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ENG INF

The Quarterly For BBC Engineering Staff

ENGINEERING TRAINING
New building nears completion

The newly-constructed Avon Wing at Engineering Training Department, Wood Norton.

Engineering Training Department has been based at Wood Norton since 1946, but it is only now about to occupy a building designed specifically for its use.

The building, which has an area of 16,000 square feet, is to be called AVON WING. It will be used for Radio, Communications, Fundamentals, and Computer training for technicians and engineers, and replaces the present rather scattered and cramped accommodation in the old wooden huts.

The design of the new building emphasises the belief that most learning is by one's own actions rather than the words of others. Thus there are only two classrooms in the building and one is designed for later conversion to a more active role. Additionally there is an audio demonstration area designed to allow sound reproduction under conditions which allow critical listening and appraisal. This area can double as a lecture theatre for conferences and has full facilities for this role.

Otherwise the learning areas are wholly concerned with student activity, either in practical work, using an extensive range of up to date equipments, or in the resource areas, using packaged learning material.

The resource areas match the latest step in the Department's moves towards 'learning on demand'. In this the traditional course format would be replaced by a system whereby individuals or small groups of students are given exactly the right training at the right time. This avoids redundancy in the training given, and allows its immediate application - it is wasted otherwise. Motivation is improved because the purpose is clearer and personal involvement is high.

To achieve this the training must become 'modular'. That is courses must

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In this edition of ENG INF

Editorial

As the BBC celebrates its 60th Anniversary, other historic events in the area of broadcast engineering take place. Almost unnoticed in the euphoria surrounding the advent of direct broadcasting by satellite, the first of the BBC's old 405-line transmitters closes down. When they were fully operational there were over a hundred 405-line vhf transmitters serving 99.5% of the population. It is interesting to reflect that in the uhf band we need nearly six-hundred 625-line stations to provide the same service.

The start of satellite broadcasting will bring a population coverage of almost 100% with only a single relatively low-power transmitter. There will be no "phased introduction" of the new DBS channels, with major connurbation benefiting from the new services first, followed by the scattered rural populations - the service will be available to everyone from the day transmissions start.

Other areas have also lost a little bit of history. At Wood Norton most of the old green huts have disappeared, and a splendid new building has taken their place. HETD reports that when they were demolished an old Players cigarette packet was found wedged between two of them. Inside it bore the message, "The bloke who finds this will know who won the war!" I wonder if there are any more epitaphs in other historic buildings, written by engineers who have long since retired?

International Broadcasting Convention 1982

In keeping with past IBC events, BBC engineers have submitted a variety of papers to the Convention, and will be exhibiting some interesting equipment in the exhibition. Also in keeping with previous years is the ticket allocation. Departmental heads have full details of the reduced rate attendance, but for lesser mortals the cost is £100 + VAT for the full Convention or £26.05 a day. There are an unlimited number of exhibition-only tickets at £20 for four days or £5 a day, obtainable from EID or the IEE. Sadly there are no FREE tickets; engineers wishing to visit only the exhibition must either pay the £5, or persuade someone to admit them as an exhibitor! For those on-shift or otherwise occupied during the period 18th - 21st September, the next edition of 'Eng Inf' will carry full details of the event, and thus keep everyone informed of the up-to-date developments in BBC Engineering.

Alan Lafferty

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DOWN to EARTH

In these days of such rapid progress, it is easy to concentrate on high technology and neglect some of the more mundane aspects of engineering practice. One example is the running of technical cables, including those for the provision of technical earths. For us simple people the latter may seem to be a problem that falls into the court of the authority providing the electricity supply. The three pin plug has an earth pin and as long as you connect the yellow and green covered wire to it all should be OK!

In practice it isn't quite so simple. Mains earth and technical earths should be separate systems. Earth loops and leakage currents in the earthing system can create hum on both sound and video, as well as such undesirable things as clicks and noise.

We have now learnt, and wish to pass on to our readers, two simple rules which apply whether running cables on a station with a simple technical earth system or in a large regional centre with a more complex noise free type of earth system, such as Pebble Mill.

The two rules are: 1. All technical cabling, including earths, must see a single route or path back to the Central Technical Area (CTA). 2. The cable connecting the technical or noise free earth distribution point in the CTA to the Station Earth must be insulated from all other earths throughout its run, as well as meeting the impedance specifications.

The diagram shows various technical cables radiating out like the spokes of a wheel from a Central Technical Area. If we continue the analogy further, the spokes become the single defined routes from the CTA to various technical facilities and the hub of the wheel represents the CTA, itself. Any new area could be positioned either along an existing spoke or on a new spoke. Any connection from a facility on one spoke to that on another must be made via the hub.

The thing NOT to do is take a short cut by joining together points on different spokes i.e. under no circumstances should any connections be made round the rim of the wheel. If you did do this, the points could be at different potentials with respect to the hub or central earth. Earth loops would be formed which would produce hum, and other types of interference could be induced in the circuit. Although longitudinal stop coils can be used on video circuits at some expense, why not try and avoid the problem at its source. Then we can all get away from the wheel and back to the high technology.

