ENG INF

WINTER 1989/90 No. 39

CWR ON TARGET FOR JANUARY 17

As we went to press, Coventry and Warwickshire Radio — the BBC's thirty-sixth local radio station — was set to open officially on the 17th January. To be known as *BBC CWR*, it is based on a main studio complex in Coventry and supplementary studios in Leamington Spa, Atherstone, Nuneaton, Rugby, Stratford-on-Avon and Warwick, among other places.

Two FM transmitters have been provided — at Lark Stoke and Meriden — bringing around one million people within range of the station's output. However this is the first new BBC local station to open without any MF transmitters — in line with current Home Office policy.

CWR will offer Coventry and Warwickshire eighteen hours of new programmes each day and, according to Manager, Mike Marsh, it will be "a station more local, more in tune with the area than any other. BBC CWR cares for Coventry and works for Warwickshire."

The Coventry facilities include a general-purpose studio, two cubicles, a phone-in booth and a News & Current Affairs studio. There is also a comprehensively-equipped newsroom.

A special feature on CWR's technical facilities begins on page 3.

CWR in full swing for Children in Need on 17th November. The station went on air for twenty-four hours and received £143,397 in donations and pledges. It's back to test transmissions now, until the official opening on 17th January.

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Looking back over 1989, we received a good mixture of informative, educational and entertaining articles from across the Directorates. So very many thanks to all those who sent in material for publication last year.

If you wish to contribute to the next issue, please inform us of your intentions as soon as possible: each issue of Eng Inf has space for only a limited number of articles. Your completed text should reach us by 23 February, at the latest.

Very best wishes for 1990 to all our readers.

Mike Meyer

TRANSMITTER NEWS

The following services opened between 17 September and 12 December:

Television

Blackwaterfoot	Isle of Arran
Bovey Tracey	Devon
Cwm Twrch	West Glamorgan
Ebbw Vale	South Gwent
Gronant	Clwyd
Harborne	Birmingham
Kensal Town	London
Lindores	Fife
Muddiford	Devon

Local Radio

On 29 September, a new FM transmitter for Radio Leicester opened at Copt Oak, 13 km north-west of Leicester city centre. And on 3 December, Radio Derby began broadcasting in stereo from its FM transmitters at Derby, Stanton Moor and Sutton Coldfield.

'ENGINEERING INFORMATION'

Following the re-launch of Ceefax in late November, EID's 'Engineering Information' page has now been transferred from 297 (BBC2) to Page 698 (both BBC1 and BBC2).

LICENCE AGREEMENTS

The following licence agreements have been signed since the last edition of Eng Inf was published:

RE Instruments Ltd of Finchamstead has taken out a licence for the range of Mk II Nicam-3 digital audio transmission equipment. This comprises a Coder (CD2L/41) and Decoder (CD3L/58), each of which handles six channels of audio in a 2048 kbit/s digital bitstream, and rack-mounting systems to expand these to 12-channel systems (either Coder, Decoder or Codec). Also, the company has licensed the GE4P/9 Nicam Test Generator to support the transmission equipment. In addition, RE has signed an agreement for the OB Multiplex Transceiver, EP2P/9, which allows a number of telephony/control channels and/or music-quality signals to be transmitted down a single 15 kHz twisted-pair bearer.

Another licence agreement has been signed by **Eddystone Radio**, to expand the range of BBC-designed equipment they can produce. The items this time round are the RC1/12A Band II Receiver (which incorporates an integral stereo decoder), the AM7/12 and AM7/13&A Audio Amplifiers, and the PA9/29 Mains Distribution Panel.

A pair of low-cost Video Monitoring D-A Converters, CO9M/513 and CO9M/514, have been taken up by **Viewtronics Ltd**. of Woking. These units (formerly coded CO9M/513 A & B) take in a feed of CCIR Rec 656 parallel digital video, and provide an output of either monochrome or colour video respectively. It is anticipated that they will be used as part of a wired video distribution system, to save the expense of re-equipping vision areas with picture monitors that have dedicated digital video inputs.

Finally, an existing agreement with **Varian TVT Ltd**. of Cambridge, dating from 1984 and concerning Two-Channel Sound-In-Syncs equipment, has been amended. This will allow them to extend their current range of 2C-SIS equipment to operate at 728 kbit/s, as well as the present data rate of 676 kbit/s. Thus, the use of this equipment as part of a Nicam-728 terrestrial stereo TV transmission chain will be simplified.

As usual, please contact the D&ED Liaison Engineer, Peter Jefferson, on Avenue House extension 375, for further details of these or other licence agreements.

LICENSED EQUIPMENT CODES

Some problems have come to light regarding BBC licensed designs — the equipment has been modified by the manufacturer (electronically and/or mechanically), even though it still carries the original BBC unit code. A recent example was a piece of equipment which had been repackaged in a 3U rack, unknown to the BBC engineer concerned who rightly had expected it to occupy a height of 4U.

This can happen quite legitimately as, until recently, the BBC placed no restrictions on licensees in how they refer to the equipment. If the manufacturer decides to modify the equipment — which he is entitled to do within certain guidelines — and continues to call it by the BBC code, then a purchaser has no means of knowing implicitly of the modification.

D&ED has now added a new clause to all licence agreements struck since last October. It requires that, if a licensee wants to continue to use the BBC unit code on his equipment, he must add '/A' immediately before the oblique stroke in the BBC code. Thus, if the equipment code is, for example, RC3/15, then the licensee would refer to it as RC3/A/15.

Although this condition is now part of new agreements, it is not possible to impose such a condition, retrospectively, on older licences. The manufacturers concerned have been asked to conform to the new coding, wherever possible, but whether they do is entirely a matter for them.

