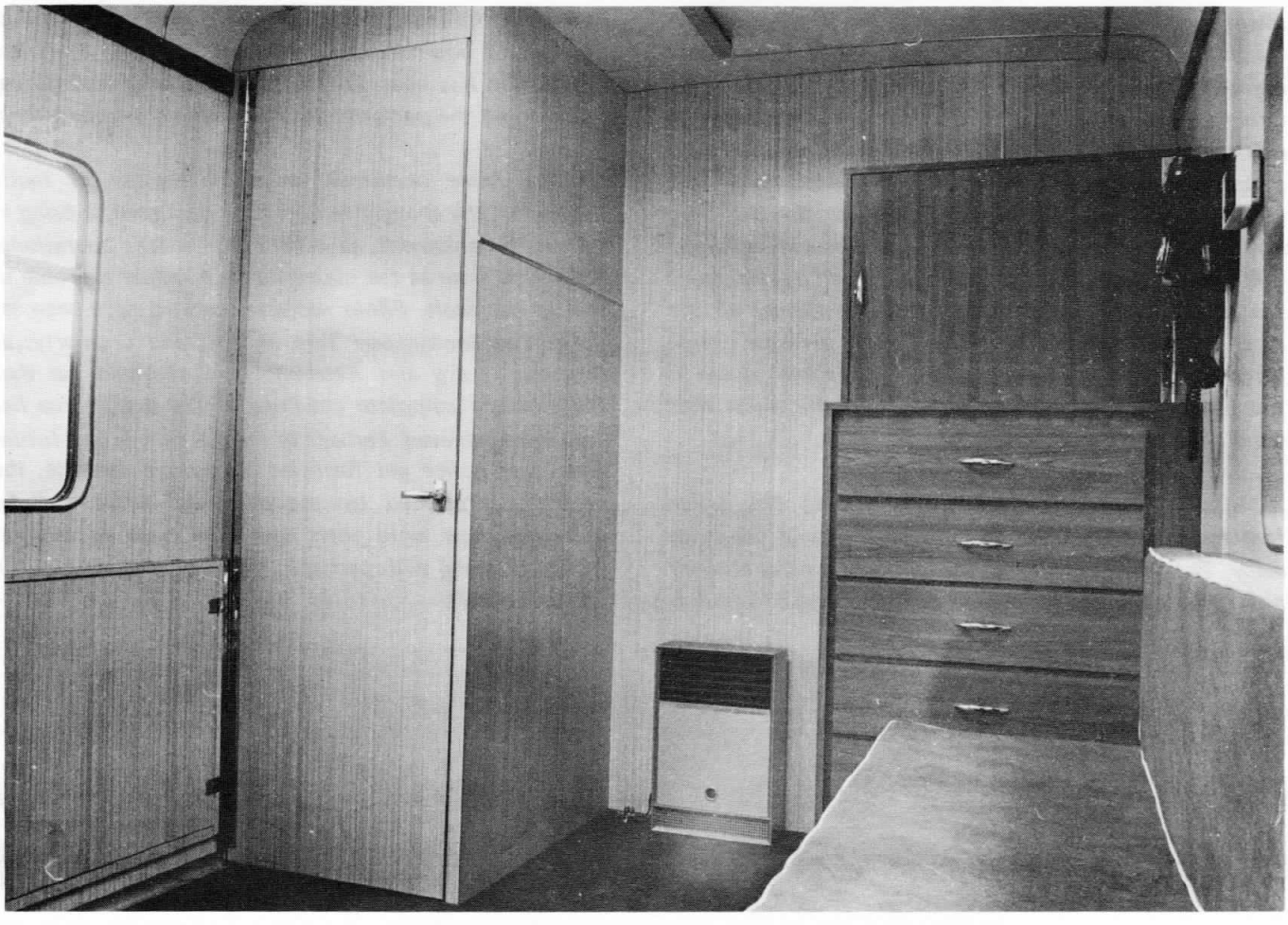
COUNTY DURHAM FIRE – MOBILE CONTROL UNIT

The Chief Fire Officer of the County Durham Fire Brigade sends us details and photographs of the brigade's new mobile control unit.

The original control unit was converted in the brigade workshops in 1952 and had seen service before that. This vehicle has proved obsolete and it has been found necessary to design a new vehicle with modern facilities.