Transmitters Opened

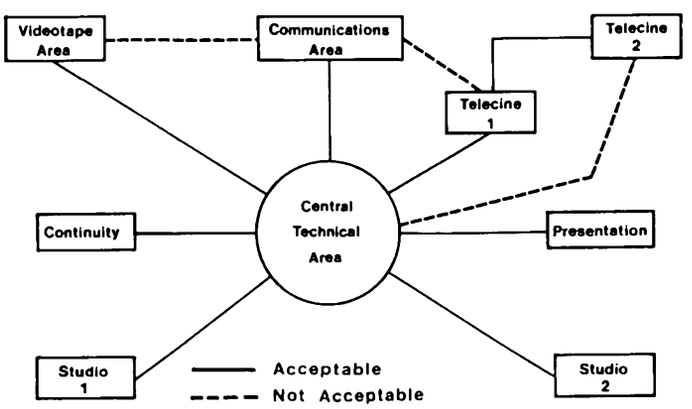
The following uhf transmitters have opened since April:
Humshaugh, Northumberland
Roadwater, Somerset
Aldbourne, Wiltshire
Crockerton, Wiltshire
Portslade, East Sussex
Patcham, East Sussex
Charlbury, Oxon
Bellanoch, Strathclyde

Mf

New Radio 4 transmitter for Plymouth

Local Radio

Radio Cambridgeshire
Radio Furness
Radio Northampton



RADIO O.B.s GET NEW MOBILE STUDIOS

The production studio at the front of the mobile radio studio.

Radio Outside Broadcasts took delivery of a new mobile studio in time for the London Marathon on May 9th. The new vehicle, designed by SCPD in conjunction with Radio Projects and OBs Departments, is the first of two such vehicles intended to complement the more specialised vehicles in the Outside Broadcast fleet.

The new mobile studios, which will be based in London, are available for use on a variety of general outside broadcasts throughout the UK demanding complex facilities. After the London Marathon the first vehicle was used for The Derby and Wimbledon, and for the Pope's visit and Trooping the Colour. Both vehicles have been designed for Party Political Conferences and Trade Union Congress sessions, the News and Current Affairs coverage of which means the setting up of temporary studio facilities close to the source of information.

The vehicle, based on a Ford R1114 coach chassis, contains three main operational areas. At the front of the vehicle is the main studio with associated microphones, fixed seats and production control facilities. Two windows on either side allow the commentators and presenters to be "on view" to the public if required. The studio has been acoustically treated, and acoustic shutters are provided to cover the windows when operationally necessary. Commentators and contributors can enter the studio via the vehicle cab and will not disturb operations in the control room. The studio is equipped with two television monitor-receivers which allow off-the-tube commentaries to be made. LS3/5A monitor loudspeakers are also provided. The studio can communicate with other operational areas via a 24-channel communications facility manufactured by Glen Sound, thus permitting Executive Producer control when required.

Access to the control room, which is located in the centre of the vehicle, can be had from the near-side or off-side of the vehicle according to local parking arrangements. A 30-channel sound mixing desk also manufactured by Glen Sound has been mounted lengthwise in the control room. The desk can handle up to 24 outside sources each with individual talkback and cleanfeed facilities. The 30 channels can be arranged to feed four stereo group faders. Comprehensive telephone and communication arrangements have been provided where necessary. The control room, which is also acoustically treated, is equipped with two LS3/7 monitor speakers, and two television monitor-receivers. Up to four stereo tape recorders and two disc reproducers can be installed in the control room. They can be remotely operated from the desk, or used independently as required for editing.

At the rear of the vehicles is a radio-link compartment. The vehicle is permanently equipped with a 10 metre pneumatic mast that can carry a range of aerials dictated by operational requirements. The radio-link equipment is mounted on a trolley and is only installed in the vehicle according to specific programme requirements; this avoids the need for permanent and expensive equipment installations. The area can be used for receiving off-air signals for monitoring and cue purposes, or for the transmission of commentaries to a suitable pick up point for insertion into the network output. It can also be used as a reception point for manpack transmitters in use in the field. Besides providing access to the main studio, the vehicle cab can be used as a commentary position, cue lights and microphone points having been incorporated in the vehicle design. In addition, the roof has been reinforced and a guard rail provided so that commentators may broadcast from this safe vantage point.

Dave Swaysland, from SCPD, the vehicle designer, describes it as probably the most complex OB vehicle in Europe built for work of this kind. Duncan MacEwan, CERB, said "I am absolutely delighted to take delivery of the new vehicle, and look forward to seeing it used productively at future outside broadcasts. It will considerably enhance the operation of Radio OB's throughout the UK."

Its overall length is 11 metres, the maximum permitted by the Road Traffic Act and the width 2.5 metres. The vehicle is equipped with a dual steerable front axle to allow manoeuvrability in confined parking spaces. The coachwork has been built to a BBC specification by CMA Coachbuilders Ltd. in London.

The 30-channel Glensound mixing desk, LS 3/7 monitor speakers, and monitor-receivers.

Avon Wing
'continued from page 1'

be broken down into small blocks which can be offered in appropriate combinations to meet individual needs. The training is thus tailored to the student, and the job to be done.

To offer such a flexible service, the traditional approach of 'talk and chalk' in the classroom must be replaced by a system which makes the training material constantly available. Many blocks or modules of material must be 'packaged' , i.e. arranged to stand alone, and not require a supporting structure of lectures. This can be done by the use of text, audio and video tape, 35mm slides and special practical equipment.