A very small percentage of licensed equipment will not be affected by this change. These are units which will only ever be made precisely to the BBC specification, because of some feature of their design and/or performance. One typical example is loudspeakers, which will continue to be referred to as LS3/5A, LS5/9, etc.

Peter Jefferson
Liaison Engineer, D&ED

CWR — special feature

CWR is our thirty-sixth local radio station, serving around one million listeners in Coventry and Warwickshire. In this special feature, Nick Sharwood-Smith describes the main studio centre in Coventry, which has been based on Mark IV equipment, while Ken Turner and Phil Osborne respectively describe CWR's communications and transmission facilities.

The Studio Centre

Mark IV local radio equipment resulted from competitive tendering to industry, based on an operational specification produced by Radio Projects. A contract was subsequently placed with Audix Ltd for the production of three sets of Mk IV desks and the first of these was installed at BBC Hereford and Worcester, which opened early in 1989. The second was fitted as part of the refurbishment at BBC Radio Derby and the third has just been installed at CWR.

The complete tender for Mark IV also included an apparatus room, news studio (NPA) and general office facilities, such as ringmain and public address system. Unlike contracts for individual mixers or studios, the Mk IV installation aims to provide the basis of a complete radio station using a single technical contractor.

The operational areas at CWR have been built in the local radio 'in-line' format, as shown in the diagram below. This provides good sightlines between the four main areas and allows flexibility in producing operator-driven or presenter-driven programmes using either:

— a single cubicle

— both cubicles

— a cubicle and studio

— a cubicle and phone-in booth.

At CWR this format is further enhanced by the extension of visual communication towards the reception area in one direction and towards the NCA studio in the other.

The Cubicles

The two cubicles are the main operational areas, each having the ability to take executive control of the transmitter chain. They contain an Audix 27-channel control desk, reproduction machines for R-DAT (Sony DTC 1000), ¼-inch tape (Studer A807), carts (Sonifex), CDs, grams (both Technics), and cassettes (Denon).

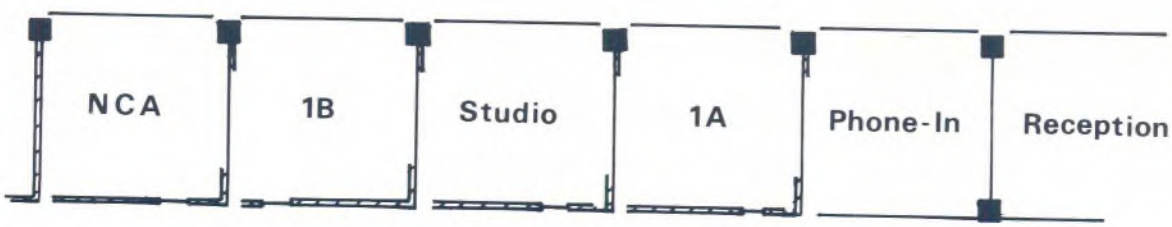
Breakfast Show presenter, Neil Pringle, at the Studio 1 desk

The desks have access to permanent music lines from CWR's fifteen outside studios, together with temporary lines from OBs. The addition of phone-in lines, on telephone balance units, gives a total of thirty-three possible selections to any of six outside source (OS) channels. A pre-fade-listen (PFL) mix loudspeaker allows multiple incoming sources to be monitored simultaneously for sports and local election programmes; opening any mic fader automatically cuts this PFL loudspeaker.

Three Beyer M201 microphones are provided for the presenter(s) and guest(s), each with its own dedicated channel. There are also three channels for studio microphones, which take their feeds from three splitter transformers mounted in the studio wallbox. This arrangement has the advantage that the microphones can be used for working to either cubicle, without the need for replugging.

The desks have no equalisation but there are independent voice-over chains, driven by the mic channels, which offer voice-over control of the repro and outside sources.

The control system for the radio cars is integral to the desk and provides for talkback to the mobiles, from vhf base stations in either Coventry or Leamington Spa. Broadcasts from the OB van or news cars will normally be via a wideband uhf link; provision exists however for the vhf talkback channel to be used, in emergency cases. In this instance, an interlock prevents local talkback from being routed out to the transmitters via the desk.



The in-line studio layout at CWR

— SPECIAL FEATURE ON CWR —

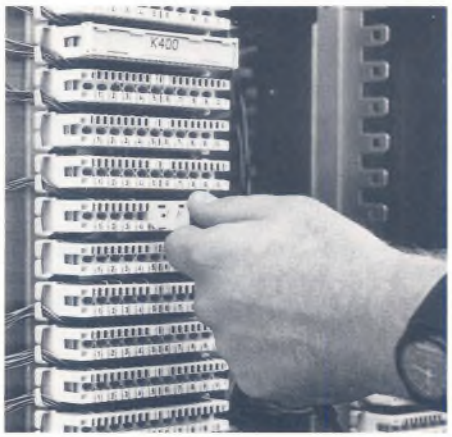
One channel on the desk is designated for RBS (rebroadcast) use and has vhf feeds of the four national networks, as well as regional sustaining services (incoming on lines LDS1 and LDS2). Locally-selected repro sources can also be sent to the transmitters — independently of the desk — using the TAPE Direct-To-Transmitter selection. This allows an operator to feed a prerecorded programme to air, from any of six tape sources, whilst simultaneously carrying out dubbing or editing duties via the desk.

Separate monitoring is provided for the presenters and the guests, each having a push-button selector bank. Due to the nature of self-operate work, much of the aural monitoring is done on headphones but a pair of LS3/5As is provided for quality checking. Four stereo PPMs monitor prefade, desk A&B, desk M&S and station output, respectively.