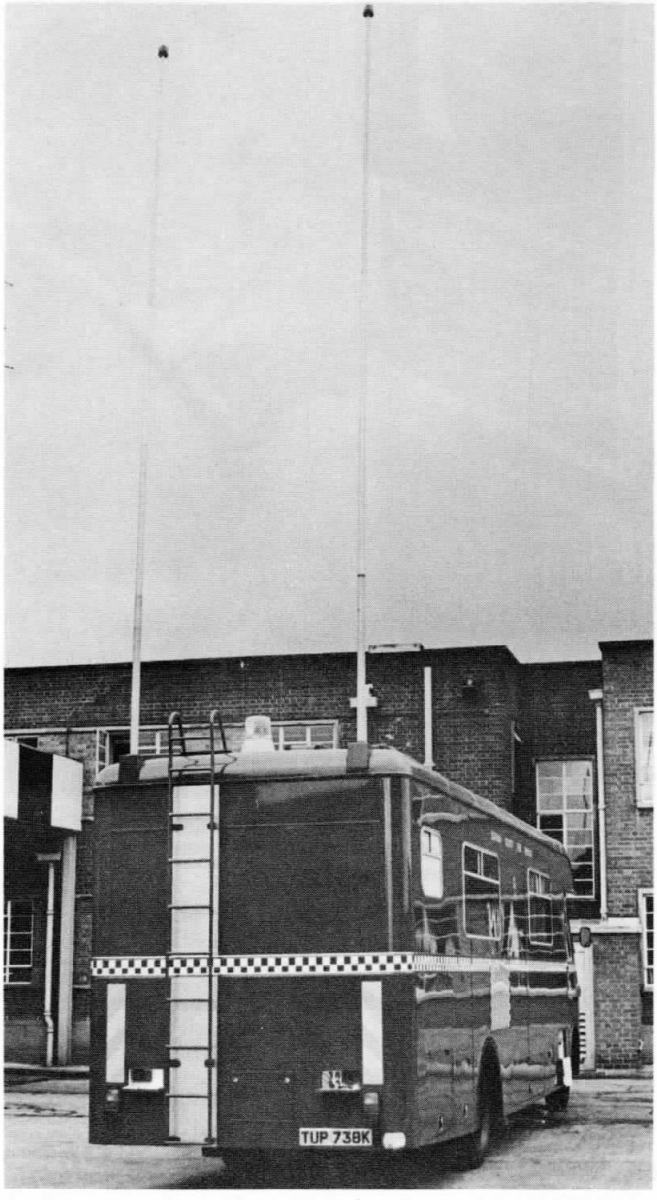
Built on a Bedford SB chassis at a cost of £7,664, the appliance provides full facilities for operation at any large incident.

The front compartment is used as the control room and houses mobilising boards and full communications facilities. Three intrinsically safe pack radio sets are carried together with five pocket portable radio sets. These sets can communicate with each other or with the control unit or back to brigade control from any part of the county. A 10-channel radio set is fitted and can communicate direct to Fire Brigade, Police or Ambulance controls. A telephone switchboard is fitted which can be connected to exchange lines if necessary and there are three extensions giving access to field telephones which can be used up to one mile away from the vehicle.



The Control Unit, showing the compact and well-designed interior. It can be used for conferences and, if necessary, can offer a bed to a casualty.

The control unit.



The rear of the control unit with masts elevated, operated by compressed air and offering an extension to the aerials.

A portable generator is carried, and this supplies an automatically compensated battery charger to maintain the heavy-duty batteries. The generator can be operated up to 150 feet from the vehicle to prevent noise interfering with radio operations. The generator will also supply a 1,000-watt searchlight to provide any necessary illumination.

Public address equipment, fed by a 50-watt amplifier, is carried with speakers on the roof and a tape recorder coupled to the equipment.

The two 30ft masts, operated by compressed air, are fitted to the rear of the vehicle to enable the aerials to be extended if this proves to be necessary in any area where radio communications are difficult.

The centre compartment offers conference facilities with blackboards and large-scale maps that cover the whole country. The seats can be made into a bed for casualties, and the rear compartment houses washing and toilet facilities, all fed from a 40-gallon tank beneath the floor. Turning on either a hot or cold tap brings a pump into operation to provide the water.

Two multi-reflector beacons are fitted on the roof of the appliance, flashing blue when travelling, but, on arrival at the incident, the beacons flash red and white to enable the control to be readily located. The lighting equipment can be fixed in any of six positions on the roof which has been reinforced to serve as an observation platform.

A COMPUTER-AIDED MAINTENANCE SYSTEM

D. Theobald

Derek Theobald is a Chief Wireless Technician in the Field Services Section of the Directorate of Telecommunications.

In INTERCOM No 2, in his article on Automatic Test Equipment, Andy Holdstock outlined the system by which the Directorate will be able to discharge its responsibility for the maintenance of video display units. These units are to be used as the operating terminals of the Police National Computer Network.

During the past few months, work on this system has been steadily progressing and operational trials have been carried out to assess its effectiveness. Results of these trials are being evaluated and the final form of the system is being evolved. Once this has been done the training of personnel can begin.

The whole system will be ready for operational use by the summer of 1973, although a pilot scheme will be operating earlier in the year.

EQUIPMENT TO BE MAINTAINED

The video display unit which has been selected to be incorporated into phase one of the network is the S.E. Laboratories (Engineering) Ltd., Model 1088. This unit will display 17 lines of 64 characters on an 11in rectangular screen. The character generation is by a PRINTICON tube which has a repertoire of 64 characters. Each character is 2mm x 3.6mm in size and is structured by a 3-phase continuous curve called a 'diddle scan'. The information is stored in a DELAY LINE and the screen is refreshed at a rate of 67 frames/sec.

The unit is of modular construction and uses TTL integrated circuits and silicon transistors.

It is a free-standing, alpha-numeric terminal, capable of direct access to a central processing computer. Information which is typed on a silent 'QWERTY' format movable keyboard is easily verified and corrected on the screen by use of the EDIT keys. By operation of the SEND key, this information is passed to the central computer which responds with the reply displayed on the screen. The keyboard which is connected to the display unit by a 'fly-lead' and a plug/socket connection, is divided into four sections each of which has colour coded keys.

(1) Alpha-numeric section;
(2) Editing section:
(3) Cursor positioning section;
(4) Communications section.

Use is made of Hall-Effect switches in the keyboard insert.

Communication with the central processor utilises the International Telegraph Alphabet No 5, at a rate of 1200 bits/sec, in a synchronous mode.

Geoff White, Wireless Technician, Weyhill, loading a program into the PDP 11 computer, using the high-speed reader.

