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Signed

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PERSONAL RADIO COMMUNICATION

INTRODUCTION

There has been a demand for personal radio communication for a considerable number of years, the Brighton Receiver introduced in 1932 was well ahead of its time. In 1959 Home Office was in touch with two manufacturers who were interested in developing a pocket receiver and it was thought that this might be about 6" x 3" x 1" and weigh around 1 lb. Ordered in large quantities the cost was likely to have been £50 with the chance of a pocket transmitter following very much later. During 1961 Lancashire were testing a Motorola transmitter/receiver which cost £240 and although by no means ideal, provided valuable operational experience.

The Technical Sub-Committee of the Police Wireless Communications Committee inspected some prototype models in July 1961 and decided on a formal specification which was issued as PWC 38. It is worth noting that the price was set in the region of £100 with a weight limit of 2 lbs.

During 1962 a Campbell Bruce pocket receiver was demonstrated and a decision made to buy 20 for operational trials. These sets were not available until 1963 and it was then decided after trials were made, not to pursue the receiver only approach.

Approval was obtained for a large scale experiment with three types of set, G.E.C. (Lancon), Cossor and Campbell Bruce and eighty units of each were ordered. It was thought that the experiment would commence mid 1964 but the sets were late in arriving and it was 1965 before a start was made. A questionnaire was sent to each force taking part in the experiment and from the information gained future action was to have been determined.

However, before all forces had a chance to take their turn and to deploy personal radio operationally, a further 1000 sets were ordered. The order was spread over three manufacturers, Stornohone sets were included along with G.E.C. (Lancon) and Cossor. About this time Pye Limited had demonstrated the early models of their UHF Pocketfone and aroused considerable interest throughout the country. Although of two unit construction, the clean design and lack of extraneous leads commended it to operational police officers. The impact of this set was such that all previous plans to buy more VHF sets were delayed until the advantages of equipment operating in the ultra high frequency band could be assessed.

During the past decade significant advances in reducing equipment size have been brought about by the big strides in semi conductor technology and the availability of useful quantities of power in small and lightweight packages. The development and large scale production of UHF transistors has enabled equipment designers to meet performance specifications equal to those at VHF. The theoretical advantage of VHF personal sets was not obtained in practice due to lack of aerial efficiency, and the physical length required proving to be inconvenient in use. Thus the hand held VHF transmitter with a half wavelength dipole aerial of convenient size was

operationally acceptable and effective.

When UHF equipment became available Home Office conducted a number of tests to compare VHF (80-100 MHz) Upper VHF (146-156 MHz) and UHF (450-470 MHz) performance. During these tests it became apparent that the close proximity of the body to the transmitting aerial had less effect at the upper frequencies and indicated that there was a marked disparity between VHF and UHF in this respect.

The threshold sensitivity of a receiver may not be realised in practice if the environment is electrically noisy, a fact that needs to be taken into account when designing a communications system. Whereas with point to point links or base to mobile vehicle systems it is possible to improve aerials or increase transmitter power these advantages are not readily forthcoming with personal radio schemes. Man made electrical noise intensity falls off with increasing frequency and it was possible to make full use of UHF receiver sensitivity in locations where VHF receivers experience considerable interference. Therefore the UHF set with marked overall system performance was considered to be the "best buy" and with a useful price advantage the Pye Pocketfone was purchased.

1. PURCHASES OF UHF SETS

Table 1 (Appendix A) shows the numbers of sets ordered for police use over a period of two years, a grand total of 21,050. The reason for the odd number is that 50 upper VHF sets were purchased at the outset for a large scale trial. They proved to have no major advantage and all further orders were for UHF types.

2. DEVELOPMENT OF PERSONAL RADIO SCHEMES

The first Pocketfones were deployed in twenty schemes throughout England and Wales and came into service from the middle of 1966 onwards. To expedite the implementation of these early schemes, the surveys and commissioning were a joint Communications Branch (as it was then known) and Pye Limited task. Table 2 (Appendix A) shows the build up and deployment of personal radio sets in the field. One year from the first order being placed there were 1500 sets operational in 130 schemes and in a further year these numbers increased to 7500 and 310 respectively. The main holding factors have been delay in obtaining planning approval and clearing legal formalities. A recent Ministry of Housing and Local Government Circular has advised local planning officers to query all future applications for radio sites and if necessary engage consultants to challenge the technical case put forward. It can be expected that the development of rural schemes will be delayed unless chief officers emphasise the urgent operational need to local government officials. From time to time difficulties arise because there are planning objections to a tower or mast of a particular type and there is considerable variation area by area as to what is acceptable. The technical criteria relate to headloading, sway, twist, distance from the equipment, height above ground level and wind survival speed; from the maintenance aspect the structure needs to be climbable and with easy access. It must be decided locally which type of structure meets particular amenity and aesthetic values.