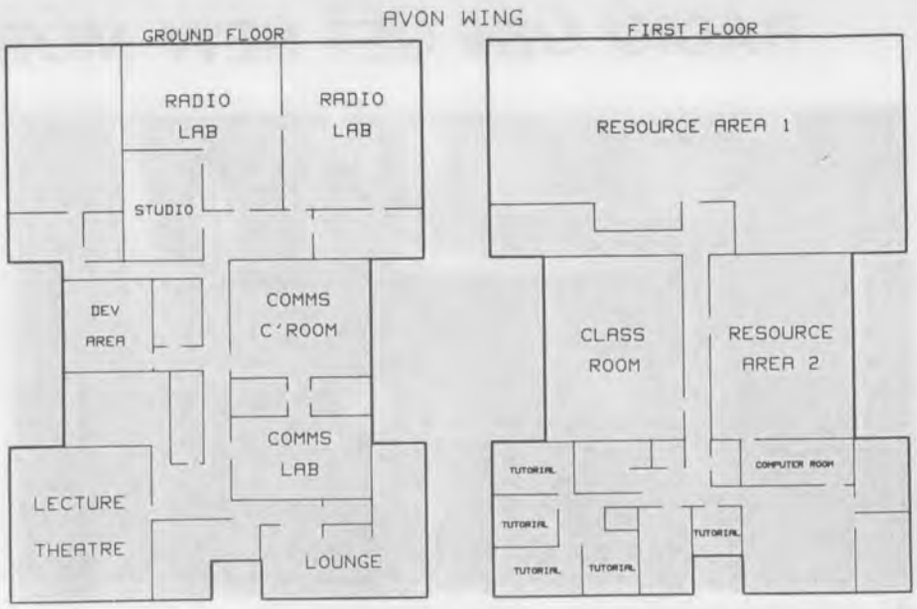
Packaged learning is not new, but the idea of using it to cut the logistical constraints of traditional course structures and so to offer 'learning on demand' is exciting. It is a dream that has been long discussed but seldom attempted.

ETD began that journey many years ago now. Firstly by placing less emphasis on the classroom in favour of hands-on experience and then, in recent years, by developing its skill in producing learning packages.

The first attempts were in the mid 1960's when a range of programmed learning books was produced. A broader and more flexible format began to be developed in the mid 1970's. This has led to courses on digital techniques and microprocessors, to the 5 week B Part 1 course for Technical Assistants and, most recently to a week covering the bulk of material on Television fundamentals, colorimetry and colour coding (see story on "back page"). There is a long way to go yet but experience is now sufficient to demonstrate that the technique is viable and well worthwhile.

The method does not fit well into traditional classrooms as the students do not all do the same things at the same time. Whilst having firm targets to meet they can nevertheless take time over areas of personal difficulty and choose for themselves the convenient moment to take a break. They discuss problems with a partner and their tutor. Many assessments - an essential feature of the system - are initiated when they declare readiness. Those who are falling behind the target programme can do additional work out of normal hours using the packages and supporting facilities.

All this requires an environment which encourages personal responsibility, allows concentrated but diverse work and close but unobtrusive supervision. Refreshments should be available constantly, particularly for those choosing to work out of hours.



A plan of the new Avon Wing at Wood Norton.

The resource areas of Avon Wing are designed to create this environment and the building provides refreshments near at hand. You can best liken the areas to a modern and very pleasant open-plan office with acoustic screens separating work points. Each work point is fully provided with mains power, a range of audio and video feeds and necessary equipments. One resource area is dedicated to computer training and in this each work point has its own data lines and many have VDU's or micro-computers. The area is served also by a powerful PDP11/44 Minicomputer.

The radio training areas cover both programme origination equipments, (sound desks, tape machines, etc.) and control room equipments, together with all necessary measuring apparatus. A typical and fully equipped radio studio is included though it is not typical in its sizes. The control room is much larger than the studio area to enable students to have plenty of room to work on equipment and to see demonstrations.

The front of the building includes five tutorial rooms - a sign that the learning system must not be seen as automation - on the contrary it is very much based on contacts between people.

The building has other unusual features; for example, part of the heating is by solar energy. The house services area, which contains the heating and air conditioning plant and the electrical switchgear, has been designed to allow house services courses to examine these facilities, and to use the instrumentation as part of their training.

Finally the front part of the building, containing the audio demonstration area, tutorial rooms, refreshments and facilities, can be isolated from the rest of the building to form an occasional weekend conference centre for up to 40 people.

The first three draughtsmen to complete the BBC's new training scheme were recently presented with certificates by ADE. Pictured in the photograph are (left to right): John Mitchell, Training D.O. Manager, Kevin Swales, Liz Errington, Personnel Officer, Bob Neale, Engineering Recruitment Officer, Colin James, George Cook, ADE, and Mario Georgiou.

AMERICAN SUB-TITLES

As about 7% of television viewers have some impairment to their hearing, more and more countries, including Great Britain, United States, Canada and Australia, are beginning to cater for this section of their audience by providing optional sub-titles. By optional sub-titles we mean sub-titles that are not displayed as part of the picture but can be selected as a specific page number within part of the Teletext service. The viewer, therefore, requires a Teletext receiver

The Ceefax sub-title service began in 1979 and has been growing in importance ever since. Any person with a Teletext receiver can view sub-titles when they are being transmitted with BBC programmes on page 170 for BBC 1, and on page 270 for BBC 2. Similar arrangements are made by Oracle on IBA transmissions. As you will have seen early in March in Ariel a specialist sub-titling unit is to be set up in Glasgow which will be capable of sub-titling about 25 hours of BBC programmes each week.

Sub-titles are normally prepared in advance on a computer system. A sub-title editor sits at a keyboard in front of a television monitor, composing sub-titles over picture being displayed from a U-format cassette recorder with a still-frame capability. Timecode, recorded on audio track No. 1 of the cassette, is used to identify the IN and OUT times of the sub-titles and is recorded together with the sub-titles themselves on a floppy disk.

During the actual transmission of the programme, timecode from the source telecine or videotape machine is used to synchronise the transmission of sub-titles from the computer through the relevant Ceefax magazine.

The time it takes to prepare sub-titles is the factor which presently limits our sub-title output. This is of the order of twenty times the programme length, but, of course, it depends upon the particular difficulties presented by the programme. Comedy programmes, for example, which rely on precise timing for their impact, are probably the most difficult.

During 1980, the National Captioning Institute (NCI) was established in the United States to prepare sub-titles for programmes and for advertisements. The Institute is an independent organisation financed by fees paid by national television companies.

The NCI prepares sub-titles on a system similar to our own, and uses a floppy disk as the sub-title recording medium. Captions are transmitted by the United States Line 21 system, similar to Ceefax, but with a very much lower data rate (480 baud against 28,000 baud).