THE MAINTENANCE SYSTEM

The Computer

The computer used in this system is a Digital Equipment Co., PDP11/20 Digital Computer. This is a 16-bit, word-orientated, mini-computer which has a unique communications system called a UNIBUS[R]. All the

Mrs Valerie Blundy, an assembler at the Home Office Maintenance Unit, Weyhill, removing a faulty component from a board which has been returned to the unit for repair.

computer system components and peripherals are connected to the UNIBUS[R] and, by this, communicate with each other.

All peripherals have a discrete address similar to that of core memory locations.

To communicate with a core memory the central processor places the address on the Bus address lines and sets the control lines for a DATA IN. The C.P. then issues MASTER SYNC. The address selected places its data on the DATA LINES and issues SLAVE SYNC. The C.P. accepts the data and MASTER SYNC as knocked down. This in turn knocks down SLAVE SYNC and clears Bus data lines. This is the end of one Bus cycle. This MASTER SYNC/SLAVE SYNC action is the basis of all communications within the computer.

The memory within the computer is of the core store variety and is word orientated, each word having 16 bits divided into two bytes, each of which can be addressed, and our model has a capacity of 8,192 words. A small proportion of this capacity is used for basic computing functions, leaving about 8,000 words for general use. The memory has a cycle time of 1.2 micro/sec.

A useful feature of this computer is the inclusion of eight general purpose registers, all of which are accessible to the programmer, although two are used for basic computing work. As these registers are contained within the central processor they are useful when repetitive instructions or data are used in processing due to the saving of time by not having to go repetitively to the core memory. The program is prepared on punch paper tape in binary format and is input to the processor either via the teletype or high-speed reader. Programs are prepared in abbreviated English by use of the instruction code book and translated into binary by a special program called the Pal-11 assembler.

The System

The basis of all fault-diagnosis is one of stimulation, measurement and an interpretation of the results. The VDU is no exception to this. In most systems in use in the Home Office the stimulation and measurement are taken manually. In this system the stimulation and measurement are done automatically, but the interpretation is done by a technician.

With mobile equipment as used by the Home Office, the policy is to maintain the equipment on a local repair basis. There are several reasons for this (eg, transportation of large numbers of units to a central repair organisation would be difficult and costly, and also large numbers of complete spare units would have to be held at local level). As most equipments are comparatively straightforward in design and unsophisticated, test equipment and methods can be used to achieve the maintenance 'end'. It is probably the most satisfactory and economic method of carrying out this task.

With equipment such as the VDU, we are faced with a far more complex problem in terms of the degree of sophistication in both the test equipment and the unit itself. In addition to the basic maintenance task a less than two-hour down-time must be achieved. To carry out this work by traditional methods would involve extensive training on the equipment and large purchases of very expensive test equipment.

It has been decided to concentrate the expensive test equipment at a central repair unit and provide the

SE Laboratories 1088 VDU. (Photo: A'Court Photographs Ltd.)

technicians in the field with the means by which they can diagnose faults on the equipment to an easily transportable module.

FIRST-LINE SERVICING

This will be carried out by the exchange of the faulty VDU for a serviceable one. The attending technician will return to his service centre with the faulty unit and, by means of an algorithm and access (via the Post Office switched network) to the computer at the central repair depot (CRD), decide by interpreting the results, which module is faulty. This module is then sent to the CRD for repair. One of the functions of the computer check is to inform the CRD of a module change, thereby initiating the despatch of a replacement.

By use of this system maximum use of very expensive test equipment and spare modules is achieved and transportation costs are kept to a minimum. Training is tailored to the technician's needs, so full use will be made of the technician's time and resources of the training sections.

The procurement specification requires the manufacturer to guarantee the 'mean time between failures' (mtbf). This guarantee has to be maintained throughout the life of the equipment, so a high level of quality assurance (QA) is required.

The emergence of these unfamiliar methods is proving interesting to those of us who are actively engaged in the planning and innovation of the system. It is hoped that the system fulfils its early promise and extensive field trials will be carried out early in the New Year when it is hoped to involve the field technicians in its final format.

UNIBUS[R] is a registered trade mark of the Digital Equipment Corporation of Maynard, Massachussettes, U.S.A.

TO GO OR NOT TO GO

Stephen M A Phillips

With this article from Stephen Phillips, Grad IERE, who is with the Home Office Maintenance Unit at Bishop's Cleeve, we welcome this indication that members of the Directorate outside of headquarters are coming forward to write for INTERCOM.

The equipment described by Mr Phillips here and which is now being used with great success, albeit in limited numbers, was triggered off by a unit produced by Mr P S Archer at Colwyn Bay for local use. This was sent to headquarters where it was seen to have merit. Production was set in motion after the detailed design had been carried out at Bishop's Cleeve by Mr Phillips. The production took place at Weyhill.

The part that this test unit has to play in the development of new maintenance methods will be evident from the article itself, but the object of this brief foreword is to draw the attention of all technical staff to the part they can play in developing future methods so that these can operate to the advantage of the customer services, the Directorate and, not least of all, of the staff themselves.

Several ideas originating from regional and outstationed staff are, or will shortly be put to good use, and the editor would be pleased to receive any comment on existing or new ideas, so that, by their use and publication, progress in the important field of maintenance can be hastened along the right lines.

INTRODUCTION

With automated test systems or ATE (automatic test equipment) as it is commonly known, being introduced at specialised units within the Directorate, the requirement naturally arises for some form of first line go/no go test facility to be made available to the technical staff working in the field.

This type of instrument would provide a means of discerning between serviceable and unserviceable equipment, and would prevent serviceable items being returned unnecessarily to the specialised maintenance unit for ATE diagnostic treatment. A considerable amount of valuable ATE time, as well as conveyance time, can be saved and the cost-effectiveness of the maintenance system made more apparent.

