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INTERCOM SPECIAL
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HOME OFFICE

INTERCOM 11 SPECIAL EXHIBITION CATALOGUE

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INTERCOM 11 SPECIAL EXHIBITION CATALOGUE

THE HOME OFFICE

As, traditionally, the Home Office looks after all the internal affairs of England and Wales not assigned to other departments, the Home Secretary's responsibilities are many and diverse. Among them are those for the four organisations whose combined efforts make up the Home Office stand at this Exhibition. They are –

THE POLICE NATIONAL COMPUTER UNIT (PNCU)

which provides an on-line real-time index to a wide variety of police records which may be up-dated or interrogated by the police any time of the day or night.

THE DIRECTORATE OF RADIO TECHNOLOGY

which, together with the Radio Regulatory Division form the Radio Regulatory Department, which is responsible for regulating the use of the radio frequency spectrum within the United Kingdom. It is divided into six technical branches which cover broadcasting, radio interference, regulation and monitoring, mobile radio, space services, and propagation and microwave.

THE DIRECTORATE OF TELECOMMUNICATIONS

which is responsible for providing advice, services and equipment to meet the telecommunications needs of police forces and fire brigades, prison services and certain emergency services in England and Wales.

POLICE NATIONAL COMPUTER COMMUNICATIONS

The Police in the United Kingdom maintain crime and criminal records that rank with the finest in the world. The Police National Computer System contains extracts from these records and an index to their location. The system has proved to be of considerable value to the police in their continuing fight against crime.

The benefits have been much faster access to information which itself is far more up-to-date and this has meant increased flexibility in police operations. Terminals in police locations can ask questions and receive answers in seconds and can also record up-to-the-minute information about crime and criminals. Previous enquiry and recording systems were slow and fragmented; the Police National Computer System is immediate and covers the whole country.

As well as providing a pointer to police held records, the Police National Computer also contains extract details from the Department of the Environment's Vehicle Licensing Computer at Swansea, thus facilitating enquiries of ownership.

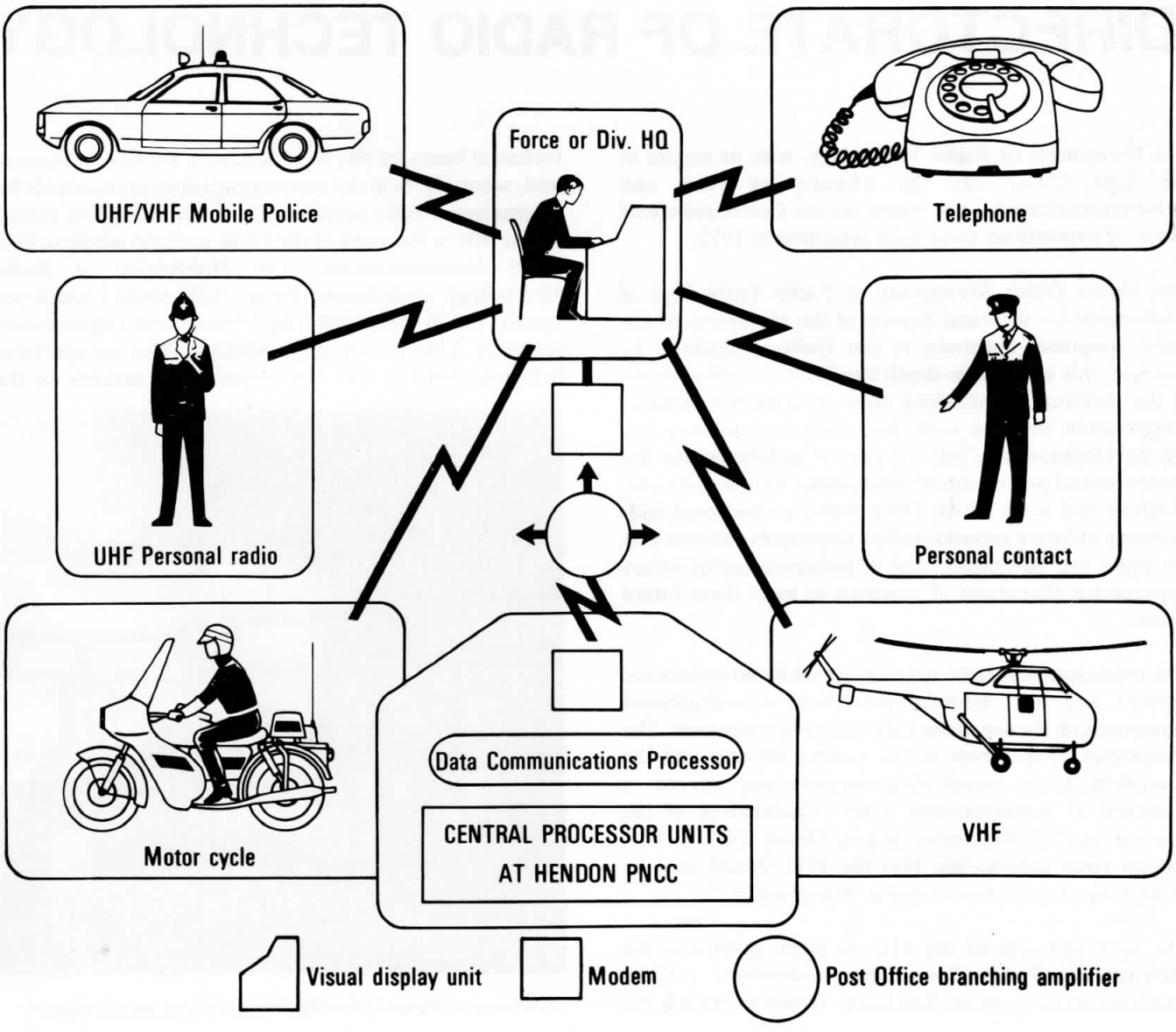
The following applications are at present in operation:-

Stolen and Suspect Vehicle
Vehicle Owners
Fingerprints
Criminal Names
Wanted/Missing Persons
Broadcasts

The first five applications are essentially indexes but the Broadcast Application is a message switching facility. It enables any terminal to pass a message instantly to any other terminal (or terminals) using the PNC communications network.

There are direct communication lines between the computer and each police force in England, Wales and Scotland. These serve two types of Visual Display Unit, the SEL 1088 manufactured by EMI Ltd and the Delta Data 4050 manufactured by Delta Data Ltd as well as the Creed Envoy Dataprinter type terminal manufactured by ITT (Creed) Ltd.

The VDU terminals are intended for urgent enquiries such as those from police officers using a radio or a telephone. VDUs are therefore located in force or divisional control



rooms normally manned for 24 hours a day. The aim is to answer or to update within seconds.

VDU terminals operate at 120 characters/second over private telephone circuits and this has permitted the design of a circuit shared network. This has a number of advantages, not the least of which is reduced system cost. Control of the network is affected by the computer using a poll and select technique to address each uniquely identifiable terminal.

The dataprinter terminals operate at 10 characters/second and are connected to the computer by dedicated telegraph circuits. The role of these terminals is to cater for less urgent transactions, or those requiring a hard copy.

There are at present 448 VDUs and 138 Dataprinters in use. The VDU network consists of 43 multipoint circuits each having a maximum of 12 spur lines radiating from two or more branching amplifier points. Originally each spur line supporting a single VDU but in an attempt to reduce costs, line sharing units have been introduced to enable two or more SEL 1088 type terminals to share a spur line. For the same reason DD 4050 type terminals are being concentrated at certain locations.

An increasing number of police forces are purchasing their own computers for Command and Control purposes. These systems have their own remote terminals which, whenever possible, are being made compatible with the PNC Delta Data type terminal. A common interface link has been defined based on the international standard X25/HDLC and this, working through a single S3 1200 bps line, ensures computer to computer contact. In this way nationwide computer to computer links are being forged.

The demonstration at 'Communications 78' shows a PNC Delta Data 4050 terminal working to the computer at Hendon.

DIRECTORATE OF RADIO TECHNOLOGY

The Directorate of Radio Technology, with its origins in the Post Office and the Ministry of Posts and Telecommunications, has supported the Communications series of expositions since their inception in 1972.