As the BBC purchases many American programmes, it was considered to be highly desirable to use NCI disks as a source of sub-titles on Ceefax. Unfortunately, the NCI caption disks are not compatible with our own. For example, they use different disk types and data format, row length, page length, timecode standard and an extra character format.

Now, however, Designs Department have produced an NCI Caption Disk Converter which will transcode an American disk and produce a BBC title disk, ready for review, in about six minutes.

The system uses two floppy disk drives, one configured for the hard-sectored disks as used by NCI and the other for the soft-sectored disks as used by the BBC. Both drives are controlled by a Z80A microcomputer system, which consists of boards from the Cromemco and Comart ranges, housed in an S-100 rack. Modifications to the disk control system, as well as extra software, enable both the hard and soft-sectored disk drives to be controlled by the Western Digital Floppy Disk Controller IC (type 1793) used in the computer, which is normally intended for use only with soft-sectored disks. The transcoding and disk control software is contained in a Read Only Memory (ROM) with Random Access Memory (RAM) with 17k bytes capability being available for program scratch pad and input/output buffers.

Although sub-title styles differ between the NCI and the BBC, no attempt has been made to resolve these in software terms and indeed the system has been made as 'transparent' as possible. Thus as far as the system allows, the British viewer will see sub-titles as the NCI intended them to be seen. For that reason the material will have to be reviewed and, where necessary modified during this session. If experience demonstrates that changes are made regularly then these might be embedded in the software later.

Initial experiments with the new equipment have proved very encouraging. A 525-line cassette copy of an episode of 'Rings on Their Fingers', a BBC production already sub-titled by Ceefax, was sent to the NCI to be captioned. The resulting disk was then converted on the Designs Department converter and reviewed using vision and timecode signals from the original BBC video tape. This enabled a comparison of styles to be made.

NCI also supplied Designs Department with a 525-line video tape of the same programme with sub-titles encoded on Line 21. Using a Line 21 decoder, as sold in the United States but modified for baseband working, we were able to make a direct comparison between the Line 21 sub-titles and the transcoded Ceefax sub-titles. The results were accurate, and it seems likely that the NCI style of sub-titling, although different from our own, will be acceptable to the audience.

As NCI caption disks become available to the BBC, they can be transcoded by this new unit, thereby providing another source of sub-titles for a section of our audience who are quite clearly asking for more and more.

Type 200 TAPE

The BBC began using magnetic tape for audio recording on a routine basis in 1952, following a period of experiment and development. In the space of the next five years tape almost completely displaced the disc as the recording medium. Early tapes were manufactured by EMI, Kodak and Kramer (a Canadian Company). The equipment installed in most of the recording channels in the 1950's was the EMI BTR2 tape recorder and most of the tape used was H50 made by EMI. Early tapes with paper or acetate bases, had a certain amount of variation in the quality and performance due to variations in the size of the oxide granules and the thickness with which it was laid on the tape. EMI continued to research and develop tape and by 1960 had replaced H50 with H77 on a PVC base with a more consistent performance and about 4dB improvement in signal to noise. Initially each recording machine was manned by an engineer who set the bias and aligned the recording level for each reel of tape, but H77 was sufficiently consistent for standard settings to be used.

As tape developed as a recording medium more and more types were produced. The BBC was recording more programmes than had been practicable in the days of disc recording, and began to search the market for the most suitable tape available. In choosing, it is necessary to compromise between signal/noise ratio, print-through, and maximum overload level and the BBC would not accept an improvement in one or two of these characteristics to the detriment of the other. In particular, because of the period for

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HF STATIONS AUTOMATE

External Service broadcasting is carried out from stations equipped with a number of high power h.f. transmitters and a much larger number of aerials, the latter being a function of the number and location of countries to be served.

Propagation conditions vary, according to the time of day, time of year, and with the sunspot cycle; consequently operating frequencies must be changed to suit prevailing conditions. To achieve the best utilisation of plant, a single transmitter may, during the course of a day, be required to serve several countries, and it will be subjected to several changes of frequency, aerial, aerial bearing, and programme feed.

Optimum utilisation of the lines carrying programmes between the studios and transmitters is accomplished by switching different programmes to the lines during the course of the day. This introduces a further complication, that is the need to "unscramble" the programmes to ensure that the transmitters are fed with the correct programme at the correct time. It is obvious that an h.f. station of this type will have a complex schedule of operations to execute; consequently there is pressure to automate stations as far as possible.

Practical constraints upon automation in the BBC

Programme and aerial switching on h.f. stations is already carried out by electro-mechanical switches so that remote control of these functions poses few problems. The transmitters, however, can be more difficult. The necessity for frequent (and often large) changes in carrier-frequency has, until very recently, rendered manual intervention mandatory. In the latest designs of h.f. transmitters, these changes can be achieved by remote control, although some designs still restrict variation to a fixed number of pre-set frequencies. The plant ranges from the latest continuously-variable (frequency-follow) transmitters, to some which are nearly forty years old, with the result that the degree of automation which is practicable to achieve varies from station to station.

The first UK station to be automated, Woofferton, includes six manually tunable transmitters within its complement. It is not practicable to modify or replace these transmitters, and it therefore follows that it is not possible to withdraw operational staff completely, and hence that there is little point in providing remote access to the system. Another station is being re-equipped with new transmitters and as a consequence, the possibility of remote access and intervention, e.g., from the studio-centre, has been incorporated in the system design.

System Philosophy

The BBC has decided in principle to automate as far as possible the operation of all four of its h.f. stations in the UK. As a consequence TCPD issued a detailed specification for a control system for the first station. The task of developing this was eventually given to Designs Department who, in competition with outside manufacturers, submitted a proposal which fulfilled the terms of the specification. The two Departments then established a team to undertake the design, development and implementation of the system.

