Fig. 1: New outside broadcast vehicle

The Post Office Outside Television Broadcast Service

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A NEW TYPE OF GREEN VAN (SEEN IN FIG. 1) of pleasing appearance and carrying the legend "Post Office Television Outside Broadcast Service", has been seen about the country in the past two years. The first van of this type appeared in Hyde Park during the Coronation celebrations, and since then several more have been put into service to assist in providing temporary vision links on Post Office cables for B.B.C. television outside broadcasts.

These vans serve the dual purpose of carrying staff and equipment and of operating as mobile repeater stations (Fig. 2). The service began on a small scale in London under laboratory supervision after the war, has rapidly grown and now is one more regular Post Office service operated entirely by Regional field staff. Specialist units are based in London, Manchester, Cardiff, Edinburgh and in Birmingham.

The means adopted to link an outside broadcast site with the main television network vary according to circumstances and may include a combination of:

(*a*) Portable radio links set up and operated by the B.B.C.

(*b*) Temporary short links set up on specially equalized telephone cable pairs as and when required. These are used, either directly into a switching centre or injection point, or as "starting" and "finishing" links giving access to high points for micro-wave transmitters and receivers.

(*c*) Temporary links set up according to a prearranged plan on permanently rented balanced pair or coaxial cables. At present such special cables exist in London only.

(*d*) Injection of vision signals into a convenient intermediate point on the main return television links.

All but the portable radio links are the responsibility of the Post Office; the B.B.C., however, uses its own micro-wave receiving equipment to inject into the Kirk o'Shotts-Manchester television link. To link an outside broadcast site to the main network calls for close co-operation between many different engineering staffs, Post Office and B.B.C. That these methods work and this co-operation exists is demonstrated nearly every day by the presence on television screens of pictures from remote sites, rarely showing any sign of impairment due to transmission.

The objective in the provision of outside broadcast line vision circuits is the completion of a channel from the site to the nearest B.B.C. switching centre; at present, there are switching centres at London, Birmingham, Manchester and at the Kirk o'Shotts and Wenvoe transmitters.

The table (overleaf) shows the equipment and scope of the Regional specialist teams as planned for the end of 1955 to meet the requirements of

Fig. 2: Mobile repeater station—internal view showing video repeater equipment

an analogous distribution of B.B.C. mobile units, known as "mobile control rooms".

The specialist mobile team is engaged fully in operating and maintaining its equipment. Enough technical staff is available, permanently attached to the team or on call, to man all equipment continuously during test and transmission times. This is necessary to ensure continuity of service, since portable equipment has its own hazards and

Table: Equipment and scope of the Regional Specialist teams as planned for the end of 1955

TEAM'S BASE	TERRITORY	EQUIPMENT
London ...	L.T.R. and Home Counties Regions	(i) Video repeaters.* (ii) 3–7 Mc/s carrier equipment for use on coaxial cables. (iii) 3–7 Mc/s injection equipment for the Birmingham–London link. (iv) 0·5–4 Mc/s injection equipment for the Wenvoe–London link.
Manchester	North-Western and North-Eastern Regions	(i) Video repeaters.* (ii) 0·5–4 Mc/s injection equipment for the Manchester–Birmingham link.
Edinburgh	Scotland	Video repeaters.*
Cardiff ...	Wales and Border Counties; South-Western Region	(i) Video repeaters.* (ii) 0·5–4 Mc/s injection equipment for the Wenvoe–London link.
Birmingham	Midland Region	(i) Video repeaters.* (ii) 3–7 Mc/s injection equipment for the Birmingham–London link.

* Video repeaters are used on telephone pair circuits; for example, on subscribers' and junction cables.

the process of setting up and adjusting may be prolonged; final adjustments to give the best compromise of the overall circuit (mobile control room to switching centre) are often made just before an actual broadcast. Furthermore, the equipment is not completely duplicated.

An office organization operates in parallel and deals with all orders and enquiries from the B.B.C. The technical possibility is first examined. If a telephone pair circuit is required, reference to the Area cable records will show if suitable plant exists. The transmission loss over telephone cable pairs at the upper television frequencies used (three megacycles per second) is so high that the signals must be amplified every mile or even at shorter distances. Repeaters are usually installed in telephone exchanges, but occasionally the local Area external staff may make a roadside interception (see Fig. 3) and install a repeater in a vehicle. When a possible route has been worked out, a field survey is sometimes made to check the suitability of the cable pairs, since characteristics which are unimportant for telephone circuits may be serious when attempts are made to use a cable for television. When it is clear that the circuit can be provided, an estimate of the cost is given to the B.B.C.