The Home Office Directorate of Radio Technology is responsible for technical aspects of the regulation of the radio frequency spectrum in the United Kingdom. In practice, this involves in-depth studies of the efficient use of the spectrum, establishing radio equipment standards, co-operation with the radio manufacturing industry and the development and introduction of techniques for the detection and prevention of interference to radio services. Much of this work of the Directorate is concerned with planning of future services, as new techniques and new uses for radio are developed, and in endeavouring to secure appropriate allocations of spectrum to meet these future needs.

The propagation of radio waves is not inhibited by national borders and it is essential that there is international agreement on the use of the radio frequency spectrum. The allocations of spectrum to the various services and the conditions under which these services may operate is achieved at Administrative Radio Conferences of the International Telecommunications Union (ITU). It is indeed most appropriate that the ITU should now be supporting the Communications 78 exposition.

The technical arm of the ITU on radio matters is the International Radio Consultative Committee (CCIR) which serves two primary functions – firstly, to prepare the technical bases for the Administrative Radio Conferences and, secondly, to make recommendations on standards for international radio services. The United Kingdom plays a major role in the work of the CCIR over the whole field of radio communications. The Directorate of Radio Technology co-ordinates those CCIR studies which are carried out in this country by Government Departments, research laboratories and industry. The co-operation between industry and the Government extends to the

Directorate of Radio Technology frequency assignment computer.

Directorate of Radio Technology – twenty metre drop test on survival craft radio equipment. (Photo: Central Office of Information).

presentation of the outcome of these studies at international conferences of the CCIR, where many of the UK Delegates come from industry. The CCIR work not only provides a framework for international standards and practices but it ensures that the British manufacturers can continue to exert considerable influence on these standards and practices, and thus have access to a world-wide market for their products.

The Direcorate of Radio Technology will be participating in the Conference as well as the Exhibition. The Directorate is responsible for the preparation of technical performance specifications for maritime and land mobile radio equipments. Before any new equipments can be employed in these radio services, the manufacturers are required to submit representative samples to the type-approval laboratory of the Home Office Radio Regulatory Department. The Directorate of Radio Technology carries out type-approval tests to ensure that the equipment meets minimum standards of performance, in accordance with appropriate equipment specifications. This also ensures that the equipment manufactured is of such a standard so that it is capable of providing a satisfactory service, and will not cause unacceptable interference. Equipment specifications are produced in consultation with radio manufacturers, and practical field trials, which may involve many measurements, are frequently required to establish the necessary parameters.

In addition, the Directorate is responsible for technical representation in the world-wide CCIR*, CEPT† and IEC‡ organisations, seeking to standardise technical performance requirements so that UK manufacturers produce equipments which are acceptable throughout the countries of Western Europe.

At the Communications 78 Exhibition the Directorate will be giving practical demonstrations of the type-approval testing of equipment in the maritime and land mobile services. There will also be photographic presentations showing how climatic and durability tests are performed, typical test site arrangements and details of radio frequency radiation measurements. In addition, there will be a demonstration of the distress alerting aspects of maritime equipment, consisting of a mock-up life raft and a watch-keeping receiver. This would represent a typical distress situation at sea and it is intended to show how the alarm is brought to the attention of other parties.

Finally, there will be photographic presentations of the method used to assign frequencies to the private land mobile radio service on the Directorate's in-house computer at Waterloo Bridge House. This unique application and achievement has generated considerable interest throughout the world and representatives from the USA, Canada, Italy, Malaysia and other European countries have come to the United Kingdom to see practical demonstrations.

* International Radio Consultative Committee (CCIR)
† Conference of European Posts & Telecommunications (CEPT)
‡ International Electrotechnical Commission (IEC)

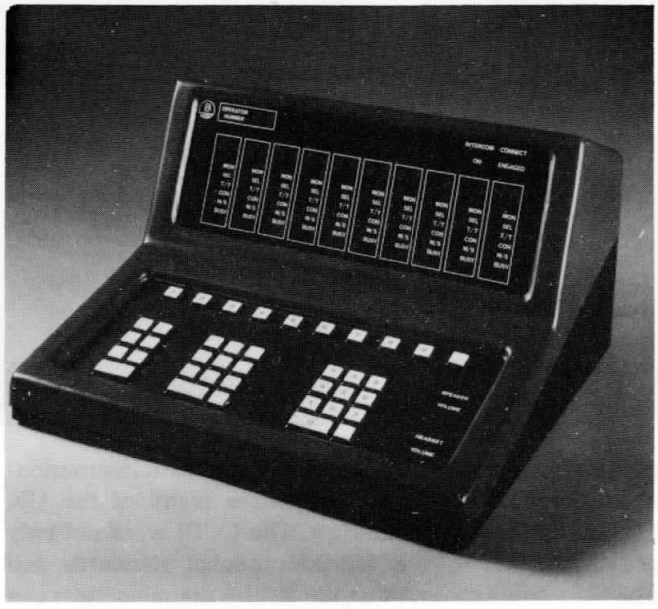
DIRECTORATE OF TELECOMMUNICATIONS

POLICE COMMUNICATIONS SYSTEMS

COMMUNICATIONS CONTROL SYSTEM

The vital facility for setting up the appropriate link between the police officer on field duty and his HQ or Division is the Telecommunications Control System known as the C Series System (C1, C2 etc). Representative components of the two systems currently being commissioned are on show, the Consort Two (Burndept Electronics Limited) and the Mascot 1000 (Pye Telecommunications Limited). These systems allow the control room supervisor to provide the best service under any set of circumstances and use the most advanced technology currently available.

Both these systems have been developed in close collaboration with the Directorate of Telecommunications engineers to ensure that they meet police requirements.



Consort Two – Burndept Ltd. An operator 10-channel console for access to a computer-based control system. (Photo: Burndept Ltd).

RESOURCE AVAILABILITY SYSTEMS (RAS)

The efficient deployment of police resources is further enhanced by the Resource Availability System. A 'resource' may be a foot-patrol officer, for example, or a vehicle occupied by an officer. It is necessary to know his location and availability of each resource on a continuous basis and to group him according to activities or responsibilities. All this must be done with minimum staff, the necessary records being kept within a mini-computer. Information relating to up to two thousand resources may be stored, and this can be recalled at several operator positions in the control room and at remote divisional control rooms by means of visual displays. A keyboard is associated with each display so that the operator can both interogate and update the information stored.

```
TIME CALL    R DTY    LOCATION    CYFAS VCD100   10 18    11 05 77
     ----    - 3.      ...
                                  TIME CALL    R DTY     LOCATION
0952 AA44    3 32     @ASC            EMERGENCY  DB=HF
0939 BC81    3 32     @BSN        1017 NC14   *3 11     @NCC
0953 CE21    2 32     @CEB
0938 CE22    2 34     @CED
1007 CE33    2 32     >CED
1017.CO13    3S31     @CFE            SPEECH
 *REPORT TO C.I.D OFFICE ASAP    1018 NC14   *3 11     @NCC
0937 CO19    2 34     >CON        1017 BC23    3 11     @PNO
0944 CS53    1 37     @CST        1016 CD11    3 11     @MNO
1007 CS54    1 32     >CSN        1014 AA13    3 11     @OEE
0937 CS55    3 31     @CSP
0954 NC03    1 34     @NAB            VAST
0953 NC08    2 32     @NCB        1015 CA05    3 62     @NLK
1008 NL99    3S33     >NLI        1013 AA13    3 11     @OEE
 *INSP SMITH ON ENQS             1012 FB94    3 72     @EOO
 *WILL BE FREE AFTER 1200
1009 SH12    2 35     @SOR            WANTED VEHICLE
0940 SH23    2 32     @SHL        1017.CO13    3S31     @CFE
1010 SW34    1 32     @STU
                                      OVERDUE VEHICLE
                                  0944 CS53    1 37     @CST

CONSOLE CALL                          LOW RESOURCES(<4) IN:-
1017 NC14   *3 11     @NCC TT MSGE SW NL
```

Resource Availability System – a typical communications control room operations display. (Photo: Cyfas Ltd)

A car installation of Cyfas VAST – Vehicle Automatic State Transmission System, to pass status information over standard mobile radio equipment. (Photo: Cyfas Ltd).