Such a test instrument has been evolved to provide a facility for checking the Pye Fireman's Alerter since this particular equipment has been selected to be fault diagnosed by an automated system (ATE)[1] at Bishop's Cleeve Maintenance Unit in Gloucestershire.

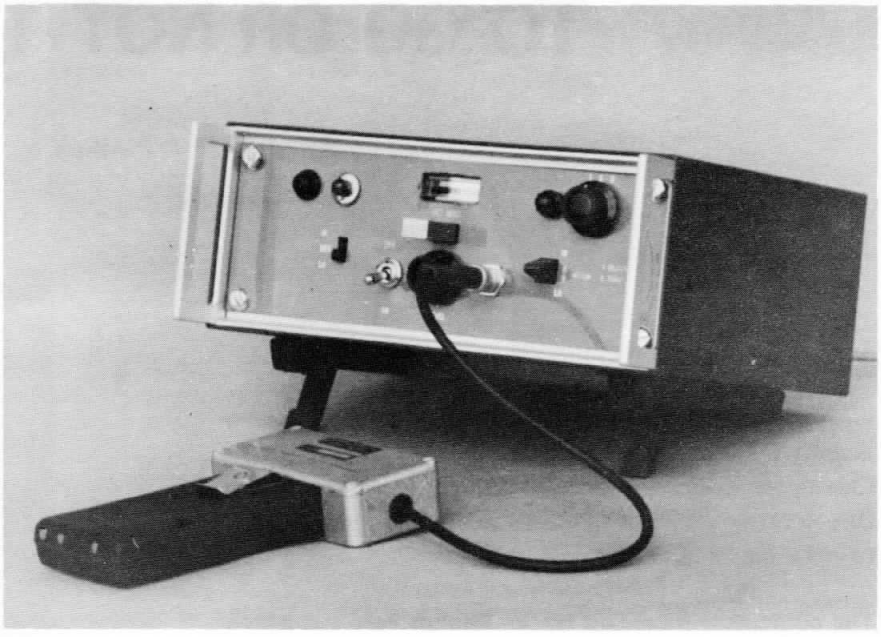
CHOICE OF EQUIPMENT FOR ATE TREATMENT

The actual physical design of the alert receiver lends itself particularly well to automatic fault diagnosis since it consists of a mother board supporting the various modules, each being responsible for a specific function within the unit. Advantage may be taken therefore of the mother board's printed circuit to feed in and out the stimuli necessary for the measurement of various module transfer functions.

However, in the basic go/no go check, the technique is to test the unit under observation without actually removing it from its protective case; the only stimulus to it being coupled electro-magnetically into its aerial system. Thus, a fireman's alerter, one almost ventures to suggest, could be checked by a layman, simply by placing it in the correct position relative to an aerial coupling interface, assimulating a base station transmission, and noting the corresponding response.

ALERTER SYSTEM

To check an alerter, one must be able to assimulate the environmental conditions it is likely to be subjected to



The technique of first line go/no go testing as applied to the Pye Fireman's Alerter using test set type WH 2107.

in the service area of the base station. Therefore, one must consider the system requirements before a go/no go test instrument can be designed.

The pocket alerter receives signals radiated by a 25-watt base transmitter whose carrier is frequency modulated by various tones. These are three in number, comprising the A tone, which is the A test tone; the B tone which is the B test tone, and the F tone which is the alert tone. The combination of tone A or B with the tone F will produce an alert call to 'call out' the appropriate personnel. The tones are transmitted sequentially, and the duration of each tone is always 200 milliseconds (mS). The frequency of tones A and B are governed by a reed filter which also decides the channel of operation whilst the tone F is of fixed frequency (3 kHz). An alerter is also fitted with a reed filter of the same frequency as that of the base station with which it is intended to operate.

REQUIREMENTS FOR GO/NO GO

To check the individual pocket alerter, therefore, a test set must be designed to assimulate the encoded transmission as detailed above. However, careful consideration must be given to the values (or 'limits') of the various levels used in the test set to achieve an adequate operational check of the alerter. For instance, it is no check on the sensitivity of an alerter to note if it responds when operated in the same room as the base transmitter or in very close proximity to the aerial array.

The go/no go test must provide a signal to the alerter of the weakest level that it is capable of responding to within the service area of the transmitter—ie assimulation of fringe area reception. Operating an alerter close to the base transmitter will, however, check if it is likely to block in very high signal areas, and so once again the go/no go test must include this HIGH RF level as well as the LOW level used in the sensitivity check.

The other parameter to which levels must be set is that of deviation. This, as discussed elsewhere,[2] is the method by which the intelligence, in this case the various tones, are superimposed by means of a process of modulation on to a barrier frequency. The alerter system utilises frequency modulation in which the carrier frequency is made to vary or deviate from its normal value in sympathy with the amplitude of the modulating tones. The base station transmitter is set up to check a deviation level of 4.5 kHz, but obviously it is desirable to check if the alerter will respond should this level increase or decrease in value. And so, the go/no go facility must include a test at a HIGH and LOW deviation level.

A test set designed to meet this specification satisfies the first and most important requirement of a go/no go test facility which is to provide a controlled environmental stimulus to the equipment under test.

As well as this, the test set should meet the following requirements:

(1) REPEATABILITY—The ability of the test set to provide consistently an indentical test stimulus.
(2) RELIABILITY—The test set should not be subject to continual breakdowns, but be thoroughly reliable, thus gaining the confidence of the user.
(3) SIMPLE TO OPERATE—Reduces the risk of mistakes being made in testing.
(4) ROBUST DESIGN—Provides for portability without unserviceability.