The Telephone Manager's Area (Regional Telephone Branch in London) nominated to handle

Fig. 3: Silverstone. "Whittlebury D.P." repeater point

all orders for the Region or Regions covered by the mobile team receives a firm order for a vision circuit on telephone pairs. Normal Advice Note procedure is followed as far as possible for the actual provision and recovery of the circuits. At some stage, the planning officer will visit the site and any intermediate and final repeater points to arrange for cable terminations (naturally, the provision of control and programme circuits is co-ordinated) power supplies, accommodation and parking. This information is recorded and filed ready for the mobile team which will move in to set up the circuit one to three days before the day of the transmission. The normal Area staff carries out all temporary cable work and interceptions, and close co-operation is maintained between the local staff and the visiting specialist team.

Enquiries and orders for injections into the main links or for coaxial carrier circuits are dealt with in a similar way, except that less survey or experimental work is necessary. The plant concerned is designed as high frequency plant of predictable performance and the stations in which it may be used are pre-determined. Special power supply arrangements may, however, be required.

Fig. 4: Intermediate video repeater point at Cardiff automatic telephone exchange

Video Links on Telephone Pairs

A new type of equalizer-amplifier (Amplifier No. 98A) has recently been introduced and has many advantages over the old models which, however, will be giving good service for a considerable time. Difficulty is occasionally experienced with the older type of repeater when used in certain situations: for example, in telephone exchanges or near electrically-operated lifts; for outside broadcast work the comparative immunity of the new design to this kind of interference is of very great advantage.

Interference from high power radio transmitters is sometimes introduced into an underground cable from an open-wire span. The adverse effect on the vision signal may be minimized by using a special "phantom coil", which must be separately designed and constructed to give sufficient suppression of the interference without introducing appreciable

Fig. 5: 0.5-4 Mc/s injection equipment assembled with test and monitor gear

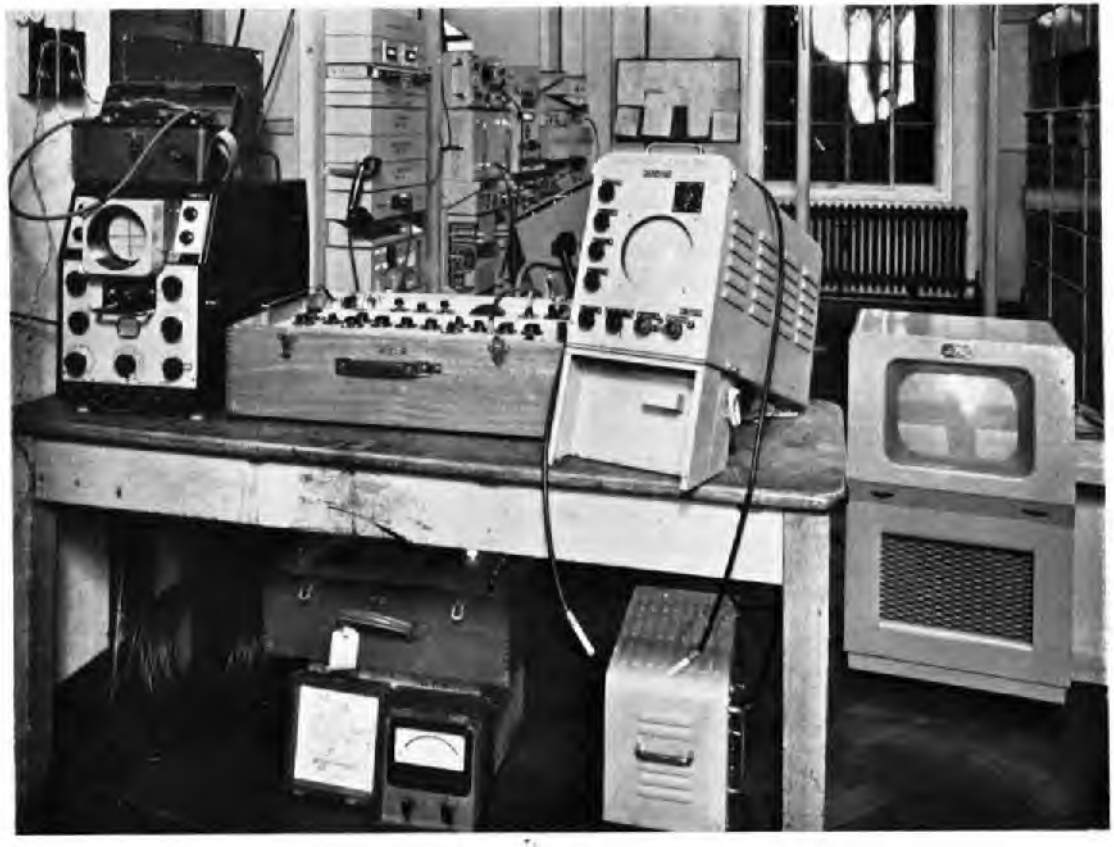


Fig. 6: Terminal video repeater and injection equipment at Cardiff repeater station

loss to the vision signal. An efficient phantom coil is fitted to the new amplifier but, even with this, radio frequency interference is one of the major difficulties met in the field. It is unpredictable and often unsuspected until a late stage in providing the circuit because the offending transmitter may operate only during limited hours. As a last resort, an auxiliary high-level "send" amplifier can be made available to strengthen the signal and so reduce the effect of the interference.