It was decided that the system should be microprocessor based, and that it should employ distributed intelligence techniques - a modular concept, involving a number of identical and relatively simple microprocessor subsystems. The distributed approach, which ensures that even multiple faults are unlikely to result in a complete system failure, was felt to be preferable on grounds of reliability to that of the single central microprocessor or microcomputer.

The allocation of groups of functions to different units was thought to be another feature which would contribute to overall reliability by enabling certain units to automatically take over the important functions of faulty counterparts, even though in taking over these functions the unit might have to temporarily shed less important ones not necessary to the maintenance of the service. Operator communications should be by way of a standard keyboard and visual display system.

Implementation

It was decided that the first station to be fitted with an automated control system should be the ten-transmitter site at Woofferton. This station, which is fed by six programme lines, has six old transmitters which require manual control of carrier-frequency and tuning, and four new transmitters with remotely controllable pre-set frequencies and tuning. The output of each transmitter can be switched to any one of eight manually pre-selected aerial arrays. The total number of arrays is forty, of which four can be remotely slewed.

System Hardware

The microcomputers associated with each transmitter are termed "sender controllers". Each one contains the entire schedule for its transmitter in random access memory (RAM) and it is able to operate independently of the rest of the system. So any single fault on the control system will only normally affect one transmitter, at most. "Interface" equipment provides manual control facilities in the event of such a fault.

The sender controllers are joined by a communication network to two more microcomputers called "supervisors". Each supervisor holds the transmission schedule for the entire transmitting station, so the schedule for each transmitter is held in three places: the controlling supervisor, the back-up supervisor and the sender controller. These schedules are continuously compared with one another over the communications "hub" so that any memory corruption can be detected and the appropriate action can be taken.

Both of the supervisors are fitted with VDUs. One of them is used to display the current status of the station, together with a preview of the next scheduled event for each transmitter. The other VDU is used to display details of alarms, but is interchangeable with the first in the event of equipment failure. Alarm details are also printed for logging purposes.

An "intelligent VDU" is used for entering schedules, for storing them on floppy discs, and for down-loading them into supervisors and sender controllers. The intelligent VDU can also be used for manual control and interrogation of the system. Two equipments are supplied; the second can be used either on-line, as a hot-spare for the first, or off-line for schedule preparation.

Communication between the sender controllers, supervisors and VDUs is provided by serial, bidirectional data links that are effectively connected in parallel in the hub. With such a system it is necessary to ensure that only one device sends a message at any one time, and this is achieved by using a polling system which is under the control of the controlling supervisor. In the event of this supervisor developing a fault the second supervisor will automatically take control.

Software

The software for this system took about 4 man-years to write and the full assembly code listing, with comments, fills about 400 pages. The detailed logic is complex and, contrary to popular belief, it is not an easy matter to modify software in this sort of system without a thorough understanding of its operation.

"AUDIO TAPE"
Continued from Page 5

which recordings are kept, there is more concern about print-through in the BBC than other users have. A special test was devised, where pulsed tone is laid on the tape and it is stored for 72 hours after which the level of the print-through is measured. The figures obtained are often significantly different from those quoted by the manufacturers which are based on 24 hours storage.

In 1969 the BBC issued a specification for its first standard tape referred to as tape type 100. This was based on EMI 815. Supplies were available from EMI and Ilford (Zonal). It was a PVC based tape with a coercivitity of approximately 300 oersteds, but the PVC base was subject to pinholes which led to dropouts and frequent rejection. As an improvement the manufacturers changed to a polyester base which the BBC included in a type 101 specification but, probably because the operational use of the two tapes was the same, type 101 which rapidly superseded 100, has always been referred to as type 100. It has been the mainstay of BBC mono recording work from its introduction until early 1980, when because of the recession and rationalisations in the recording industry, supplies of unbacked tape ceased. Small quantities are still being reclaimed and some Local Radio Stations are still using it.

Towards the late 1960's the BBC was experimenting with stereophony and a search began for a tape for stereo work. A higher recording capability was needed for two track work and a physically stronger tape, less susceptible to edge damage. Stereo was accompanied by a PCM distribution system and UK-wide high quality broadcasting; 15kHz audio band-width was needed. By the start of formal stereo broadcasting in 1972, the BBC had adopted type 102, a backed tape, based on 3M's type 262, for stereo work. Each track was capable of a peak flux level of 600 nanoWebers (nWb) per metre and it was fully compatible with the full-track recording machines, producing a peak flux level of 400 nWb/m to a full-track head. As soon as type 102 was adopted a search began for a better stereo tape. Type 102 was able to match the capability of the recording machines, such as the Studer A62, available at the time, but it was clear that machines of a better performance were on their way. When the Studer A80 and Telefunken M15A came along they were capable of recording at a much higher flux level. Although many tapes were available, most gave improved performance at the expense of print-through as professional recording studios, mostly operating at 30 i.p.s. and then transferring to disc, are not so concerned about print-through. Agfa PEM 468 was found to be the best for BBC use, and based on it, a specification for type 200 was drawn up. It requires more bias flux than the older machines have been designed to supply, although A62's, B62's and some Nagras can be modified to meet its requirements.

The BBC uses the equivalent of two hundred thousand 2400 ft. reels of tape per year and during the last twelve months some 40% of the recording work has transferred to type 200, leaving External Broadcasting, Local Radio and News and Current Affairs on type 102. Type 200 gives the maximum advantage of 5dB signal-to-noise ratio that can be obtained from current developments in analogue tape machines and tapes, (4dB higher recording level and 1dB improvement in tape noise). It uses a peak recording flux level of 1012 nWb/m. Any further analogue improvements would only be possible using noise reduction techniques, which, with over 1000 machines in use would not be financially viable. There will be a progressive change to type 200 over the next few years as older recording machines only capable of using type 102 are replaced.