The control head of a DSL 'Standard' CTG, the mobile encoder unit used for FSK data transmissions in DSL 'Datafleet' resource availability systems. (Photo: Kent Constabulary).

The control head of a DSL 'Standard' CTG, the mobile encoder unit used for FSK data transmissions in DSL 'Datafleet' resource availability systems. (Photo: IAL).

Special map displays are sometimes used to give an indication of the overall situation, these being automatically updated through the system. Information may also be stored in floppy discs and hardcopy provided by logging printers according to the operational requirement.

The police officers in the field may also use their radio-equipment to send data directly into the Resource Availability System, using mobile encoders specially developed for police use.

The operational procedures have to be studied in detail before any RA System can be specified. The Force Communications Officer, his Senior Officers and Operations colleagues in collaboration with Directorate of Telecommunication engineers decide the features required to meet their needs. An individual specification is then prepared for each Force System.

Some of the terminal devices currently used to provide RAS facilities are shown.

A DSL 301 series visual display unit used with DSL 'Datafleet' resource availability systems. A microprocessor and all the electronics are contained in the keyboard. (Photo: IAL).

MASCOT 1000, PYE TELECOMMUNICATIONS LIMITED

The first of these new systems will be installed in the new control room of the West Midlands Police in Birmingham, and a number have been ordered for other locations.

The Mascot 1000 communications control system uses Time Division Multiplexing techniques in order to provide for Selective Presentation at the operator position.

The users will be able to control VHF and UHF radio channels and land line circuits to all Divisional Control Rooms from the central point. The maximum channel capacity of the system is 99 and up to 99 operators may be connected. Use of a facility is available whereby a complete operator position may be sited remotely from the central control room in a special command room.

Particular attention has been given to the system design in order to minimise the possibility of catastrophic failure. The use of CMOS logic and Light Emitting Diodes has reduced the total power consumption to a level when 'battery stand-by' operation of a complete system becomes feasible.

Special push-buttons with in-built LED's have been developed for use on the operator panels. Operator positions are built up using modular units which include channel access, loudspeaker, system supervisory and switching panels. These may be housed in desk top cases or placed in a user's console.

CONSORT TWO, BURNDEPT LIMITED

The Consort Two communication network control system is computer based and is being provided by the Home Office for use in seven Police Headquarter Control Rooms in England.

This system enables the users to control a complex of up to a total of 40 VHF and UHF radio channels and land line circuits to lower level controls, from a central point. Up to 24 operators may be given access, on an individual basis, to up to any ten channels on the selective presentation system.

The Consort Two employs a central processor as its organising medium and the logic, expressed in conventional systems by switching and cabling, is provided by suitable software.

The system integrity is met by the use of a triplicated processor arrangement. For example, any one of the processors may be 'on line' with a second automatically on 'hot' standby. The third processor can be brought on line manually, when required. Power supplies are provided in a fully duplicated form and the power distribution and fusing of circuits is arranged to minimise and localise any fault conditions.

An operators position may be in the form of a self contained desk top unit or alternatively the panels separately mounted in a user's console. The position is formed from a keyboard and a display panel and in each system one position has special system supervisory function available.

MOTORCYCLE EQUIPMENT

A police Triumph Bonneville 750cc motor cycle, which has been equipped with some of the currently available communications facilities is on show.

A Pye Westminster mobile radio is mounted behind the rider and a Forward Control Unit has been designed by the Directorate of Telecommunications to permit operation on the move.

Apart from the normal facilities either of the two preselected channels (out of the ten available) can be brought into use whilst moving.

Two types of crash helmet facilities for listening and speaking are shown, both have been submitted for approval against BS Standard 2495. Two snatch plugs are used in each model for convenience and safety reasons. The normal handset is still available when required.

Triumph 'Bonneville' motorcycle.

Triumph 'Bonneville' fitted with forward control facilities.

PERSONAL RADIO – 'HANDS FREE' OPERATION

For mountain rescue and similar operations it is necessary to use the radio whilst occupied with manual work.

The transmitter is operated by a pressure operated pad which may for example be worn underneath the arm.

A throat microphone is used since this is unaffected by noisy surroundings.

Reception is by earphone fitted with an earhanger attachment.

Storno 'hands-free' harness for use with personal radio equipments. (Photo: Storno Ltd).

CONTROL SYSTEM FOR FIRE BRIGADE RADIO SCHEMES

A control system for the control of area V.H.F. radio schemes for fire brigades, manufactured to Home Office, Directorate of Telecommunications Specification C12, by Lero Telecommunications of Coventry.

This system enables the control of up to 10 channels, from a maximum of 12 operators positions in a fire brigade control room. Each operator has the ability to control:-

1. A number of Duplex area VHF channels;
2. A number of Simplex 'fixed mobiles';
3. A maximum of two multichannel interbrigade 'fixed mobiles';
4. One public switched network telephone line to a predetermined radio channel.

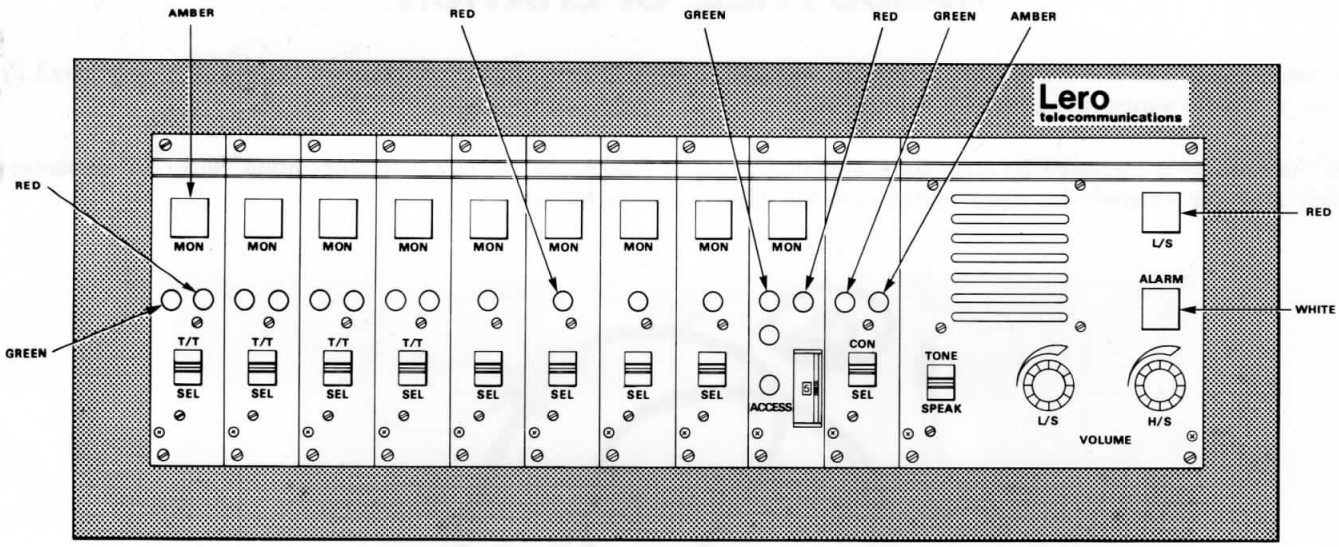
The operators unit, which is of modular construction may be supplied in two formats:-

a. A 10 channel unit;
b. A 6 channel unit.

Depending upon the requirements of particular fire brigades.

The operators units are connected to a common distribution box from which a cable highway runs to the Central Equipment Rack.

The Central Equipment Rack contains the control circuits, amplifiers, line terminations, and power supply units for the system.