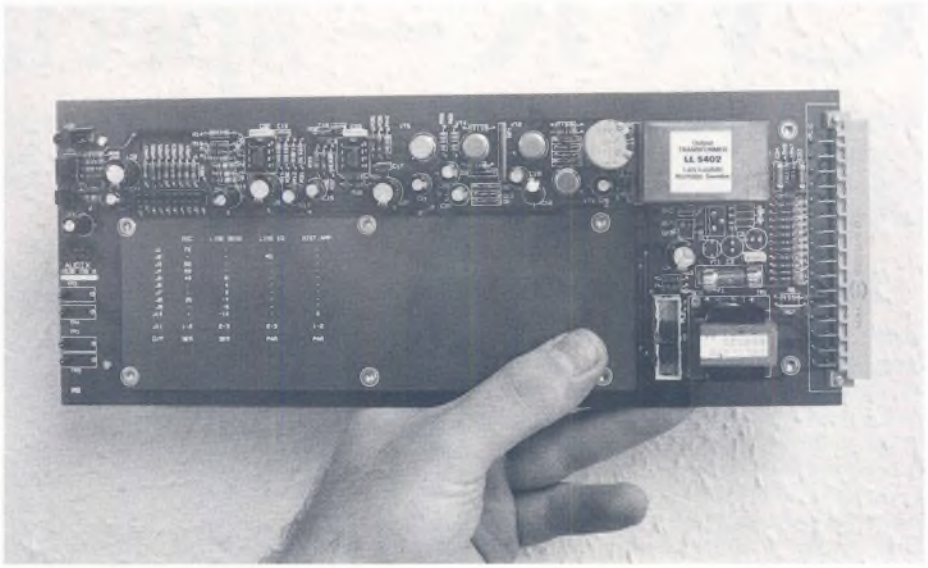
An intercom system, based on the Philips M100, gives communication between the cubicles and other production areas. Due to the slight delay inherent in establishing a call using the Philips unit, an alternative technical talkback system is also available, to give instant communication between the cubicles, studio and phone-in booth. Three miscellaneous destinations are included on this system to allow for expansion.

The Phone-in Booth

This area is primarily for the control of phone-in programmes but it can also be used for the production of any items needing good internal and external communications. There are no audio sources in the booth but the following facilities have been provided: audio and video tielines; radio car talkback; talkback to the cubicles and studio; audio ring-main, and intercom.



A Krone Frame in CWR's apparatus room. These carry all the audio and signalling circuits, having replaced the older (hard-wired) tag-block type of system. Headphones and breakjacks can readily be inserted into (and removed from) a Krone Frame, using a special tool, making it extremely versatile.



An Audix multi-purpose board at CWR. The common board design can be configured as a Mic, Line Send, Line Receive or Distribution Amp, simply by changing jumper leads.

The video tielines are routed to the apparatus room where video distribution amplifiers feed monitors in the cubicles and studio. This allows a BBC computer to be used to feed visual information on callers to the presenter (ie, visual talkback).

Two answering units for the Telecaster phone-in system can be used here. The Telecaster is a system for broadcast use developed by Austin Taylor from their Sprite key-and-lamp unit. The hardware is identical in each case, but with colour variations used on the keypads to simplify operational recognition. Software changes have been made to allow the nomination of different parts as either answering units or routeing units.

Answering units are used to pick up incoming calls, originate outgoing calls and to place calls on hold. Routeing units can put incoming calls directly to a telebalance unit, but more often take calls from 'hold' and send them to the desk following screening by a production assistant. A routeing unit is mounted at the top of the desk script space in each cubicle, allowing calls to be sent to any one of six telebalance units. Each cubicle is additionally equipped with an answering unit to enable outgoing calls to be made.

A hand-held programmer, plugged into the main processor, is used to carry out the initial configuration of the system and this makes local alterations simple to implement.

The Studio

This area is primarily used for interviews and other discussion programmes which need to be operator-driven, or involve more people than can be comfortably accommodated in the cubicles. The studio can also be used as an additional production area, having talkback, intercom, video and audio tielines and two Telecaster answering units.

The loudspeaker and headphone feeds to the studio can be switched between either cubicle as desired. An amber switch on the wallbox is used for this purpose, while repeater lamps have been fitted to the wall on either side of the studio to give a visual indication of the switch status.

The News Studio and Newsroom

The news studio contains a small nine channel mixer with carts, tapes and microphone, designed to allow bulletins to be compiled and presented by the news staff. A second microphone allows interviews and reports to be recorded or inserted live into the news.

A single channel carries the same selection of outside sources as the larger desks in the cubicles, while an adjacent channel gives access to all vhf and uhf radio car sources. A talkback selector for communication to the mobiles is integral to the desk, as is an intercom unit.

In the newsroom, located on the first floor, a similar radio car talkback unit is provided for the use of the bulletin editor. Additionally, an OS selector enables monitoring of studios, OBs or other incoming line feeds. Audio ring-main is available at every desk in this area while the news secretary's desk has been provided with video tielines to the studio and cubicles. These allow news input direct to the presenter(s), via the visual talkback system without the need to generate hard copy.

— SPECIAL FEATURE ON CWR —

The Apparatus Room

The apparatus room contains amplifiers for audio, video and rf distribution, mono derivation and all the incoming and outgoing line equipment. Jackfields for monitoring and fault-finding allow access to all parts of the broadcast chain in the station. There are also comprehensive communications facilities for engineering use in setting up OBs.