Economics and availability of supplies are likely to precipitate the next changes, rather than a search for improved recording quality, and in the interests of ensuring continued supplies of 102 and 200, the BBC has recently begun placing 3-year contracts for tape supply.

NEW HIGH POWER AMPLIFIER

The start of transmissions from Radio Northampton, one of the Corporation's most recent local radio stations, saw the first commissioning of a new, BBC-designed, 2 kW solid-state vhf Band II amplifier. This station, which involved constructing a new tower and transmitter building on a new site, was brought into service in less than a year and to meet this deadline Designs Department were required to complete the development and testing of the amplifier within this period.

The new amplifier is a state-of-the-art design, and provides about the highest power obtainable from transistor devices at vhf. The complete unit, which occupies a standard 19 inch bay, has shown an appreciable cost saving. Each unit is less than half the cost of the commercially available equivalent which is of foreign manufacture. Already more than twenty 2 kW amplifiers are on order, the bulk of which will be production models manufactured by Equipment Department. The next bays to be delivered are earmarked for use at new local radio transmitters for Radio Furness, Devon and Cornwall.

The 2 kW amplifier has been developed with several important features in mind, particularly efficiency, reliability and ease of maintenance. Reliability and maintenance are key points since low-power transmitter sites are largely unattended. The modular construction of the amplifiers allows rapid exchange for maintenance and the complete unit incorporates 8 pairs of push-pull transistors in its output stages. Only slight loss in output power occurs should one or even two of the active elements fail. The amplifiers are also broadband enabling spares holdings to be minimised with consequent further reductions in capital costs.

The 2 kW amplifier at Northampton feeds a mixed-polarisation transmitting aerial system which produces an effective radiated power of 4 kW (2 kW horizontal, 2 kW vertical). The transmitter serves Northampton, Corby, Kettering and Wellingborough to the north and east, and reaches as far as Brackley in the South West.

The use of mixed polarisation, now standard BBC practice for vhf, gives much improved reception for car radios and listeners with portable receivers using vertical rod aerials. Altogether several hundred of this design of vhf amplifier will be manufactured over the next few years and it will be a major element in the vhf transmitter refurbishment programme.

The new 2kW amplifier installed at Radio Northampton. The left hand bay contains the amplifier, the right hand bay contains the programme input equipment.

CLEARER PICTURE MONITORS

The subjective assessment of picture quality in studio centres is usually carried out using Grade 1 television monitors. Although there have been improvements in other areas of signal processing, monitors have, until now, remained static with only minor improvements to the electronic circuitry.

The delta-gun shadow mask tubes found until recently in conventional monitors have fairly good resolution, but in certain environments are not bright enough. To overcome this, a glass capable of high light transmission has been used for tube manufacture, and to obtain better contrast between the bright and dark parts of the picture, the gaps between phosphor dots have been coated with carbon - the so-called "black matrix". The carbon is exceptionally difficult to work with and this construction can cause a "dirty window" effect where the carbon is uneven. The convergence for these shadow mask tubes is via large electromagnets placed around the neck of the tube. Anyone who has tried to reconverge a monitor will know that this is a difficult and time-consuming adjustment.

In the early 1970's the tube manufacturers produced a brighter tube known as the PIL. The domestic 'Precision-In-Line' tube uses a slotted mask and an in-line gun, and a black matrix which is easier to lay down when slots are used rather than holes. Convergence is provided by fixed magnets outside the tube, and the tube looks brighter both because the beam currents can be larger since less current is intercepted by the shadow mask, and the area of phosphors is larger. This type of tube is fine for domestic television receivers, and because there are no convergence adjustments or circuitry, the number of service calls is reduced to a minimum. Unfortunately, the professional viewing monitor could not use PIL slotted mask tubes because the height of the slots takes up too many picture elements. This reduces the number of visible picture elements, with a consequential loss in resolution. Although it is possible to move the slots closer and closer together, the vertical aperture is still quite large in relation to the picture element, and light output is reduced.

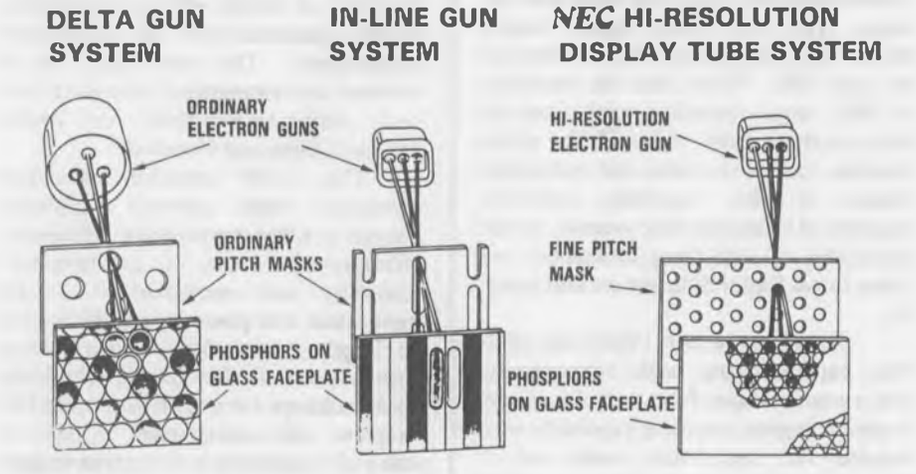
Unpleasant patterning can also be produced due to interference between the slots and detail in the picture. This is exploited in some domestic receivers to produce a 'sharper' picture.

The BBC, in common with other broadcasters in this country, has managed (until recently) to maintain a constant supply of monitors by purchasing tubes of a type primarily intended for data display with computers. Now even these sources have begun to show signs of drying up.