INTER SERVICE COMMUNICATIONS

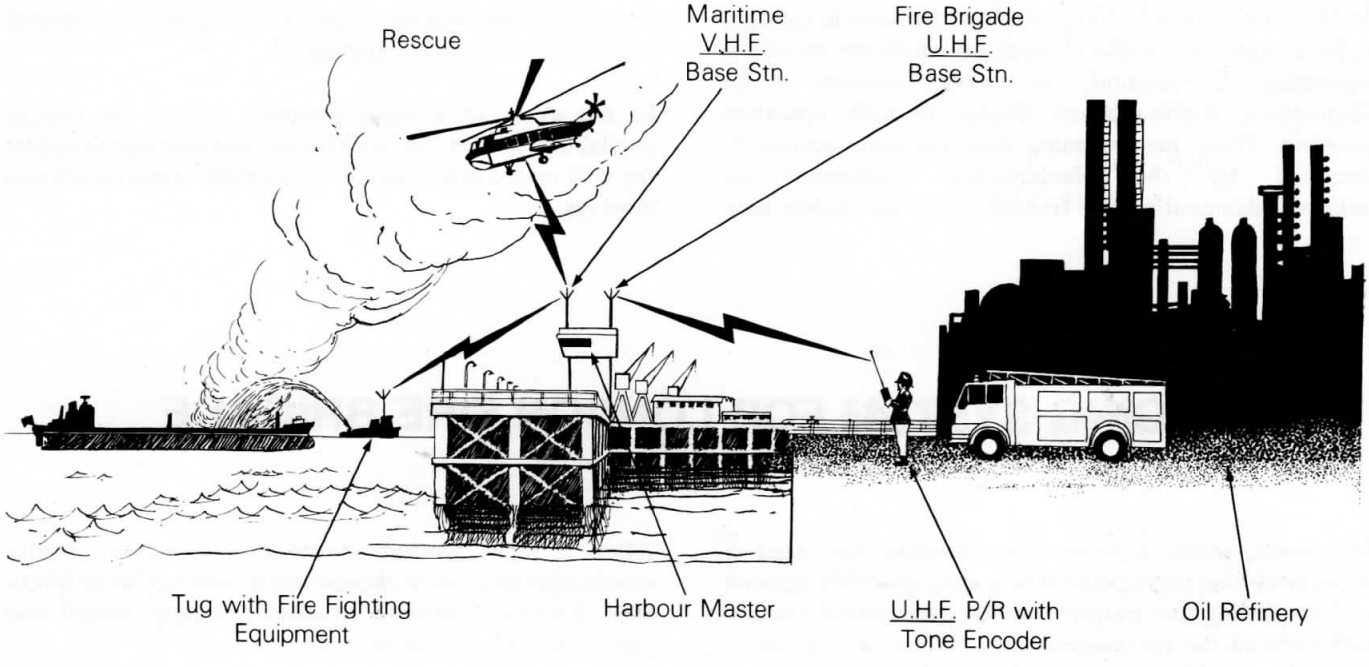
DYFED FIRE BRIGADE/MILFORD HAVEN CONSERVANCY BOARD

This equipment is an example of interservice communications. It enables fire brigade personnel equipped with UHF hand portable radios to communicate with the Harbour Masters' control room and, by remote means (sub audio tone from the hand portable), patch through to the maritime VHF channel in use by harbour vessels which are available for fire fighting duties.

The system consists of a number of UHF personal radios fitted with sub audio tone encoders.

Ch 1 of the personal radio is single frequency enabling man to man communication.

Ch 2 of the personal radio is double frequency to enable communication with a fixed UHF base station located at the Harbour Masters' office. The base station contains a sub audio tone decoder, which when activated, connects the voice frequency signal to the Maritime VHF base station.



VEHICLE AVAILABILITY SYSTEM FOR GREATER MANCHESTER FIRE BRIGADE

A Vehicle Availability system for use by the Greater Manchester Fire Brigade manufactured to a Home Office, Directorate of Telecommunications specification by CYFAS LTD of Crawley.

The system consists of:-

VEHICLE UNITS

The vehicle encoder unit is similar in size to a mobile radio control unit.

The front panel of the encoder unit contain two rows of five push button switches numbered from 0 to 9. In addition there is a 'send data' switch and a 'Priority message' switch. Also a set of three thumbwheel switches each numbered 0-9.

The function of the numbered press button switches is, when selected, to initiate the transmission of a digital tone appropriate to the number selected. The tone is not transmitted until the 'send data' switch is pressed.

Each numbered push button indicates a vehicle 'state'.
e.g. 1 = resource mobile and available
2 = resource mobile to incident
etc.

The call sign of the vehicle derived from a callsign card, is automatically transmitted either with data or when the handset pressel switch is operated.

The vehicle encoder unit location codes are set up by selecting the appropriate location code on the three thumb wheel switches.

HEADQUARTERS EQUIPMENT

The coded signals from the mobile unit are received at Headquarters over the VHF radio scheme. The data is routed via channel decoders to the Ferranti computer through a data interface. When the data has been processed by the computer it appears on the operators VDU. The operators VDU displays, the vehicle callsign, vehicle state, and radio channel on which the mobile is operating. In addition, the callsign appears on an illuminated Alpha-numeric display at each operators position. Once the incoming data has been accurately decoded by the Headquarters equipment an acknowledgement tone is transmitted to the mobile unit.

Resource availability vehicle unit laboratory development model by Cyfas of Crawley.

To enable senior officers to obtain an overall resource availability state indication, a wall map display is updated simultaneously with the VDU, showing limited essential information about fire appliances.

In the event of a main computer failure the vehicle availability system can 'stand alone' and continue to update the wall map display and operators alpha-numeric call sign displays.

PAGING SYSTEM FOR LONDON FIRE BRIGADE

For some years, London Fire Brigade has used a sequential-tone paging system operating on a VHF channel and employing five transmitters to cover central London and parts of the surrounding area. For several reasons, extension of this scheme was impracticable and it was decided to introduce a digital system which had the advantage of increased receiver sensitivity, simpler phasing and greatly increased address capacity.

Fault finding paging system – remote control unit with key arrangement specifically designed for Fire Brigade use.

After a short period of study and survey, twelve transmitter sites were chosen and a contract let to Multitone Electric Company to design, supply, install and commission the whole system.

The twelve transmitters are landline-controlled from a microprocessor-based encoder at Lambeth headquarters. Remote control unit keyboards at Stratford, Croydon, Wembley and Lambeth have access to the system.

REMOTE CONTROL UNIT

Virtually all communications with the system is by means of a remote control unit. Characters to form the call sign (eg F231) are keyed in on the alphabetic and numeric keypads. This information is sent down the line and the call sign checked for validity by the processor, at the same time 'echoing' back the call sign for display on the remote control unit. Errors are signalled by an audible bleep and the words ERR or INV, depending on the type of error. When the operator has checked that the correct call sign has been set up, a send key is depressed.

Three send keys are provided – one activating a slow bleep on the receiver for administrative non-urgent calls; a second faster bleep for urgent operational calls; and a third with rapid pips as yet undesignated for function.

TWO ENCODER PROCESSORS

are employed, one on-line, the other a hot spare, both connected to a remotely operated changeover unit which also provides facilities for intercepting and monitoring all incoming and outgoing lines. Each processor runs through a basic routine which is used to check correct operation. Processor failure causes a system fault alarm to be signalled. Requests for paging calls, or any other function, are signalled as interrupts to this basic routine. Consequently, the processor is always doing something.

THE TRANSMITTER SITES

receive signals from the processor via standard modems and these signals are fed into digital delay lines to ensure phase equalisation of the outputs from the transmitters. Each delay line forms part of a transmitter site interface which is responsible for two-way communication with the processor. The Transmitter is a 25watt transmitter utilising pure FM transmission to achieve the deviations required at 250Hz and 500Hz, the frequencies chosen as Binary 0 and 1.

BUILT-IN FAULT MONITORING

is the most interesting engineering feature of the system. Remote control units are scanned at 7-minute intervals and a fault status returned, checking the unit as far as the display, but not the keys. Transmitters are scanned sequentially on a 10-minute interval. Each transmitter site interface has a unique address and will switch on when commanded. The transmitter feeds back to the interface whether the modulation or VSWR are not out of limits. The interface then signals the information back on the modem return path.

At the processor, an area of the erasable store is devoted to fault listing and all faults are listed with an equipment type and number designation, and a fault type. When a new fault occurs, an alarm sounds on the Lambeth keyboard and this cannot be cancelled until the fault store has been examined. A fault lamp is illuminated at all controls, which will only be extinguished when the fault store is empty.