Of particular interest in the Mk IV apparatus room is the absence of any BBC-designed equipment, apart from the rebroadcast receivers — all items were either manufactured or bought in by the contractor.

This particular Mark IV project was led by my colleague, Nigel Fry, and we jointly wish CWR every success in providing a strong BBC presence in their editorial area of Coventry and Warwickshire.

Nick Sharwood-Smith
Project Leader, Mk IV Scheme
Radio Projects, English Regions

Communications facilities

CWR has been provided with a typical set of Local Radio broadcast circuits. These fall into three distinct groups:

Local Contribution Circuits

Network Circuits

Transmitter Feeds

Local contribution circuits to the Coventry Studios have been provided from: radio car receiver-sites at Coventry and Leamington Spa; outside studios including Warwick University, Stratford RSC, and the Royal Showground at Stoneleigh; and OB sites such as the local Police traffic control and Coventry City football ground. Local 'ends' from British Telecom's exchange in Coventry are also available, for use with occasionally-booked main circuits.

CWR is connected with the rest of the BBC through the sustaining feed (DLR) and via programme-sharing lines to and from Radio WM. The latter forms part of the Midnet system. There is also a News and Current Affairs circuit to Birmingham Comms Centre, which enables news items to be fed to London for use nationally.

The transmission facilities for CWR are provided by two FM transmitters — sited at Meriden in the north and Lark Stoke in the south of the county. At both transmitters, the main feed is via a 15 kHz stereo circuit (EPS 84), routed on digital bearers, while a separately-routed 10kHz mono circuit (EPS 82) is rented as a reserve.

The EPS 84 stereo circuits were fully-equipped by BT but the final equalisation of mono circuits was carried out by BBC staff, supervised by Mike Day, BSE Midlands.

Planning of the engineering requirements and co-ordination of BT work was carried out by the Lines Unit of Broadcast Comms Section, TED.

Ken Turner
Project Leader
Broadcast Comms Section, TED

Transmission facilities

The incoming stereo feed is applied to a pair of ganged, variable pre-emphasis, limiters; these progressively reduce the limiting threshold, as the audio frequency rises. A standard flat limiter would cause over-deviation of the carrier at high audio frequencies, as a result of the pre-emphasis applied during the next stage of the transmitter chain — coding.

The coder produces a stereo multiplex signal conforming to the Zenith-GE system, with the addition of Radio Data (RDS) signals on a 57kHz subcarrier. The radio data signal is produced by an assembler and modulator, which provides static information about service name, frequency and time. The time signal is taken from an onboard real-time clock which is synchronised to the off-air Rugby time signal.

Drives and amplifiers

Stereo multiplex from the coder is fed to the main drive where it is modulated onto a 10.7 MHz i.f. before being mixed with a crystal-controlled oscillator to yield the final frequency (94.8 MHz for Meriden and 103.7 for Lark Stoke). This arrangement ensures linear and constant deviation from the modulator, irrespective of the final carrier frequency. The r.f. is then amplified by a wideband solid-state drive stage, producing an output of 15 watts.

A reserve drive is also available, fed with mono programme via a dedicated variable pre-emphasis limiter and a line equaliser/amplifier.

R.F. output from the main and reserve drives is fed to the amplifier via a co-axial change-over switch. The latter is controlled by a system control unit (SCU) which monitors the status of incoming programme sources, drive power, frequency and modulation. The SCU also passes information about the transmitter's status to a fault reporter, which signals any faults to the monitoring centre at Sutton Coldfield.

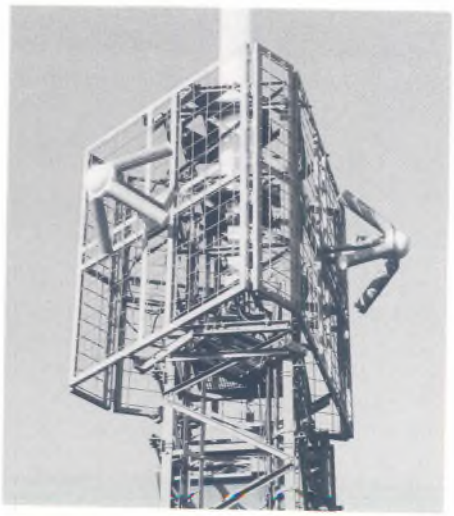
The selected drive feeds a D&ED-designed 1 kW solid-state amplifier (AM14/54A), manufactured under licence by Eddystone Radio Ltd. The amplifier consists of eight push-pull bi-polar transistor stages operating in parallel, each with its own power supply. This arrangement offers high reliability — failure of any one stage making little difference to the service coverage.

Aerials

The output of the amplifier is fed to a tier of three mixed-polarised aerial panels, supplied by Marconi Communication Systems Ltd. These panels are fed with unequal amplitudes and phases, in order to give the required radiation patterns. Each panel comprises a pair of halfwave dipoles, mounted at 90° to each other, in front of a reflecting screen.

To produce equal fields in both the vertically- and horizontally-polarised planes, the dipoles are oriented at 45° to the horizontal. And to achieve optimum beam-width, the dipoles are angled backwards towards the reflecting screen.

Phil Osborne
Project Leader
Transmitter Section, TED



The CWR transmitting aerials at Lark Stoke

TELEVISION CENTRE — new music studio

An important ingredient of many successful tv programmes is *music*, which is often specially-commissioned and recorded for the purpose. In the sixties, the TV service introduced its own dedicated music recording studio at Lime Grove in west London. It occupied what was formerly Studio H — the home of the original 'Tonight' programme, among others.