3. FREQUENCIES

From the outset the early frequency assignments had to be met from a small UHF allocation to Home Office for point to point links. For easy reference the frequency sub-band was divided up into ten 50 kHz channels and numbers assigned to them. Subsequently Home Office made a case for additional channels and there are now twenty-three primary channels spaced at 50 kHz intervals. Long term tests on equipment for 25 kHz channelling have commenced and it is expected that eventually there will be a total of forty four 25 kHz channels to take care of expansion. Included in the overall allocation are four channels for special purposes, these are known as Common 1 and 2 and Mobile 1 and 2. The term mobile includes ground to air and mobile striking force needs. A multi-channel set capable of mains or battery operation and talk-through which can be reasonably easily transported is currently being tried out as a mobile control set. Appendix B shows allocations by channel numbers and regional wireless depots. Chief Officers may find that in an emergency they be able to obtain help from neighbours who share their assignments. It is useful to note that whereas it is difficult to assign main VHF county channels more than four or five times throughout England and Wales there are some UHF channels with more than forty assignments and in one case sixty eight.

The original concept of personal radio was short range communication with foot patrols and during the initial planning stages frequency assignments were made with this in mind. However, with the introduction of unit beat policing and the control of personal radio schemes at divisional level there was a need to plan assignments for much longer operational areas. Therefore the premise that within a ten mile radius of a base station each separate scheme had a different frequency has been modified to take account of the greater distances essential for some unit beat schemes.

4. RURAL SCHEMES

A technical appraisal of the problems encountered in developing schemes for rural areas was given in paper PWC 112 to the Police Communications Committee and a copy can be provided if required. Since that paper was written a device called the Pocketfc³ Adaptor has been developed to overcome the serious loss in reception encountered inside vehicles. There is an external aerial and together with the loudspeaker and amplifier comprise a permanent fitting. Reports on the samples tested have been favourable and 2000 are on order.

Up to the present time the deployment of On Frequency Relays (OFR) has been slow and only one duplex device is in use. It has been found valuable in filling in a small gap in coverage and it does save annual land line rental of about £100 in this instance. The aerial requirement is very critical and great care is needed in siting the two required. A total of twenty sets will be available by the end of 1968 and several months will elapse before sufficient experience is gained in their use. It is very unlikely that OFRs can be used other than for covering sectors of about 90°.

In some areas where more than about five UHF base stations are required and the area is difficult in terms of terrain and amenity objections to radio stations, the mobile repeater is a possible solution.

The mobile repeater requires two car sets, one VHF and one UHF in addition to the normal pocketfone. The annual rental of one mobile repeater is about three times that of a pocketfone and it will only be cost effective if land line rentals and base station capital costs are taken into account.

It is practical to plan schemes for patrols covering very large rural areas which will allow the police officer a useful working radius from his vehicle of about a quarter of a mile. The working radius will depend upon the location of the vehicle with respect to the patrolling officer and tests have shown that the radio path need not be optical. It is essential for efficient operation to have the UHF aerial on the vehicle roof top with the VHF aerial relegated to the rear fin position.

5. PURPOSE BUILT SET.

Annual rentals for the present UHF set were calculated on an operational life of five years. Allowing one year from the date of order to delivery, specification and design features must be resolved in less than two years from now if a replacement is to be forthcoming in 1972.

During the past two years valuable experience has been gained by the users of the present two unit set and it should be possible to achieve agreement on the format of the new set reasonably quickly. Some of the features that may be required are listed below and it will be invaluable if chief officers will express their views in writing as soon as possible, giving the priority of each parameter.

- (i) Dimensions and Weight
- (ii) Operational Use and Endurance
- (iii) Format
- (iv) Number of Radio Channels
- (v) Speech Security
- (vi) Selective Calling
- (vii) Battery Charging
- (viii) System Design
- (ix) Servicing Philosophy

(i) Dimensions and weight. The users should specify the target size and weight for the ultimate or ideal set and not concern themselves with any limitations at the preparatory stage. Designers will soon come up with the constraints and offer a choice related to "the state of the art, cost and delivery dates".

(ii) Operational Use and Endurance. It is essential to define the operational use as carefully as possible. For example, is the set to be a personal issue or is it to be passed freely from one user to another. The difference in summer and winter uniform is important and C.I.D. needs must be borne in mind. The various tasks that a policeman undertakes from driving a car to cliff

rescue ought to be listed and the relative importance of each one emphasised. Furthermore the environment must be defined; is the set likely to operate in an explosive atmosphere if so it has to be intrinsically safe. By drawing attention to each need and the scale of issue, decisions can be reached. For example for cliff rescue a variant can be produced with perhaps a voice operated transmit switch, whereas in the underwater role a special communications system is required.