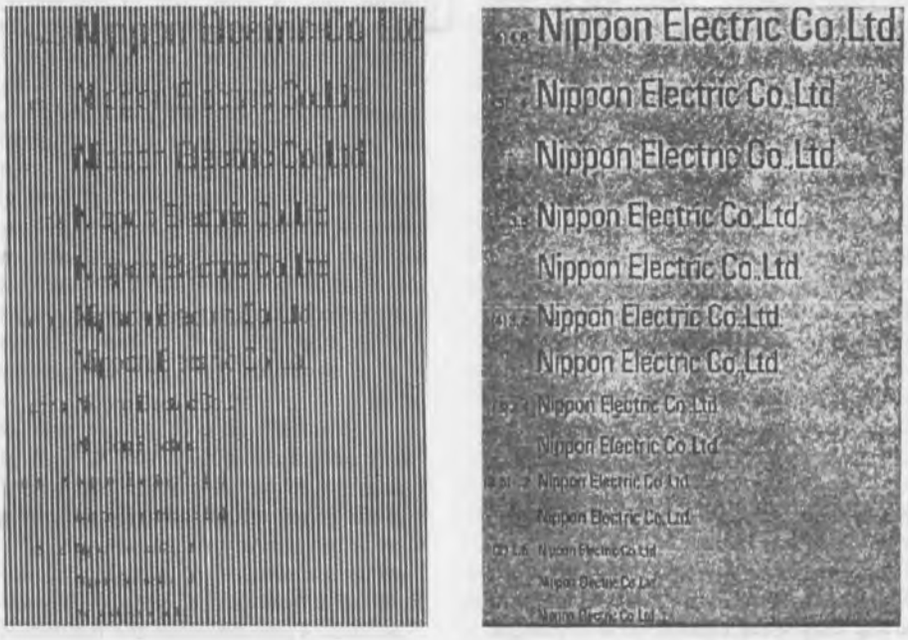
Japanese firms have been working on the problem, and have produced a dot phosphor PIL gunned tube. From the front the tube closely resembles a delta-gun tube, as the phosphor dots form a similar style matrix. However, the guns are in line and the dots are scanned in line. As a result the interior of the monitor is noticeably simplified. In common with PIL slotted mask tubes the convergence is performed by permanent magnets glued to the neck of the tube; therefore, there are no coils to adjust and the picture display provides high resolution.

For any improvement there is always a price to pay, and in this case the new monitors are more susceptible to stray magnetic fields than the earlier delta-gun variety. Care needs to be taken to ensure that stray magnetic fields from loudspeakers or steel monitor stacks do not affect the purity of the monitor. Operationally the monitors are no different from earlier generations, but may take longer to warm up.

The first of the new monitors, manufactured by Melford, has been installed in Bristol, and others, manufactured by Melford and EV, are shortly to be installed in Southampton and Plymouth. Mike Cox, an SCPD engineer with specialist responsibility for monitors said, "The new generation of monitors should be operationally more convenient to use than earlier generations, with higher reliability. However, we should take care to make sure that stray magnetic fields do not upset the purity of the monitors."



Photos: NEC Ltd.



New high resolution display tubes for grade 1 monitors provide better quality pictures. Left: a PIL tube display. Right: the new high resolution tube display.

CARDIFF GETS TWO NEW CONTINUITIES

BBC Wales has recently put the first two new continuity suites into service for Radio Wales and Radio Cymru. A third continuity suite is being installed at present and is expected to be completed by the end of the year. It will be used mainly by Radio Wales, the English language service; but will also be used as a standby continuity production studio, in which mode it will provide backup support for the two radio services which are in operation for periods of eighteen hours each day. All three studios will be interchangeable.

Each suite offers a production studio with associated self-operated desk, and a network control cubicle. Both the studio desk and the cubicle desk have been designed within the BBC. The main mixer programme chain and control circuits, as well as the compressor/limiters in the cubicle desk, were under the control of David Smart of Designs Department while the desk frameworks, programme monitoring, transmission/rehearsal routing, telephone outside source prehear and talkback were designed and installed by SCPD.

Peter Eves, the SCPD Project Engineer, says "Comprehensive facilities were included to give BBC Wales greater flexibility of operation. In the course of planning, we had a great deal of co-operation with Audio Unit in Wales, through Dave McCarthy, Assistant Operations."

Although each continuity cubicle would normally control a single network, the cubicle desk is the first to be designed to be capable of driving two networks simultaneously, when required. This has been achieved by having two outputs of equal status, although they are nominally entitled 'Main' and 'Sub'. Equal status means that they each have all the facilities available and are interchangeable.

The cubicle and production desk each have five groups followed by a main output unit and network switching facilities. With two complete suites, these can provide feeds to up to four networks although only two are used at present. The desks will accept up to six microphone inputs, six studio reproduction and six cubicle reproduction sources, up to 50 stereo 'outside sources' (selectable to five stereo channels) and six mono 'outside sources'. Four of the mono sources are tied to telephone control balance units for 'phone-in' programmes. The 'outside sources' available to the desk include a number of unattended studios covering a wide geographical spread throughout Wales, and three PCM (pulse code modulation) link circuits from London. All the inputs are routable to either of the two output channels, 'Main' and 'Sub' through the group module, each having a stereo compressor/limiter associated with it.

Dave McCarthy seated at the Radio Cymru desk, with left to right Peter Eves, SCPD, John Meredith, Cardiff, and Dave Lawson, SCPD.

In addition, fourteen sustaining network sources can be fed to the outputs through a network fader. This facility allows the BBC's other National Radio networks, regional opt-outs and local programmes to be broadcast as required.