In more recent times, there has been a desire to centralise as many television resources as possible at Television Centre. Thus, at an early stage of planning the new Stage 5 complex, it was decided that a new music studio should be provided. Now called 'The Music Studio', it entered operational service on July 15th, 1989, and can accommodate up to forty musicians.

It is the first completely new studio facility of its type to be built by the BBC for a number of years. Its design and construction was achieved through the close cooperation of a number of BBC departments, principally ACED and P&ID Tel, with considerable assistance on the acoustic design from Sound Section at Research Department.

The Music Studio is on the ground floor of the Stage V block, with convenient pedestrian access at the front of the building. At the rear, there is vehicular access from the scenery roadway, which permits easy access for heavy items of equipment and instruments, such as grand pianos.

The Studio

The studio itself comprises a main room (17 x 8.5m) together with an isolation room (6.5 x 5m), both of which are viewed through triple-glazed windows from the large and extensively equipped control room. The whole of this area is a floating 'box in box' arrangement, designed to give good isolation from the surrounding building as well as between the rooms themselves. The remainder of the suite consists of an equipment store, local maintenance room and an artists 'green room' for relaxation, etc.

When considering the requirements of the new studio, the users — Television Studio Operations Sound Department — wanted the studio to be a modern, flexible and comfortable environment, in which musicians would enjoy working. The design should also provide sufficient control of the acoustics, such that a very wide range of musical material could be handled with ease.

The method chosen uses hinged acoustic wall panels (one side hard and reflective, the other soft and absorbent) as successfully installed in the Christchurch radio drama studio at Bristol. The provision of an absorbent canopy across one end of the main studio enables the control of loud drum kits and guitars, as a further aid to successful recording.

To relieve the stress of long periods of concentration for musicians, it was decided to finish the studio with natural materials such as wood and fabric. An attractive, light oak, parquet floor has been laid while wooden features around the studio include covers to ventilation ducts and technical trunking. Furthermore, two lighting arrangements have been provided — a high-key bright and functional style, and a low-light arrangement using spotlights on suspended tracks.

With the adjustable acoustics mentioned before, it is now possible to vary the reverberation time in the main room between approximately 0.6 and 1.0s, with good dispersion across a wide frequency range. The smaller isolation room is less reverberant, at just over 0.3s.

The Control Room

The main technical equipment from Lime Grove has been transferred to the new music studio, as it was less than five years old. It comprises a Neve 48-channel mixing console with 'Nicam 96' automation; two 24-track Studer A800 tape machines; two Studer A820 ¼-inch mastering machines, and a comprehensive selection of 'out-board' equipment. This now includes digital reverberation, delay units, samplers, and other effects devices.

During the move, the opportunity was taken to modify and enhance some of the

The new Music Studio (left) and its Control Room (right)

facilities. For example, as part of the new installation, comprehensive facilities have been provided around the studio and control room to handle MIDI signals. Also a new headphone monitoring system, complete with high sound-level warning lights, has been provided for use by musicians. The transfer and installation of equipment was undertaken in seven weeks, by contractors working to P&ID Tel.

Following an earlier assessment, it was decided that a change of monitoring loudspeaker would be undertaken at the time of the move. The three original LS5/8s have thus been replaced by three new ATC 100As, from Loudspeaker Technology Limited. Their improved If performance over the LS5/8s, coupled with their ability to offer a higher SPL (sound pressure level) in that range, is much appreciated by the users.

It remains now to thank all those staff in P&ID Tel and ACED who co-ordinated the efforts of the many contractors involved in the project. This new venture has got off to a very successful start and is already beginning to achieve delighted reactions from producers and musicians alike.

Jeff Baker, H.Tel.Sound
and
Wynne Griffiths, P&ID Tel

D&ED — Open Days report

D&ED held its 1989 Open Days last October, in conjunction with the annual EsIC Conference in London. Around 260 people attended over the three days, with a roughly even split between BBC and external visitors. This brief report illustrates the wide variety of designs which were on display.

DESIGN GROUP

Video

Among the new designs were: a pair of video generators, producing SPLUGE and SWARF; a pair of low-cost DACs which allow picture content monitoring of digital video signals (CCIR Rec 656), on monochrome or colour sets, and a versatile digital wipe-pattern generator.

The digital vision mixer is now complemented by a fully-featured CSO (Chromakey) unit. A quantity of these have been produced as an add-on facility for some of the digital mixers already in use within the BBC. The complete mixer/CSO system is also available under licence from Vistek.

A data decoder will shortly be available for use with the single-line ITS waveform. This will allow the time-critical elements of the old ICE signal to be replaced by the new data signal. The remaining parts of ICE, such as Presfax and Apology data, will be conveyed using Datacast signals.

Audio

One of the new projects in this area is the development of an application specific integrated circuit (ASIC), to facilitate interconnection with the AES/EBU interface standard. This device ic called AESIC and is described in the special feature on digital broadcasting, which starts on page 17.

Another new item on show was an add-on module which will automatically switch on Schools radio/cassette recorders, when triggered by a tone burst at the start of the programme: up to three such recordings a day may be made. The tones are similar to those heard when using a modern push-button telephone, and up to nine programme 'labels' are available.

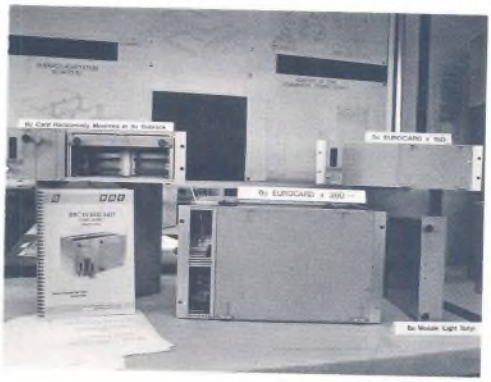
Radio Frequency

A new generation of Band II relay equipment is being developed. Known affectionately as TARDIS, this 2m high bay of equipment can house up to eight independent FM transposer channels. Each of these has a maximum r.f. output power of 25 Watts and can be tuned over the entire 87.5 — 108 MHz frequency range.