GO/NO GO TEST SET TYPE WH2107

The following information details the specification and operational use of the test set type WH2107 designed specifically for pocket alerter maintenance.

Specification

Carrier frequency: 147.8 MHz.
Type of modulation: Frequency (FM).
Fixed carrier levels: LOW RF sensitivity test; HIGH RF blocking test.
Fixed deviation levels: LOW 3.5 kHz ± 0.25 kHz; HIGH 5.5 kHz ± 0.25 kHz.
Modulation signals: (1) Alternate 200 mS bursts of reed tone and alert tone F; (2) Continuous alert tone F; (3) Continuous reed tone.
Power supply: 230-250v ac mains.
Dimensions: 12cm high, 28cm wide, 25cm deep.
Weight: 3.63kg.

Operation

The functional pocket alerter consists of the following three separate items:
(1) receiver unit;
(2) reed filter;
(3) battery—9v, 70 mAH, nickel cadmium.

When the alerter is reported defective, it may be one or more of the above-mentioned items that is causing the malfunction. The alerter unit complete is presented to the test set and a go/no go test sequence will establish whether or not all three items are in a 'go' condition. Admittedly, in the case of the battery, it will only be 'go' or 'no go' at that particular instance in time and may therefore still require a capacity check to establish its complete serviceability.

The schedule of go/no go testing practised within the Directorate using the test set WH2107 is detailed below:

(1) Select a base station spec. reed on the desired channel and adjust the reed 'SET LEVEL' control to give the required indication on the test set meter.
(2) Insert a serviceable battery into alerter and check for a continuous tone response.
(3) Check the defeat action of alerter by pressing the defeat, thus silencing the receiver.

NOTE 1.
Wait for a period of not less than 26 seconds after 'defeating' in order that the receiver may begin economising again and then continue with test (4).

(4) Select on test set: function switch to position 1, deviation to LOW.
(5) Position alerter correctly into aerial coupling box.
(6) Select LOW RF position on test set and check for correct alert functioning.

NOTE 2.
Immediately the alerter has been activated, disengage the RF ON switch and allow the alerter to continue its response until it automatically closes down (15-26 secs). It is then in an economising state ready to receive the next test stimulus.

(7) Continue to test the alerter by selecting the other periphery values of deviation and RF levels, viz: HIGH deviation; LOW RF. HIGH deviation; HIGH RF. LOW deviation; LOW RF.
(8) Ensure that after each test NOTE 2 is adhered to.

REFERENCE

[1] *AUTOMATIC TEST EQUIPMENT, A N Holdstock, INTERCOM No. 2.*
[2] *AM, FM AND ALL THAT!, N Morley, Directorate of Telecommunications Exhibition 1971.*

BREATHING APPARATUS—COMMUNICATIONS

A. Hulme

The Forward Planning and Research Section of the Directorate of Telecommunications is currently looking at the problem of Police Officers who are wearing gas masks and communicating with their colleagues and dogs, in a gas environment.

The difficulty was first brought to light after an incident in Hertfordshire during which it was necessary to use CS gas to arrest an armed besieged criminal. In the course of the incident the following observations were noted:

(1) an inability to obtain communications between senior officers, directing operations, and those officers of the assault party who were wearing gas masks and who had entered the gas-filled bungalow to search for the besieged criminal;

(2) lack of communications between officers searching within the bungalow;

(3) dog-handler members of the assault party not having voice control over their dogs.

The first problem could be overcome by using either a gas mask fitted with a microphone or a bone conduction device which the section is investigating as a separate project. However, the use of a microphone in the mask is restricted to certain types of mask as some cannot be fitted with a microphone owing to the distortion which takes place in the rubber when the fittings are attached.

The second and third problems are not quite as straightforward. In the case of person-to-person communications, garbled speech can be transmitted through the gas mask and, providing the persons involved are relatively close together, a message may be passed.

Where dogs are involved, good quality speech is necessary so that the dog can recognise his handler's voice.

A means of overcoming these three problems appears in the use of an audio amplifier clipped to the officer's tunic top pocket and a microphone in the gas mask.

The advantages of these methods are that good quality speech at an acceptable level is available for man-to-man and man-to-dog communication, and when the officer wishes to use his personal transmitter to communicate with a person outside the area, he can hold the microphone in front of the speaker and transmit normally. This overcomes the problem of having a specially converted radio tied to the gas mask or having to change over connections from normal to gas mask microphone which, in the case of the Pocketfone, would involve an undesirable modification.

The difficulties encountered in producing a suitable unit lies mainly in the size, which is determined by the speaker and battery.

The considerations are:

(1) The unit should be as small as possible.

(2) The speech should give a faithful reproduction of the operator's voice so that the dog can recognise the voice.

(3) The unit should be easily fitted and be as near to the mouth as possible. When a handler speaks to the dog it looks at the source of the sound which in normal circumstances is the mouth. If the amplifier is fitted lower on the body the dog tends to be confused because the sound is not coming from the usual place.

(4) The unit must be securely fitted so that it does not become detached when the officer is running or in a struggle.

(5) The range must be at least 25m. This is considered to be a minimum range for this application.

A local firm has undertaken to produce two units complete with masks for evaluation. Unfortunately, they are not ready at the time of going to print, but it is hoped that details will be ready, together with an evaluation report, for the next issue of INTERCOM.