An important feature of the 'self-op' desk is that the audio is not routed to the fader but each fader varies a d.c. level which in turn controls the output of Voltage Controlled Amplifiers (VCA's). The audio being d.c. controlled in this way gives several advantages. Removing the faders from the audio path reduces noise. Further, the audio can be controlled from positions on either desk (although the cubicle maintains overriding control) and this gives it the widest operational flexibility. The 'grams' and cartridge machines outputs are d.c. controlled as well, and in general the use of VCA's offers the additional advantage that the supervisor can pre-hear the studio before the studio fader. This is especially useful when the studio is being self-operated by an inexperienced contributor.

Comprehensive pre-hear and monitoring facilities allow programme rehearsal and recording to take place even when the Continuity is providing a sustaining network to the transmitters. Then, still with high quality in mind, the desks have been designed so that all the push buttons operate electronic switching. This reduces the possibility of clicks when they are operated.

Each cubicle is equipped with five Studer A80 tape machines, a Revox B710 cassette machine, two BBC-designed RP2/10 disc players, one ITT record cartridge machine and two bays with a tape control panel and four telephone balance units for 'phone-in' programmes. Three ITT replay cartridge machines and three EMT 950 disc machines complement each studio desk.

The studios are the first BBC continuity areas to be fully equipped with the EMT 950 turntables. They have the advantage for continuity working that the announcer can listen to and time the introduction and then runback and re-cue it automatically. The machine's counter automatically sets itself to zero when the operator sets it to 'Start'.

Another new feature in the studio is a microphone bridge mounted on the 'self-op' desk. This has been especially designed by Trevor Lofty of SCPD so that its resilient mounting effectively decouples it from the desk - always a source of unwanted noise from bumps and tapping fingers.

* * *

COLOUR TRAINING PACKAGED

Students at Wood Norton learn fundamental colour principles using packaged–learning techniques.

ETD have recently produced a revolutionary method for training students in the fundamentals of television engineering. Based on the "packaged-learning" concept, the student works at his or her own pace using purpose-designed demonstration equipment, supported by specially written learning texts. Packaged learning has been a feature of Engineering Training for some time, but because of the high cost of broadcast television equipment, it has not been possible to teach television fundamentals in this way until now.

The overall package covers the fundamentals of television engineering. Scanning is covered first, together with synchronisation and interlace. Picture signal processing is covered next including clamping and gamma correction. The associated equipment allows the student to demonstrate many of the aspects covered in the text. The waveforms are displayed on an oscilloscope, where 'before' and 'after' comparisons are possible. In addition, by means of a split screen switch, the equivalent picture comparison can be displayed on a small black and white monitor. It takes the average student about 2 days to master the basic fundamentals, and then to move on to the second aspect, colorimetry.

The colorimetry section deals with the principles of colour vision and the simulation of spectral colours using additive mixing techniques. The separation of a scene into its red, green and blue components is considered and the analysis required of a camera determined. In addition to the literature a VHS format cassette tape is used, together with simple colour vision experiments. The section concludes with an investigation into the signals required to convey the colour television information. About a day is taken by the students to cover this section.

The third and final section of the package describes the coding and decoding of the colour television signal, with specific reference to PAL system I. In addition to the text this section is supported by its own demonstration equipment.

The colour fundamentals demonstration equipment provides for the generation of Red, Green and Blue (RGB) components and thus allows the student to build up a conventional colour bar waveform from its constituent parts. Facilities are provided to allow students to matrix, code and decode PAL, PAL-D, and NTSC signals. The original RGB signal together with its coded and decoded counterpart is displayed on an oscilloscope and split-screen colour monitor. Phase changes can be introduced to the signal in both PAL and NTSC modes, and the results displayed. By changing the mode of the 'scope it is also possible to display the waveform vectorially. This section takes about 2 days to complete by the average student.

The total package comes in three parts: i) the basic television principles equipment ii) the colour fundamentals demonstration equipment iii) the support literature and video cassette tape. Each part is easily identified, but is not necessarily self-supporting. For example, the literature requires the appropriate equipment for the student to work with.

SOME FIRSTS FOR LIME GROVE

Some time ago Studio D at Lime Grove came back into service after a major refurbishment scheme by SCPD. The studio, which now boasts a complement of five Link 110 cameras, can claim some notable engineering firsts. It is the first studio to use a new generation of more versatile vision mixers, first with comprehensive signal routing matrices and the first studio anywhere to have its vision circuitry wired with newly-developed miniature coaxial cable.

The 24-channel vision mixer was made to BBC specification by the Grass Valley Group. The extended number of channels compared with previous designs of mixers currently in use means that each signal source can now be assigned its own mixing channel rather than have sources sharing channels, the present bugbear of many a complex television production.

Another aspect is that complicated special effects are more easily achieved with the mixer. Source selection is arranged in seven banks of 24 buttons and signals can be routed between the selection banks whilst building up, in stages, quite ambitious visual effects. A greater variety of wipe patterns is available and a memory system will hold up to 20 effects and transitions between sources. Additionally, a Quantel 5001 Digital Video Effects unit has been installed to process vision signals for an entire new range of effects.

A complex production also demands versatile source selection for monitors and this is provided in the studio by a "PRO-BEL" 40-by-40, hard-wired, solid-state matrix. The control system for this was further developed by the BBC to make source selection as comprehensive as possible within the limits of the system.

Finally, the miniature coaxial video cabling in the studio was developed to conform to an Equipment Department specification. Using it in the confined spaces of equipment bays was a boon since its smaller diameter reduced packing density and enabled tighter bends to be made. In a colour video installation this has an extra advantage since, to avoid colour phase errors, cable must be cut to specified lengths and this necessitates accommodating timing correction loops in the wiring looms.

The major SCPD contributor to the scheme was Television Studio Unit with John Pollard as Project Leader and Win Carnall leading the vision team.

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