Complete paging transmitter. It is at the top of the cabinet with the site interface panel and the modem located underneath

An individual transmitter can be interrogated to obtain more detail. The display will then show previous faults and existing faults. Also a transmitter can be individually put onto transmit with or without modulation.

CHANGE NUMBER FACILITY

It is possible to arrange that an off-duty officer has his calls automatically transferred to a second number.

PERFORMANCE

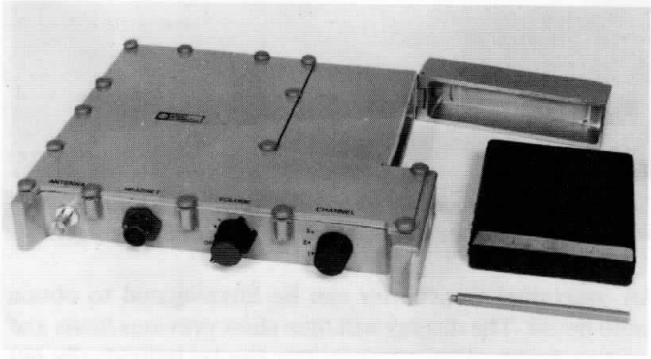
Since installation in mid-1977, tests have shown that the system meets the original operational requirement.

FIGARO

A. An H.F. (3MHz) communication system for fire brigade personnel. Manufactured to a Home Office, Directorate of Telecommunications Specification by Plessey Ltd.

B. The primary function of FIGARO is to enable radio communications in situations where conventional VHF and UHF personal radio signals are ineffective; eg. tunnels, basements, etc.

C. This system consists of:-
1. A battery-powered portable base station and aerial.
2. A personal transmitter receiver carried in a tabard which incorporates the personal antenna.



FIGARO – the portable packset.

INTRODUCTION

The PVS2200 Series Communications equipment consists of the following:

PTR2201	Portable equipment
PTR2202	Base Station
PV2203	Portable equipment battery charger
PV2204	Base station battery charger.

The equipment is designed for use with fire brigades and other emergency services for communication in all types of buildings (including basement areas), ships and other screened surroundings. The system consists of a duplex base station and associated half duplex portable equipments. It has a three-channel capacity.

The range is sufficient to cover the following typical environments:

(a) Basements down to 2 levels, 15m deep.
(b) High rise buildings of 50 storeys.
(c) Floor areas (e.g. warehouses) of 1500m^2 (4 acres).
(d) Ships up to 10,000 tonnes.
(e) Underground tunnels (with rails, telephone cables etc.) up to .7 Km.
(f) Underground stations to a depth of 25m.

It will operate under adverse conditions, eg. water spray, high temperature and rough handling.

The base station consists of a separate antenna and a transmitter/receiver unit containing a rechargeable battery. It is capable of being quickly deployed.

The portable equipment consists of a transceiver and a garment containing the antenna. The garment also contains a pouch to house the transceiver. The equipment can be worn by a person wearing breathing apparatus with no part of it protruding beyond the person. The rechargeable battery is easily changed.

SCOPE

This specification covers the electrical performance and physical details required of the PRD2200 Communication System, comprising the PTR2201 and PTR2202, but excluding the battery chargers, and defines this product for all technical and commercial purposes. It is based on the Home Office Directorate of Telecommunications Specifications S/17 Issue 1.

RELATED SPECIFICATIONS

Base Station Battery Charger. 630/SM/33880
Portable Station Battery Charger. 630/SM/33870

PHYSICAL DETAILS

BASE STATION
OUTER CASE
The outer case has the following characteristics:-

(a) Integral design fitted with removable protective cover over control panel;

(b) Rounded corners and edges;

(c) Fitted with carrying handles and feet;

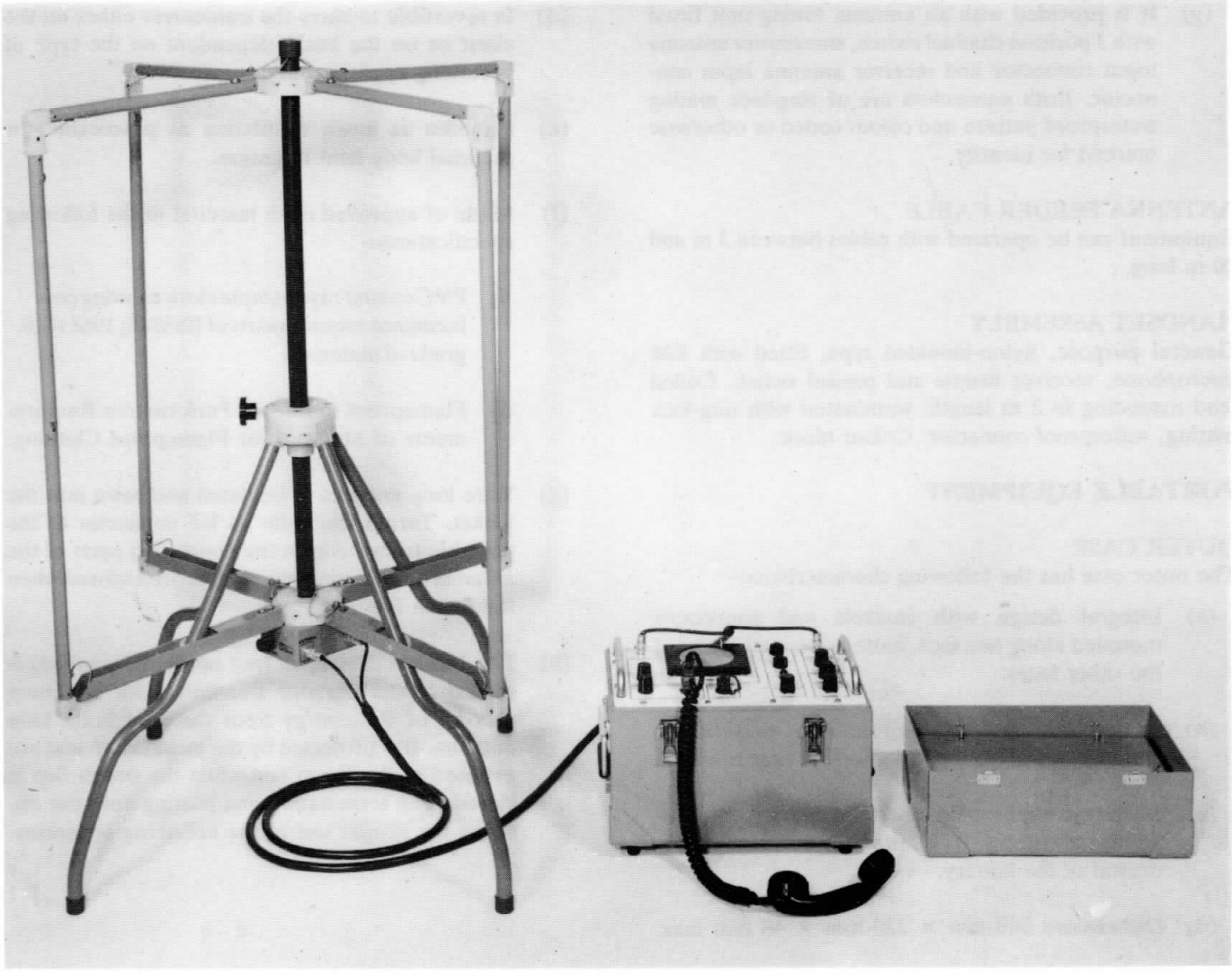
(d) Battery simply withdrawn from the base of the case. (With the battery withdrawn the equipment is not subjected to the driving rain test.)

(e) Height 260 mm.)
Width 385 mm.) Max.
Depth 270 mm.)