ANY IDEAS?
The Home Office Staff Suggestions Scheme

A M H Shah

Mr Shah is the Secretary of the Staff Suggestions Sub-committee in Establishment and Organisation Division 2, Home Office.

Wherever there is a collection of people, there is a pool of experience and human resource. Every individual has the ability to think because the human brain is active night and day. From thoughts come ideas. A good idea does not have to be intricate or involved; you have only to stop reading this passage, raise your eyes and look round you to appreciate that almost everything you see was the product of the human mind. J S Blackie said: 'a man may think as well standing or sitting—often not a little better'.

Henry Ford went further with: 'Thinking is the hardest thing there is, which is the probable reason why so few engage in it'. Ideas and thoughts provide a springboard for all achievement and progress. All too often we tend to dismiss ideas too quickly and without translating them into suggestions.

The Staff Suggestions Scheme provides an avenue for offering your ideas to the Department. The Staff Suggestions Sub-committee welcomes suggestions that can:

(1) IMPROVE the telecommunications service generally:
(2) DECREASE safety hazards
(3) ELIMINATE wear, waste, breakage or reduce damage;
(4) AVOID duplication of work;
(5) SIMPLIFY a job, resulting in a better way of doing things;
(6) INCREASE the efficiency of any operation or communications;
(7) DECREASE the cost of supplies or materials;
(8) SAVE time, labour, money, heat, transport;
(9) IMPROVE training courses:
(10) SIMPLIFY office procedures, forms and records.

This list does not cover all the ideas you can submit. All ideas are welcome, but should exclude conditions of service, pay, etc, or complaints. All grades in the Telecommunications Directorate are eligible to submit suggestions direct to:

The Secretary
Staff Suggestions sub-committee
Portland House
(Room 9/12)
Stag Place
London SW1E 5BX

The identity of a suggestor is known only to the Secretary.

When your suggestion is received (it may be written on plain paper or a staff suggestion form) it will be numbered and then examined for originality. If it is original, you will receive an acknowledgement, and your suggestion will then be forwarded, without your name being revealed, to the Directorate of Telecommunications to advise on the merits and practicability of your idea. A sub-committee of the Home Office Whitley Council then consider the reply and decide whether your suggestion is eligible for an award.

Whether your suggestion is accepted or declined, you will be given the reasons in a personal letter. If your suggestion when received is found not to be original, the secretary will write to you straight away, giving the reasons why your suggestion is ineligible for an award; a declined idea having special merit can qualify for a small award, but it is unlikely that an award would be made for a trivial suggestion even if it were adopted, eg, for drawing attention to an obvious error in printing or punctuation on a form or rewording of a phrase the meaning of which is already clear.

Broadly speaking, awards fall roughly into three categories—a nominal award of up to £10; a moderate award £10-15; and a substantial award over £25. Commonsense suggestions can attract awards as high as those given for ingenious or technical ones. Before the end of the year (31 March) all suggestions which have received an award or commendation are considered again for a supplementary payment.

Remember:
(1) A suggestion is a solution—not a problem.
(2) All ideas are welcome.
(3) Sketches can help where applicable.
(4) Be Patient. Suggestions are thoroughly examined and it may take some months to evaluate an idea. Use this time to develop other ideas and send them in.
(5) Every stage of the procedure is monitored by the secretary and every effort made to get decisions. An interim reply will be sent to you if evaluation takes a long time.
(6) Keep thinking and keep suggesting. You may not be given an award for your first idea, or even your second, but eventually you will find a system or a procedure that can be improved. Whatever happens, you can lose nothing, and will have the satisfaction of knowing that your ideas are considered carefully.

CRANKS' CORNER

J. Luxton

The Streatham Caravan, 1900. (Photo: Courtesy of Greater London Fire Brigade.)

IN THE BEGINNING . . . ?

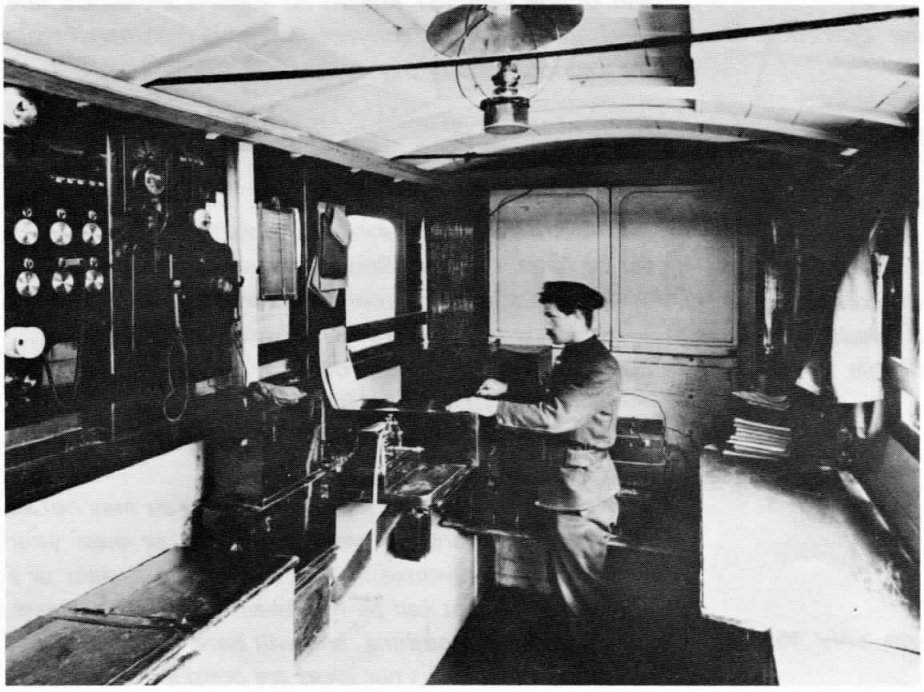
The original title of this episode was planned to be the ROARING TWENTIES. This was hastily abandoned when photographs were received from the London Fire Brigade which clearly laid rightful claim to being 'a first'.