The process of equalizing a telephone-pair circuit is guided mainly by observation of pulse wave-forms. It is a rapid process and the great flexibility of this method of adjustment permits some compensation to be made for cable irregularities or, exceptionally, for small deficiencies elsewhere in a composite link.

Figure 4 shows a typical intermediate repeater point. Each point is staffed continuously during testing and transmission. In addition to the video repeater, a picture monitor, a video oscilloscope and a wide-band decibelmeter are provided to assist in alignment and in tracing transmission faults.

Injection

During the planning of the first television cable links, it was realized that they passed near to potential outside broadcast sites or to suitable pick-up points for micro-wave links, and that a valuable facility would be obtained by providing portable terminal equipment which would permit the injection of a video signal at any intermediate repeater station on the main link, after modulation into the correct carrier band.

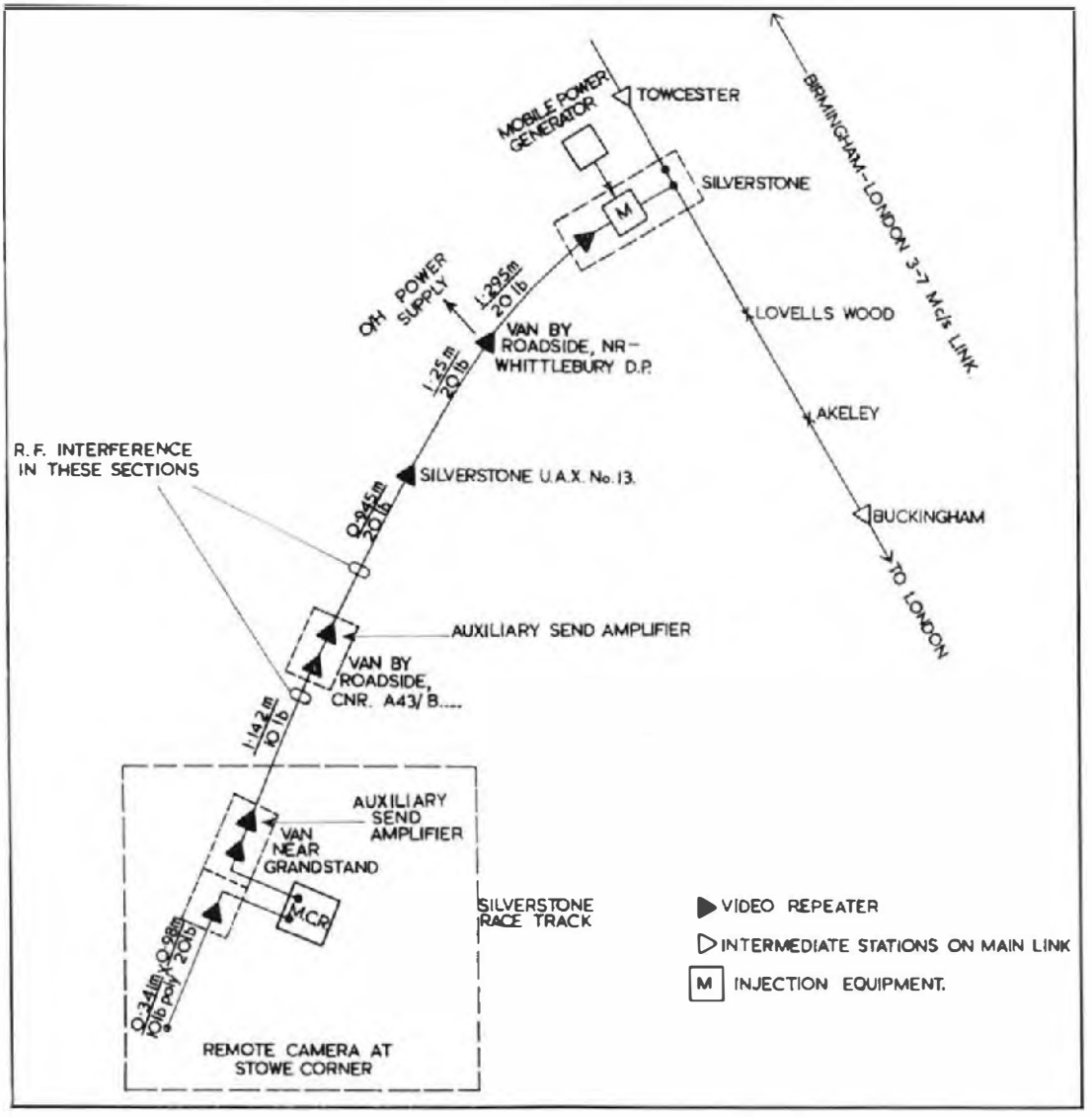
Such injection equipment has now been provided for the Birmingham-London link and for the Manchester-Birmingham and Wenvoe-

London links. Although the designs of the types of equipment are very different, the facilities provided have a common basis.