CONTROL PANEL
The control panel has the following characteristics:
(a) Outer surface is non-glaze and scratch resistant;
(b) The control panel and internal equipment forms an integral assembly which can be withdrawn from the outer case;

(c) Fitted with the following:-

i) Loudspeaker.



ii) Loudspeaker volume control. Continuously variable from zero to maximum. Fitted with knob.

iii) Handset volume control. Continuously variable from low level listening strength to maximum. Fitted with knob.

iv) Channel switch, 3 position rotary. Fitted with knob.

v) Normal/Talkthrough adjust control. Continuously variable. Fitted with knob.

vi) Talkthrough adjust control. Continuously variable. Fitted with knob.

vii) Power switch, 3 position rotary. Fitted with knob.

ix) Auxiliary connector, ring locked mating, waterproof pattern.

x) Transmitter antenna connector, ring-locked mating, waterproof pattern.

xi) Receiver antenna connector, ring-locked mating, waterproof pattern.

xii) Internal supply fuse, waterproof pattern.

xiii) Auxiliary supply fuse, waterproof pattern.

xiv) Power ON indicator lamp, red.

xv) Talkthrough indicator lamp, red.

BASE STATION ANTENNA

The base station antenna has the following characteristics:-

(a) Twin antenna assembly for duplex operation comprising two independent rigid metallic loops, each vertically suspended from an insulated central support column.

(b) The loops are suspended at right angles to each other.

(c) Each loop is 830 mm high by 830 mm wide maximum.

(d) Able to fold lengthwise to form a package less than 1.5m, high by 500 mm dia.

(e) The lower limb of each loop when erected for use is clear of the ground by at least 300 mm and not more than 450 mm.

(f) Loop surfaces are insulated.

(g) It is provided with an antenna tuning unit fitted with 3 position channel switch, transmitter antenna input connector and receiver antenna input connector. Both connectors are of ring-lock mating waterproof pattern and colour coded or otherwise marked for identity.

ANTENNA FEEDER CABLE
Equipment can be operated with cables between 3 m and 30 m long.

HANDSET ASSEMBLY
General purpose, nylon-moulded type, fitted with EM microphone, receiver inserts and pressel switch. Coiled lead extending to 2 m length, terminated with ring-lock mating, waterproof connector. Colour black.

PORTABLE EQUIPMENT

OUTER CASE
The outer case has the following characteristics:-

(a) Integral design with controls and connectors mounted along one face, battery inserted in one of the other faces.

(b) Smooth outline excepting prominent controls and connectors with rounded corners for ease of fitting.

(c) Battery compartment does not allow wrong insertion of battery. Its lid prevents accidental withdrawal of the battery.

(d) Dimensions 248 mm × 220 mm × 48 mm max.

(e) Weight: 2 Kg max.

CONTROLS
The following controls are fitted:-

(a) Combined ON/OFF and 3-position volume control switch. Rotary, fitted with knob.

(b) Channel switch 3 position rotary, fitted with knob.

(c) The knobs are distinctive, one from the other, for ease of identification.

(d) Headset connector, ring-lock mating, waterproof pattern.

(e) Antenna connector, ring-lock mating, waterproof pattern.

JACKET
The jacket has the following characteristics:-

(a) A loose fitting garment for carrying the portable transceiver and containing the wire loop antenna.

(b) Easily put on and fastened. Fasteners used provide for at least three wearer sizes.

(c) Fitted with strong flap-closed pouch to hold portable transceiver. Closure of the flap prevents the transceiver falling out even when the wearer is bending down or crawling. The pouch does not retain water.

(d) Is reversible to carry the transceiver either on the chest or on the back, dependent on the type of breathing apparatus in use.

(e) Provides as much ventilation as practicable for minimal body heat retention.

(f) Made of approved cloth material to the following specifications:-

i) PVC coated rayon staple cloth meeting performance requirements of BS3546; 1962 (MR grade of material).

ii) Flameproof to BS3120 Performance Requirements of Material for Flameproof Clothing.

(g) Wire loop antenna is insulated and sewn into the jacket. Terminated with an RF connector to the portable transceiver in the pouch. No parts of the antenna or interconnection cable are exposed when the pouch flap is closed.

(h) The headset cableform (not normally supplied) is routed to the portable transceiver for minimum pick-up of RF energy from the wire braid loop antenna. It is protected by the jacket cloth and not exposed at the lower end when the pouch flap is closed. The termination and routing does not obstruct the proper use of the breathing apparatus.

AN EXPERIMENTAL LOW MODULATION AND COMBINING SYSTEM FOR FIXED RADIO SITES

The Directorate has for some time recognised that a common aerial array used for all transmissions and receptions in the same band, could offer a solution to the problems of providing a uniform radio coverage, reducing intermodulation generation, and perhaps, reducing mast loading.

Given a suitable aerial array, (which should provide 3 – 5 dB of gain) some means of combining the outputs of several transmitters is required. The R&D Section of the Directorate has been considering various techniques, including one approach which uses a linear amplifier.

Previously, the problem with a linear amplifier approach was that the linear amplifier was merely compensating for the power loss introduced by the preceeding combiner network, which used hybrids and/or cavity resonators. (In fact, high levels of r.f. power were generated, to be lost in the combiner, and then made up in the linear amplifier.)

The cost of the combiner, linear amplifier and the aerial array was additional to the basic cost of the transmitters, and the whole system became uneconomic and physically large. The low level modulation/combining approach attempts to overcome these disadvantages.

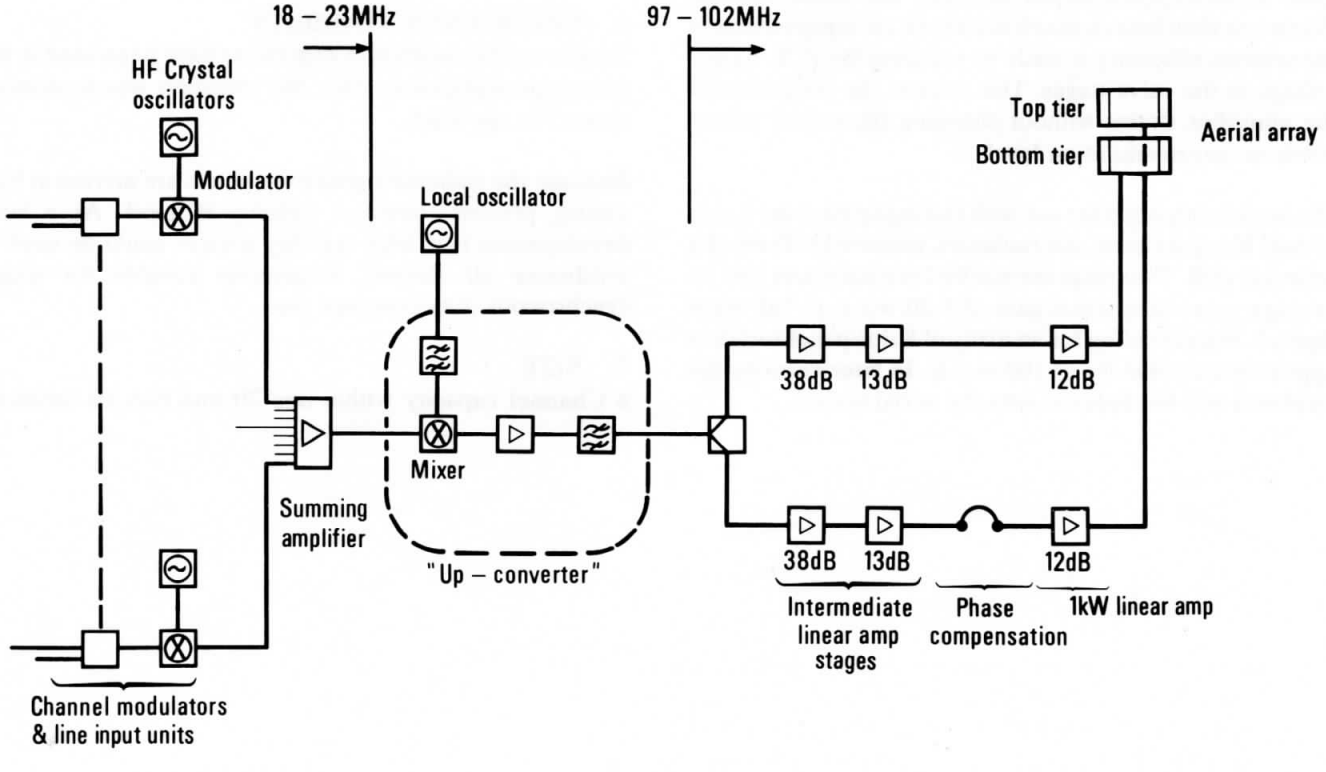
Work on the low level combiner started late in 1976, and construction of the prototype system started in Spring 1977. Nearly all the construction work has been accomplished within the R&D Section by laboratory staff.