It appears that in 1900 (surely the mind boggles just at the date), during the building of Streatham Fire Station, IT was used to send calls, received at a street station at Streatham Green, to the temporary fire station in Mitcham Lane. This had been found necessary because the fire authorities had been unable to obtain permission to run overhead cables, and the General Post Office had demanded the exhorbitant sum of £280 to run such a cable underground. This charge was considered to be out of the question for a line which would no longer be required after the completion and opening of the Streatham Fire Station.

Hence the brave, and surely unprecedented, decision to experiment with Marconi's wireless apparatus. It is edifying to note that the equipment shown in the photographs gave satisfactory service for the required period.

These few details have been taken from an article in the London Fire Brigade Welfare Review of 1953/54. It goes without saying that any further information that readers can let us have would be most welcome.

Note the 'spark gap transmitter'.



The interior of the Streatham Caravan.

Wireless Equipment in Streatham Fire Station. (Photo: Courtesy Greater London Fire Brigade.)

SOMEWHAT LATER . . .

I make no apologies for a leap forward into the 1930s which is due to a most interesting letter received from Ian Auchterlonie who, as all the old hands will know, was very much involved in police communications during that period. He provides me with a cryptic synopsis that brings some order to my quest.

Here are some of the milestones he reveals for us:
1930—Metropolitan Police two-way radio on vans.
1931/2—Nottingham City Police two-way radio communication to vans. (The scheme was instigated by Captain Popkess, the then Chief Constable.)
1932—Liverpool City Police two-way. Stockport one-way using Super Regen sets made by a local firm. Newcastle upon Tyne, Standard Telephone and Cables adapted aircraft equipment. Lancashire Police radio communications from headquarters to divisional stations.
1935—First regional scheme from Heaton Park, Manchester.
All these schemes were on medium frequencies.

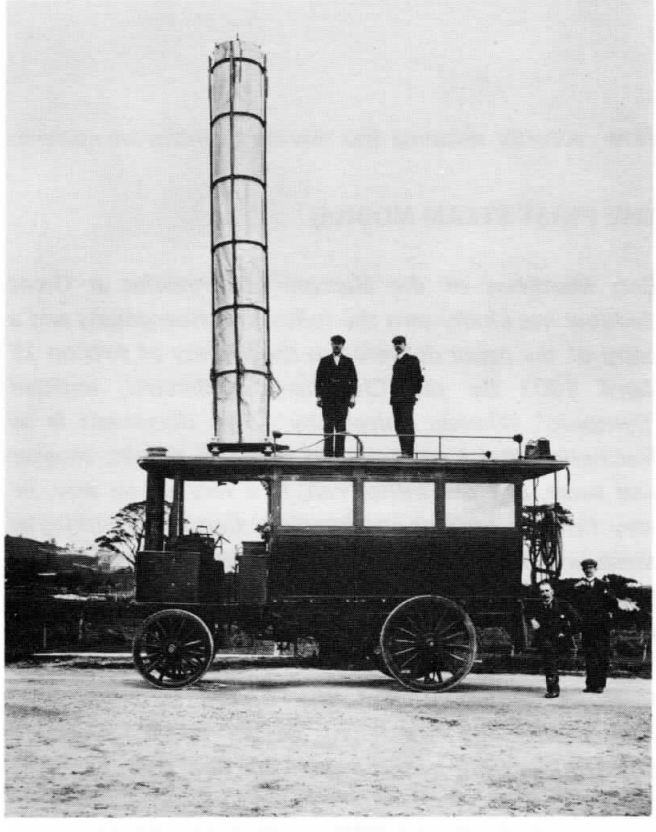
Mr Auchterlonie provides us with a vivid and full description of equipment and methods used in Manchester for the early MF tests, which is in itself a complete article, but I would like to highlight an extract where the MF's potential and limitations had been realised at least for semi-local coverage. And the new thinking was in terms of VHF.

The VHF band as we know it today extends from above 30 MHz to 300 MHz, but in those days 30 MHz was considered high and 100 MHz very high indeed.

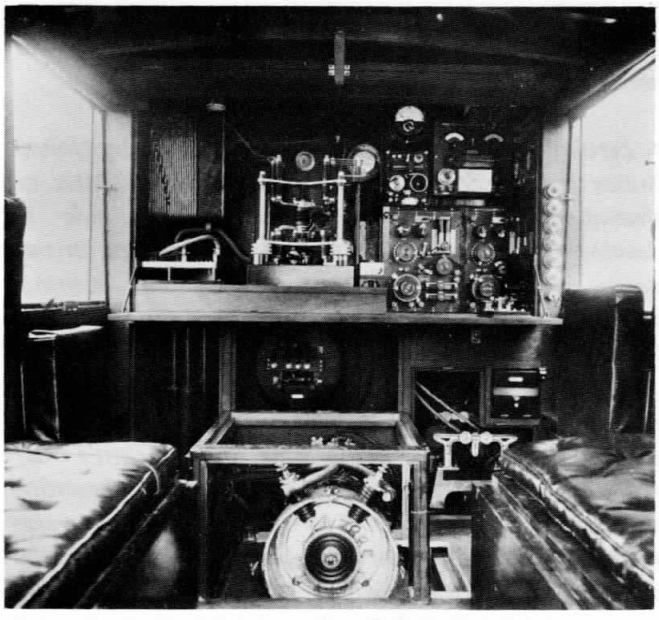
A certain British manufacturer had studied the United States police communications which used 30 MHz or thereabouts and invested considerable funds in developing comparable 30 MHz equipment for British police. However, the United Kingdom licensing authorities had already denied the police the use of the 30 MHz band.