With the advent of Radio 5, Schools programmes will be broadcast on MF rather than FM. Many schools have FM-only receivers so a low-cost converter has been developed which can be added to existing equipment, as a front-end. It remodulates the incoming AM signal into an FM signal which can be received in the normal way by the school's receiver.

Control

Over the last year, much effort in this section has been directed towards the Q2 and Leopard lighting control systems. These are described in greater detail by David King on page 14.



Part of the Eurocard display at Avenue House

SUPPORT GROUP

The Laboratory staged an exhibition of current and historic microphones while the Listening Room offered practical demonstrations to compare different loudspeakers and amplifiers.

Standards Section displayed some examples from the Eurocard system of equipment hardware and also showed a number of their computer-based facilities. These included a semiconductor database on CD-ROM, desk-top publishing, and the computer-aided design of broadcast cables.

If you couldn't get down to Chiswick but would like some further information on individual exhibits — why not give me a ring (on AH 375) and I can send you the relevant details. Otherwise, why not attend the exhibition next October. You never know, you might enjoy it!

Peter Jefferson
Liaison Engineer, D&ED

INFORMATION TECHNOLOGY — special feature

Information Technology (IT) affects all of us to a greater or lesser extent. In this special feature, Paul Jarrett explains how the use of IT is regulated within the BBC and explains the raison d'etre of his own department, Information Technology Engineering.

The use of Information Technology (IT) techniques, in general, and of office automation techniques, in particular, is regarded by many as the principal objective of 'computerisation' — to coin that particularly ugly and overused word. The term, unfortunately, is widely mis-understood and/or misinterpreted. In my own experience its meaning has ranged from the complete and automatic handling of all office functions — word processing, finance, mail, fax, telephone, etc — through to the provision of tea and coffee machines and an air pump for the office fish tank, to the extermination of office mice!

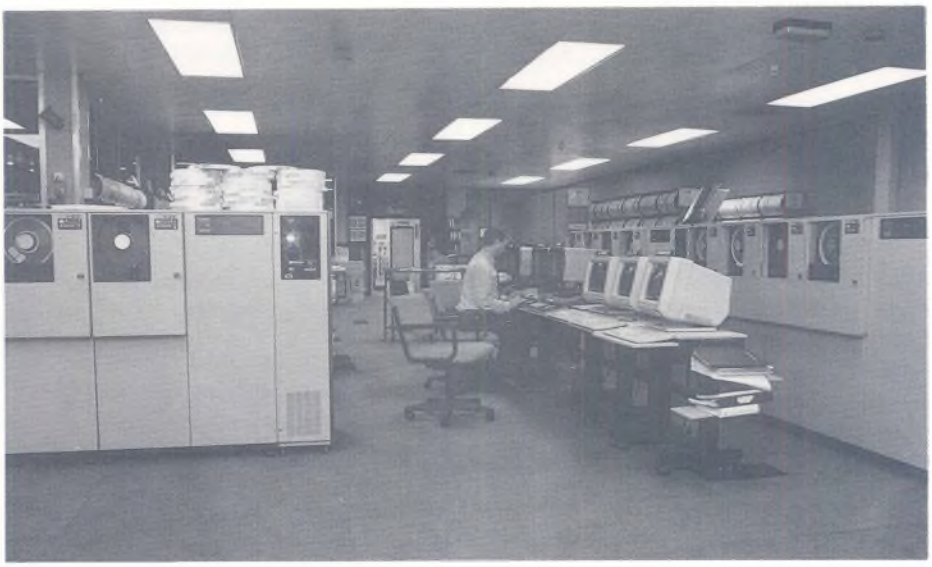
In order to understand more clearly the problems resulting from the introduction of office automation techniques into the BBC, it might be helpful if I firstly describe the background to IT development in the Corporation.

Background

To misquote St John slightly: 'In the beginning was the machine...'

Over the period ranging from the early sixties until the mid seventies, computing in the BBC was centralised around a number of large mainframe computers. Data communications was in its infancy and the majority of data input to the 'machines' (as they began to be termed) was originally in the form of punched cards and punched paper tape. This preparatory stage was very operator-intensive and, hence, the majority of input data was provided in batches, leading to the term 'batch processing'.

The advent of the mini-computer and the development of data transmission techniques were both heralded with a degree of suspicion by computer professionals. Despite this, the BBC recognised the potential advantages which could accrue from the devolution of its data-processing operation. Until then, this had been wholly centralised and operated as a 'corporate resource' under the wing of Personnel Directorate.



A computer hall at Sulgrave House

In consequence, the 'computer' staffs were dispersed into Directorate-based work teams — the origin of the present computer (IT) services departments. Considerable autonomy was given to these groups, in so far as choice of systems and equipment was concerned. This has resulted in the mixture of hardware and software — both proprietary and tailor-made — which we currently find across the Directorates.

The range of hardware alone is impressive. In the mini field, it includes ICL, Hewlett-Packard, Unisys, DEC, Bull, Data General and Tandem. And in the IBM PC camp, with its great variety of clones, there is a host of differing brand names. The applications software which has been developed on this range of machines has, in the main, been applicable to each specific vendor's equipment only (by the employment of proprietary packages and languages).