Each injection equipment is completely self-contained, having normal and stand-by facilities and all necessary test and monitoring equipment. It is built on special small racks to permit easy handling. The equipment used for 0.5-4 Mc/s links, which is necessarily very large and complex, has been broken down into functional units mounted on stackable racks. This can be seen from Fig. 5. Figure 6 shows a typical installation of injection equipment in position for an actual outside broadcast transmission.

Three examples of the more complicated circuits using the techniques described may be interesting. These show how the potentialities of the telephone and television network are exploited and give some

Fig. 7: Schematic diagram showing routing of Silverstone circuit



idea of the temporary work required in providing the circuits.

Silverstone, July, 1954

The television broadcasts of the British Grand Prix at Silverstone in July, 1954, were routed back to London entirely by line link. A rather difficult video repeatered link was provided on telephone plant from the race-track through Silverstone exchange (U.A.X.13) to an intermediate repeater station on the Birmingham-London link. Injection equipment was set up at this point. Figure 7 shows a straight line diagram of the circuit. A war-time perimeter cable was used in addition, to provide a remote camera link from "Stowe Corner" to the grandstand. Three special vehicles were in use, one as the sending-end control and a receive-repeater point for the remote camera link, and two as road-side repeater-points on the main video circuit.

At the "Whittlebury D.P." site (Fig. 3) a temporary mains power supply was provided by the local Electricity Board as a tee from a convenient pole on the overhead distribution. This, and the Post Office cable drop feed from the distribution pole are visible in Figure 3. Possibly because of the temporary aerial spans of "mole-drainer" twin cable, there was considerable radio interference (probably from the nearby 647 Kc/s B.B.C. broadcast transmitter at Daventry) in the first two sections, and auxiliary sending amplifiers were needed at two points to give an acceptable signal/noise ratio.

At Silverstone Repeater Station hut (an un-equipped station on the Birmingham-London cable link) the receiver repeater and the injection equipment were operated from portable engine sets as there was no mains supply at this station.

Oxford, February, 1954

A series of broadcasts was made from well-known buildings in Oxford. These required a combination of Post Office cable starting links, B.B.C. micro-wave links and an injection into the Birmingham-London cable link at Grandborough, near Aylesbury. Video repeater equipment was installed in the Telephone Manager's Office (the roof serving as a convenient starting point for the B.B.C. micro-wave link) and in Oxford telephone exchange. Five short cable links from here gave access to the various sites.

Television has been prominent in reporting State occasions by outside broadcasts. Vision circuits were provided for the State visit to Edinburgh in June, 1953. A B.B.C. control unit was set up in the test room in Rose Street telephone exchange, which also accommodated the terminal repeaters for the video links connecting six sites to the control unit. The vision signals were then brought into the main network by B.B.C. micro-wave links via the Castle to Kirk o'Shotts.

Future Developments

The total number of vision circuits provided each year has grown from 38 in 1947 to 407 in 1954.

This growth has followed the opening of transmitters giving national coverage and the provision of B.B.C. mobile outside broadcast units for the B.B.C. regions. The present phase of expansion of the Post Office service to meet B.B.C. requirements should be completed during the current year and full exploitation of the present facilities should lead to a fairly steady increase in the total number of outside broadcast circuits provided for the B.B.C. So long as the present hours of broadcasting remain, no great change is to be expected.

There is now, however, a new factor to be considered. The introduction of commercial television and the opening of the new stations of the Independent Television Authority will bring a demand for outside broadcast circuits of magnitude comparable with that of the B.B.C. television service.

This will lead to considerable increase in outside broadcast circuit provision by the Post Office. Additional special equipment and staff are being provided. Such additional work will bring new problems, particularly if simultaneous transmissions are required from the same or neighbouring sites, since cross talk conditions may not permit the operation of two video circuits in the same telephone cable.

A special position exists in central London, where the B.B.C. has exclusive use of a low-loss television cable linking many important sites and strategically sited exchanges. Most B.B.C. television outside broadcasts in central London use this network.

Technical developments are likely to be limited to simplification of equipment and methods of working. This will be most desirable under the different conditions which may exist in the future when outside broadcast activity becomes more widespread. Some developments in local cable networks, such as reduction in conductor gauge or the adoption of a non-metallic cable sheath, may restrict the extent to which the local telephone network can be exploited for television.