It is delightful to note with the hindsight now available to us that when Ian Auchterlonie told the firm's chief radio engineer that he himself had been experimenting successfully with 60 and 78 MHz in Manchester and also that it was likely that the band eventually to be allocated might be as high as 100 MHz, the gentleman threw up his hands indignantly and cried: 'Ridiculous! It can never work, especially in a city'. When he had been calmed down by his chairman, there followed a convoy journey to Manchester with a special VHF test laid on from the Heaton Park Station for the chairman and the sceptical chief radio engineer. The result, I am pleased to say, was a slap-up meal paid for by the now fully convinced chairman and company.

The chief radio engineer returned to his drawing board and the result was 100 MHz equipment made by the company modelled on the 1937 Manchester transmitter



The earliest form of mobile radio. This steam bus by Thornycroft was used in experiments with the Haven Hotel Station in Bournemouth. The cylindrical aerial could be lowered to a horizontal position when the bus was on the move. Marconi himself stands at the extreme right. (Photo: Courtesy the Marconi Company Limited.)



The inside of Thornycroft's steam bus as used in experiments with the Haven Hotel Station, Bournemouth. We would all like to know more about this equipment. Can there possibly be any living memories of this remarkable set? Or, failing that, has anyone a written record of these experiments? Don't forget to get in touch with the editor or the author if you have any accounts or pictures of historical experiments or vintage equipment. (Photo: Courtesy the Marconi Company Limited.)

which gave good service until the end of the 1939-45 war. It may be of some interest to know that the RAFT1131 also had what might be called a 'close family resemblance' to this equipment.

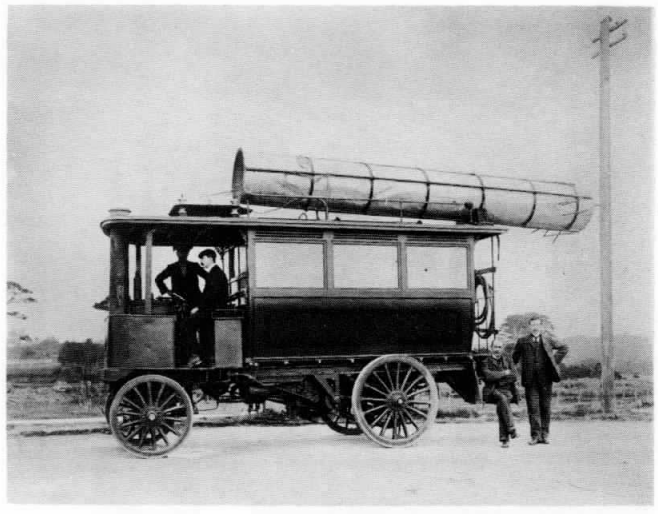
Now, adroitly skipping the roaring twenties we come to

THE FIRST STEAM MOBILE

Bob Matthews of the Marconi Laboratories at Great Baddow has kindly sent the following photographs and a copy of the paper delivered to the Society of Arts on 15 April 1901 by the Chevalier G Marconi, entitled 'Syntonic Wireless Telegraphy'. This document is so fascinating that I am prepared to quote details, chapter and verse, but the Editor can, in a very subtle way, be very firm. So perhaps another time. Certainly, looking at these wonderful pictures, I feel that words are rather superfluous and that it is enough to feast one's eyes on past glories.*

However, assuming that the Editor is lulled into complacency by the sight of so much electronic pulchritude, I will permit myself this final gem . . .

In his reply to the great Marconi's paper, the Chairman said that, although still far away, he thought that they were gradually coming within thinking distance of the realisation of a prophecy he had made four years ago, of a time when a person wanted to call a friend he knew



The cylindrical aerial lowered to a horizontal position. (Photo: Courtesy the Marconi Company Limited.)

not where, he would call in a loud electro magnetic voice, heard by him who had the electro magnetic ear, silent to him who had it not. 'Where are you?' he would say. A small reply would come: 'I am at the bottom of a coal mine, or crossing the Andes or in the middle of the Pacific.' Or, perhaps in spite of all the calling, no reply would come and the person would then know that his friend was dead . . .

**Syntonic = tuned*

SOLUTION TO CROSSWORD

1 P	H	A	S	2 E		3 A	M	4 P	L	5 I	T	U	D	6 E
R				A				U		O				T
O		7 S	T	R	I	8 P		9 L	I	N	E	10 S		H
P		E		N		L		S		S		T		E
11 A	U	T	O		12 L	E	V	E	L		13 P	A	I	R
G		U		14 S		A		M		15 C		I		
16 A	S	P	O	T	O	F	B	O	T	H	E	R		17 A
T				E		O		D		A				N
E		18 A	F	A	I	R	Q	U	E	S	T	19 I	O	N
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20 S	H	O	T		21 C	A	R	A	T		22 A	P	E	X
T		D		23 P		R		T		24 B		U		U
A		25 E	M	E	N	D		26 E	X	I	S	T		R
F				R		O				T				E
27 F	R	E	Q	U	E	N	C	Y		28 S	O	U	N	D