The complete integrated system (which includes the aerial and feeders) will handle 8 channels in P. band VHF, with an e.r.p. of 50 Watts per channel. This is achieved with the 3rd order intermodulation products being kept to 55 dB below carrier. This approach makes it possible to accommodate the eight channels, including receivers (and perhaps control links) within two 7ft, 19inch equipment racks, plus two linear amplifier racks.

TECHNICAL INFORMATION

Each discrete channel frequency is generated by an H.F. crystal oscillator unit providing an output of −10dBm within the range 18 - 23 MHz. Co-axial cables feed the signal to a modulator unit, and thence from each modulator unit to the signal combiner.

The combiner comprises a wideband summing amplifier and output driver. This unit provides high isolation between input ports and so eliminates coupling between the



Low level modulation/combiner in an experimental multi–channel transmitter system

modulator outputs. A switched attenuator is fitted to adjust overall gain within the system.

The combined signals from the signal combiner are then 'up-converted' to the transmission band of interest. A conventional diode ring mixer is used for this purpose.

The local oscillator feed for the mixer is developed from a high-stability crystal oscillator after a suitable frequency multiplication. Two high-stability oscillator units are mounted in the rack, main and standby.

The mixer output is then buffered and filtered prior to being applied to the linear amplifiers.

Two linear amplifier chains are used and each drives a separate tier of the aerial array. This method allows a margin of safety, as if one half of the system fails, communication is still possible with the other half, but at a 3 dB reduction in output power. Each half of the system is carefully 'phased'. The other advantage is that the linear amplifier chains are driven at half the power level, which improves the intermodulation performance.

In the present prototype system each amplifier chain is split into 3 sub section:

1) Wideband Amplifier	Gain 39 dB
2) Penultimate Driver	Gain 13 dB
3) Main Amplifier	Gain 13 dB

The wideband amplifier uses Vmos semi-conductor devices and the penultimate and main amplifiers employ air-cooled valves.

The output from each main amplifier directly connects to two low loss co-axial transmission lines, each connected to a separate tier of the aerial array.

Each channel when keyed activates the whole system. When less than four channels are keyed an improvement in the systems efficiency is made by reducing the H.T. supply voltage to the valve stages. This reduces the dissipation of the amplifier chains without changing the carrier power levels or intermodulation levels.

The aerials intended for use with this equipment are a ring of dual band skeleton slot radiators, mounted in front of a reflector grill. Two rings are stacked vertically and give an average omni-directional gain of 5 dB w.r.t. (a half wave dipole). Wind loading for an array of 8 slot/panel aerials is approximately 400 lbs at 100 m.p.h. In later versions the receivers will be diplexed into the aerial system.

SUMMARY OF PROVISIONAL SYSTEM DATA AND PERFORMANCE

1. a) Channel Capacity – Provisionally 8 channels. Possible extension to 10 or 12 channels.

   b) Channel Modulation – Depending on modulation card in use. Suitable FM, AM, SSB, DSBDC.

2. Effective Radiated Power of system:
   - up to 50W per channel or 60W e.r.p. if a degradation in I.M. performance is tolerable.

3. I.M. PRODUCTS, typical.

a) 25W e.r.p./channel	3rd orders −64 dB ref to carrier.
b) 50W e.r.p./channel	3rd orders −55 dB ref to carrier.

Measured with 8 channels keyed, using H.P. 8558 analyser. Spectral line measurements relative to mean carrier powers.

4. OPERATIONAL BANDWIDTH (present equipment only).
No restrictions on frequency assignments within a typical 3% of centre frequency lying within 97 – 102 MHz.

The present equipment can be made to function over the range 97 MHz to 160 MHz. It is expected that the range could be extended upwards to 200 MHz.

5. POWER CONSUMPTION
Channels at maximum output – approximately 6KVA.

6. FREQUENCY STABILITY
Simple crystal oscillators with ovens have been used in the prototype equipment since the intention was to demonstrate the approach.

Because the radiated signal frequencies are arrived at by a mixing process, inherent stability is good. As a later development twin high stability sources could be used to synthesize all channel frequencies suitable for quasi-synchronous area coverage use.

7. SIZE
8 Channel capacity within one 7ft and two 5ft cabinets.

UNDERWATER COMMUNICATIONS

For the last two years or so, at the request and with the help of the ACPO Sub-Committee on Police Diving, work has been going on to provide an improved communications system for police diving teams. Advice from the Sub-Committee and consultation with working police divers led to a formal User Requirement and this formed the basis for the system development shown in the photographs and on the stand display.

The Essential Requirements that the system needs to meet are as follows:-

GENERAL

1 To be able to work "through water".
2 Have a range of at least 200 metres irrespective of water density.
3 To be able to work at a depth of at least 40 metres irrespective of water density.
4 Be able to work between Diver and Diver and Surface Attendant.
5 Provide Simplex (one way at a time) operation as a minimum.

DIVERS EQUIPMENT

6 Be able to work with both "wet" and "dry" suits.
7 Be able to be used with a Full Face Mask.
8 To be mounted on the head, possibly as part of a mask or helmet.
9 To be able to be worked with "Mouth Free" masks.
10 To be able to be used with "Bone Conductors" and mask mounted microphones.
11 Be able to communicate without using hands.
12 Weight must not exceed 1 kg in water.
13 Battery to operate equipment in water for at least two hours and to be quickly and easily replaced in the field.

ATTENDANTS' EQUIPMENT

14 Equipment able to be "body mounted" or "free standing". When "free standing", it should be capable of operation from at least five metres.
15 To have Loudspeaker or Headphone option.
16 Able to operate with one hand only.
17 To have a battery the same model as that in the diver's

The photograph shows the newly-developed system about to be used in Shoreham Harbour. Both the diver's helmet and the surface attendant's transducer will need to be under water before communication can take place.

equipment, but to have a variable capacity (eg by stacking batteries) to ensure at least eight hours continuous average operation.

TECHNICAL

1 It is desirable that the equipment should work in the "upper" frequency band, ie 30-40 kHz, to take advantage of an improved signal to noise ratio.
2 It is desirable that the equipment should work at NATO frequency of 8.0875 kHz subject to workshop change of transducer and crystals.
3 The "mask mounted microphone" can be considered as a separate development but be integrated into the system as a whole. The oral/nasal mask cavity and the mounting of a microphone is at present a subject of liaison between MOD(Navy) and Home Office Directorate of Telecommunications.

When the Requirement had been established, a survey of equipment available showed that no one underwater communications system completely met the needs. It was therefore decided to obtain a ready-made system that came closest to the Requirement and to undertake modifications. The system shown in the photographs and on display shows that approximately 90% of the Essential Requirements have been met.

Some interesting points to note –

The transducer mounted in the top of the diver's helmet which operates similarly to a radio aerial to transmit and receive the 38-40 kHz single sideband ultrasonic signals.

The earpods on the helmet containing the battery, transmitter/receiver and miniature loudspeakers.

The helmet itself which provides protection for the diver's head and the minor differences in shape which allow for different types of diving mask.