(iii) Format. By separating the transmitter from the receiver a useful reduction in the package size has been achieved. What problems has this approach presented to the user?

(iv) Number of Radio Channels. Early VHF sets had a multi-channel capability which permitted their use in various schemes within the force area. The alternative is to make use of common radio channels. This method has the advantage that should need arise a considerable number of sets can be gathered together in an emergency.

(v) Speech Security. A purpose built design with this facility provided at the outset is feasible and could be achieved by a radical change in the system mode or by building in one of the methods normally fitted as an add on unit in conventional mobile schemes. If the present method of passing crime information to the collator by radio continues some form of speech security is essential.

(vi) Selective Calling. Usually, selective calling is fitted to reduce the number of messages that a particular person hears and allows different groups to share a common radio system. Selective calling will be effective in cutting down the total information flow to the mobile unit and it could happen that the loss of information might seriously effect operational efficiency. However on the return circuit where calls can be routed to the appropriate receiving point useful savings in manpower can be foreseen in the bigger schemes by dispensing with radio operators. An alarm circuit that can be operated by a mobile user in difficulties and which displays his callsign at the control point is possible and indicative of what can be done.

(vii) Battery Charging. Expensive police man hours are devoted to the very necessary procedures for efficient control of battery charging. Without adequate supervision the efficiency of a personal radio scheme drops if this important point is neglected. No one knows how much this is costing in policeman hours and information on this aspect of the personal radio system is welcomed. It may be that dry batteries are less costly in some schemes or that larger centralised charging schemes would be more cost effective.

(viii) System Design. Although it is not part of the personal set format it is essential for the operational user to be clear where the various control points should be and an idea of what the devices might look like in relation to other items of furniture. The operational command structure is an essential feature that must be taken into account in system design. Integration of personal radio communication into the whole structure of voice and data communication must be considered at the outset and not piecemeal if an efficient system is to be planned.

(ix) Servicing Philosophy. Reduction in the physical size of a purpose built set will be brought about by the use of integrated circuits and large quantity production techniques. Most of the bulk and weight will be in the transducers and battery supply. Simultaneously with the design of the set the servicing procedures must be considered as most of the circuits will not lend themselves to the routines employed nowadays. Automated circuit testing associated with modular construction and throw away units must be features essential to the specification of any modern personal set. To gain full advantage of an efficient servicing organisation using automated test procedures and purpose built equipment it is essential that only one design of set is dealt with. The likelihood of a different set each year which is possible with the present method of tendering annually cannot continue. The achievement of stability within the repair organisation and economy in the provision of spare parts together with the fast turn round of sets add weight to this point of view. To bring this single set approach into reality either large once and for all purchases must be made or a single manufacturer selected to supply equipment spread over a number of years. Alternatively a design must be purchased by the Home Office and manufacture put out to tender annually.

6. CONCLUSION.

The present personal set is inexpensive for what it provides in short range operational and administrative communication. Using the past as a guide and comparing the cost of a single channel vehicle set of today with its predecessors, industry has kept the price virtually constant for twenty years. This has been no accident, it is directly related to mass production methods and large markets. Only by giving industry the incentive of large orders relative to new production techniques will the police service obtain a set designed for their operational use at a price close to that which obtains today.

(R. Stoodley)

November 1968.

Table 1Pye Pocketfones Purchased 1966-68

Date of Contract	No. of sets
22. 3.66	1,950
17. 6.66	1,000
21.11.66	5,000
19. 7.66	500
20.11.67	4,000
1. 4.68	5,500
24.10.68	<u>3,100</u>
Total	<u>21,050</u>

Table 2Numbers of separate Schemes and Sets in use

Date	Schemes Operational	Sets Allocated	Sets	
			Operational	Increase
21.10.66	21	1674	279	-
7. 4.67	132	3193	1731	1452
2. 6.67	176	3566	2596	865
11. 8.67	213	4920	3343	747
6.10.67	253	5133	4165	822
31.12.67	266	8877	4871	706
15. 2.68	279	9798	5834	963
15. 4.68	310	10990	7680	1856
15. 7.68	319	11156	7980	300
15. 9.68	407	13422	11068	3088

Base Stations Ordered

450 single
350 dual
175 "

Appendix B.

Frequency allocations by Channel Numbers
and Regional Wireless Depots

Owing to the confidential nature of this Appendix it will be issued separately at a later date on the basis of one per Force.

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