This is the stage on which players in the office automation theatre are attempting to promote their first-night offerings. It is also the stage on which Information Technology Engineering is trying to perform its role as corporate office-automated producer and director, without stunting the growth and development of each individual actor.

Each computer manufacturer has over the years developed proprietary in-house mechanisms, aimed at simplifying the preparation and transfer of documentary information between workstations connected to its network.

Unfortunately, and for a variety of technical reasons, such proprietary protocols cannot be adopted between products of unlike manufacture. This means that, whereas it is perfectly possible to have a single-manufacturer-based office automation policy (ranging from word processing through electronic messaging to fully distributed processing by the use of networks), it becomes a sticking point when multiple suppliers are involved; no two manufacturers will have developed along the same road.

Further, the development and use of tailor-made systems — based on manufacturer-specific hardware and software — led to a total lack of portability in applications software, even where there was a clear need for Corporation-wide usage.

This situation demanded urgent review and this was undertaken in 1986. A hierarchical sequence of control committees was established with fundamental terms of reference described briefly opposite.

Corporate organisation of IT

The overall organisation of IT strategy in the BBC is perhaps most clearly demonstrated graphically. The chart on page 10 shows the structure of, and relationships between, a group of executive Committees. The purpose of these is aimed at co-ordinating and integrating, as far as possible, IT developments across the Corporation. I will attempt to describe the functions of each of these committees individually.

ITPG

The Information Technology Policy Group (ITPG) is the BBC's most senior IT strategy committee, chaired by the Director General. It meets twice in each year, and its terms of reference can be summarised very simply: 'To establish a policy aimed at overcoming the inconsistencies and constraints which can now be seen clearly to have accrued, as a result of the wide "freedom of choice" in the selection of Information Technology systems'.

The ITPG is composed of members of senior Directorate management (eg, Directors of Resources, Director of Finance, Deputy Director of Engineering, etc) rather than of computer professionals. One member is nominated by each Director to represent that specific Directorate's interests.

ITMM

The Information Technology Management Meeting (ITMM) 'shadows' the ITPG and comprises a representative of each Directorate's senior IT technical management, (in general the Heads of IT Services). It meets approximately every six weeks under the chairmanship of the Director of Finance who, being a member of the ITPG, is able to give direction to its proceedings in line with strategy underwritten by that body.

Members of the group are charged by the ITPG with debating IT issues of current Corporation-wide interest; with identifying areas where conformance in practices can, and should, be achieved (eg, technical standards, etc); and hence, with making recommendations to ITPG on ways of ensuring that maximum value and cost effectiveness of systems of wider applications can be achieved — even where a particular applications package has been developed solely within an individual member Directorate.

ITLM

The third layer in this corporate-wide hierarchy is the IT Liaison Meeting (ITLM), which brings together senior analyst and programming staffs from each of the Directorate computer services departments. Its aim is to share experiences and technical problems encountered in present project work, with the principal objective of eliminating the 're-invention of the wheel'. It has no direct 'executive' function but it can, and does, influence the policy-making process by virtue of its direct relationship with ITMM, through the Heads of Computer Services. On occasion it can be commissioned by ITMM to undertake an investigation into a specific subject — for example security — which can then be considered by ITMM as a prospective submission to ITPG for incorporation within the corporate policy statement.

Steering Committees (ITSCs)

The three committees described above have a Corporation-wide base. Within each Directorate, however, an Information Technology Steering Committee is responsible to ITPG for the control and application of all aspects of IT within that Directorate.

Each IT Steering Committee therefore polices all aspects of IT policy within its own Directorate by:

- filtering and co-ordinating the preparation of that Directorate's IT annual budget submissions
- controlling the use of approved budget monies
- determining systems' implementation and development priorities
- developing, publishing, maintaining and regularly reviewing Directorate IT strategy
- guaranteeing and monitoring the implementation of Corporate IT policy within the Directorate, as directed by ITPG
- developing, and discussing new topics, to be considered for presentation to ITMM and ITPG, for possible inclusion as potential new corporate 'standards'

Each Steering Group is chaired by that particular Directorate's representative on ITPG. The detailed memberships of ITSGs vary from Directorate to Directorate: in addition to the Chairman and Head of IT Services, membership ranges across Chief Accountants, Heads — or representatives — of major user departments, and Personnel Officers.

It can be seen from this structure that there are two routes through which proposals and recommendations can

Nash Kalirai at an Enterprises network control station

be forwarded to ITPG from individual members of Directorate IT staffs:

— firstly, through the Directorate Steering Committee; with the Steering Committee Chairman representing the interest at ITPG by virtue of his/her personal membership on that body.

— secondly, through the Directorate's Head of Computer Services, via the ITMM and its Chairman, the Director of Finance.

Clearly, it is advantageous for both these avenues to be employed as a general rule. Submission through the first route guarantees the support of the individual's own Directorate Steering Committee, and hence of its Chairman. The second route guarantees the agreement, at a technical level, of all the BBC's IT services teams.