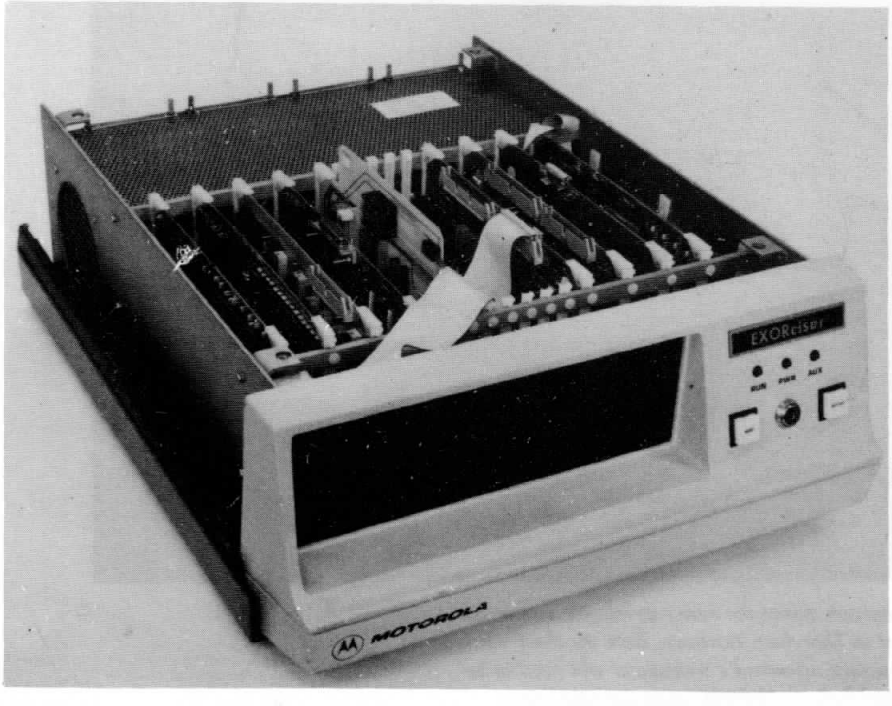
The surface attendant's unit enables communication between one or more divers and other attendants similarly equipped. Note the levers on the earphones on the headset to allow the attendant to shut off surrounding noise and concentrate on the diver's message alone. Communications are established when the attendant lowers his transducer into the water. The operating technique is then the same as with conventional police radio systems.

MICAT

MICROPROCESSOR-CONTROLLED ANALYSER FOR TELEGRAPH TRAFFIC

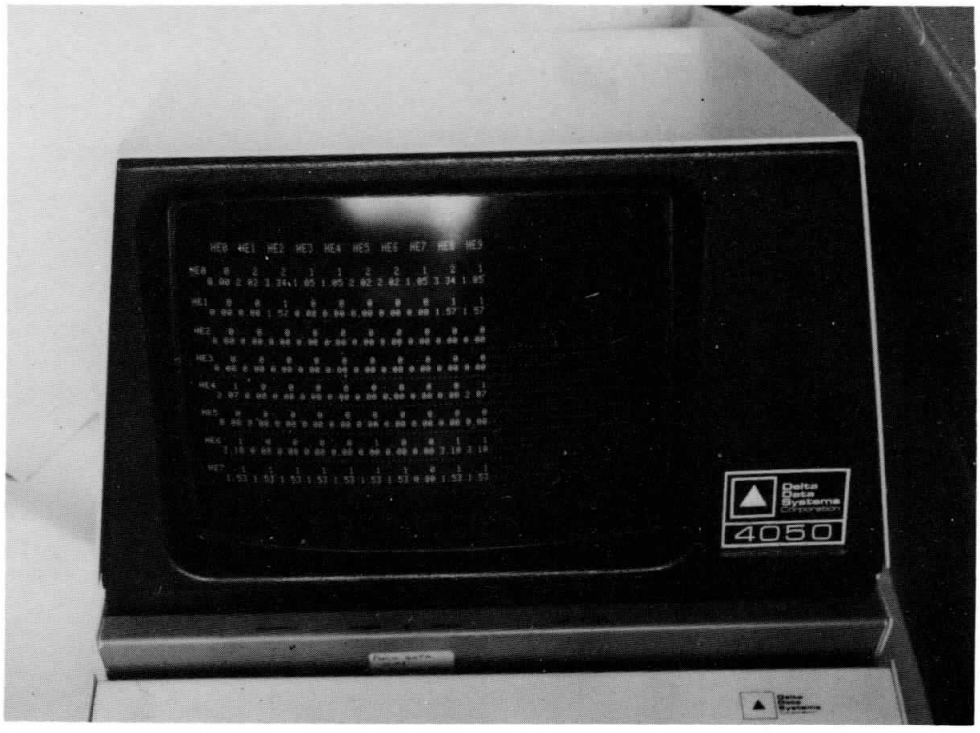
In the course of restructuring or modernising private wire, torn tape, telegraph systems, it is necessary to obtain a measure of the traffic carried by the system. Currently, traffic measurements are made using a docket-orientated method and analysed manually – a process typically requiring in excess of a man month.

MICAT has been designed to replace the docket system and the resulting manual analysis. The analyser measures the traffic on the network directly from the telegraph lines, stores and processes this information, and finally outputs the results to either a printer or to a cassette storage device (for printing later). In operation, MICAT is situated at a



Microprocessor development unit. (Photo: Colin Poyton).

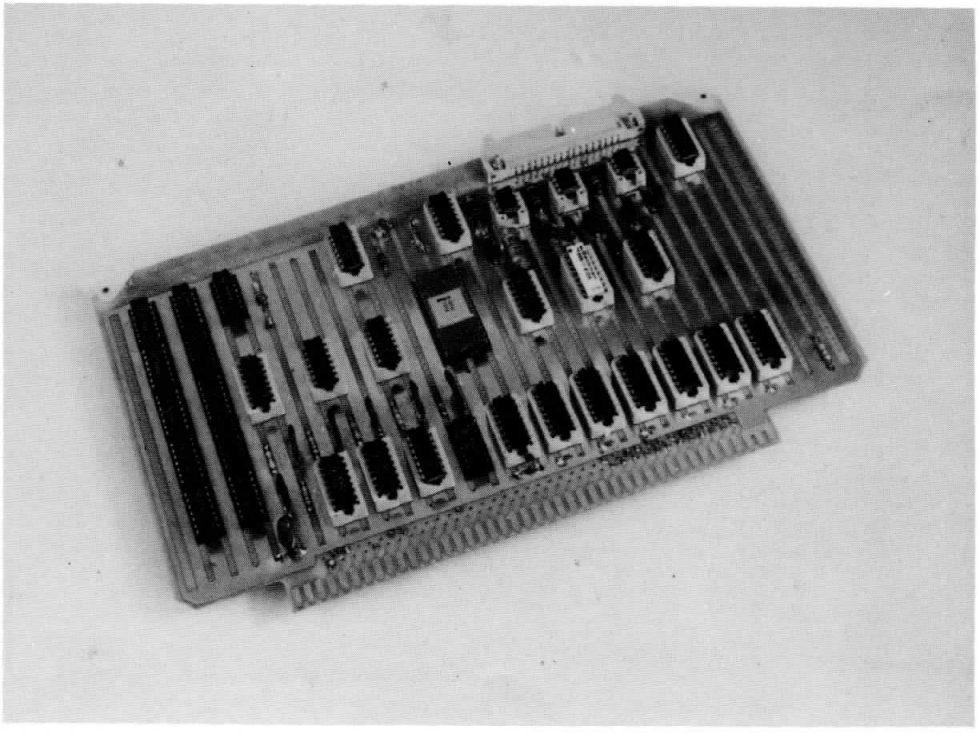
A typical traffic matrix from Micat. (Photo: Colin Poyton).



traffic node, usually a force headquarters, and monitors traffic at the output of the line concentration units. Operation of the machine is completely automatic and it is protected against short term supply interuptions and other outside disturbances. The only modifications required to the network operating procedure are: the addition of the internationally accepted start and end of message groups, ZCZC and NNNN, and a strict observance of the station identification code in use on the network. A normal survey with MICAT would be of 4 days duration with the traffic results available almost immediately.

MICAT is controlled by a Motorola microprocessor, this system being employed so that the analyser will be flexible enough to accept virtually any telegraph operating procedure. The analyser is capable of handling simultaneously traffic on 8 channels at data rates from 50 to 300 baud, the nominal input levels being ± 80 volts. Any group up to 3 characters in length, can be accepted as a valid terminal identifier since the operation of the machine is program-controlled. Programming of the machine is easily implemented, using the Research and Development microcomputer development system, thereby enabling complete flexibility of operation to be maintained.

The MICAT system on display will be the first prototype model, following a development project executed on the Exorciser microcomputer development system. Nominal out put of traffic data will be on an hourly basis, but, for the current exhibition, this rate has been somewhat accelerated.



Micat interface board. (Photo: Colin Poyton).