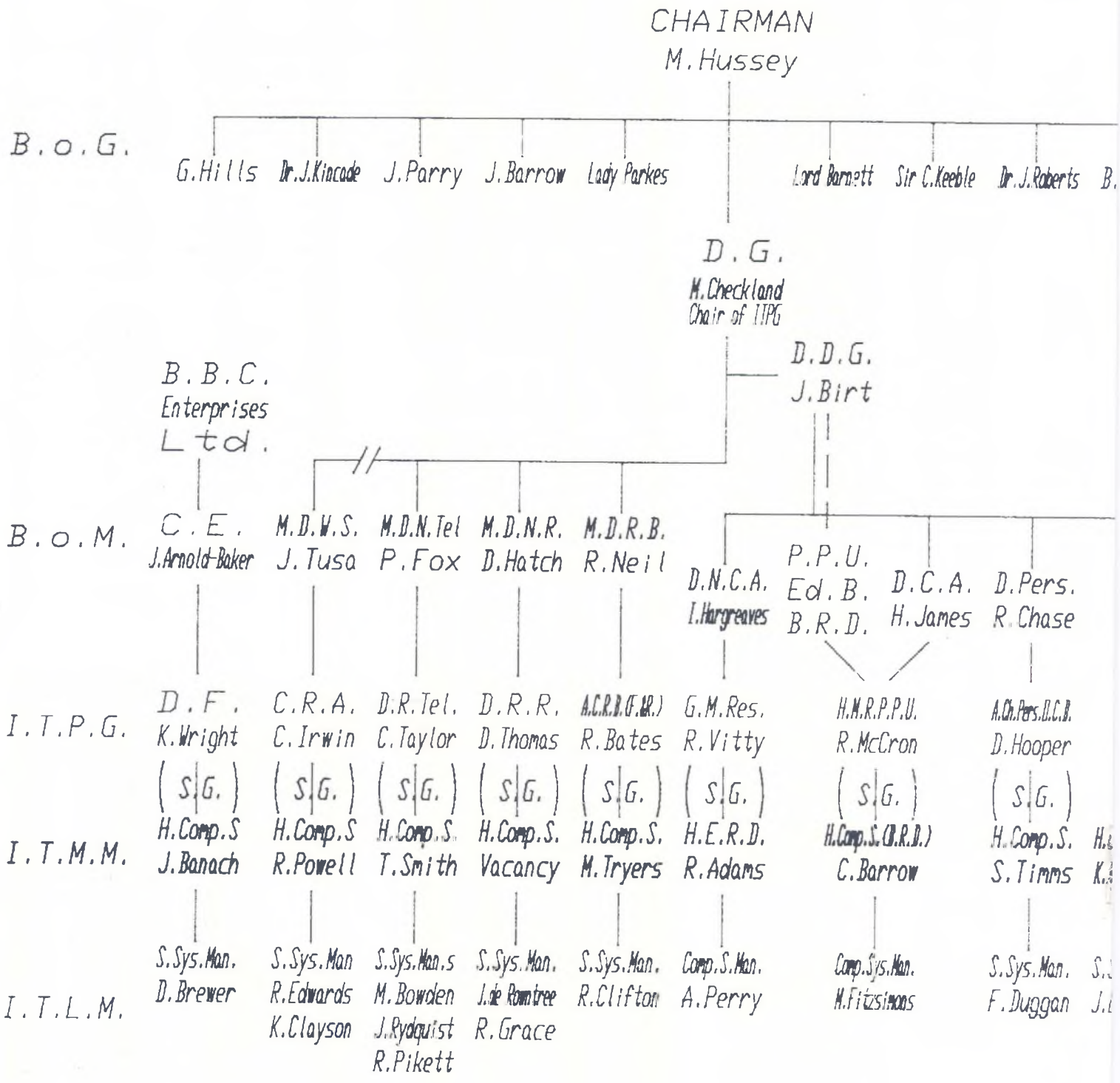


Figure I: the IT executive committees in the BBC

INFORMATION TECHNOLOGY ENGINEERING

Information Technology Engineering (Inf Tech Eng), as an independent Department within Engineering Division, was created in 1986. It started life as a small kernel of staff from the former Computer Systems Section of Studio Capital Projects Department (SCPD), following the devolution of that Department, and has grown to meet the expanding needs of Directorates.

It was retained within Engineering Division in order to provide two fundamental services to the BBC:

— Firstly, an 'IT integration' role between BBC Directorates.

— Secondly, a 'project management' facility for the provision of IT systems within the BBC's Central Directorates; ie, those Directorates not concerned directly with radio and television production and output and, additionally, to BBC Enterprises Limited.

Recently, however, there has been considerable reorganisation and realignment of responsibilities in respect of certain of the output areas; for example, the creation of the new Directorates of News & Current Affairs and Regional Broadcasting. Similarly, departments of the former Public Affairs Directorate have been re-grouped within the Directorate of Corporate Affairs, the Planning and Policy Unit, and in DDG's Directorate.

These changes have led to considerable enhancement in the field of operation of Information Technology Engineering. In addition to merely providing a 'hardware installation' service — as was the general case in former times — the Department is now involved widely in assisting Directorates in the formulation of their IT strategies, and in helping them to fulfil their objectives and aspirations in this rapidly changing but vital area of activity.

In order to undertake this task most effectively, Information Technology Engineering is divided into two operating groups, each led by a Senior Systems Planning Engineer. Malcolm Kirby is responsible for the first of those groups, and Norman Hitch for the second.

The two groups are further subdivided into a small number of Operational Teams, each of which is led by a Systems Planning Engineer. Inf Tech Eng services to each of the Central Directorates are provided by one such specific team within the Department. It is that team's responsibility to assist in the establishment and co-ordination of all the basic and IT integration needs of that Directorate; and to recommend and advise on the feasibility of any possible alternative solutions.

A flavour of the range of activities of the Department can be gained from a look at the focus of responsibility of the leaders of each of the operating teams:

Steven Clifford:
Engineering Directorate including ACED, ETD, D&ED etc.

Martin Davies:
White City developments and the co-ordination of all planned IT moves and new provisions.

Anthony Prior:
Personnel Directorate plus Legal Advisors and Solicitors.

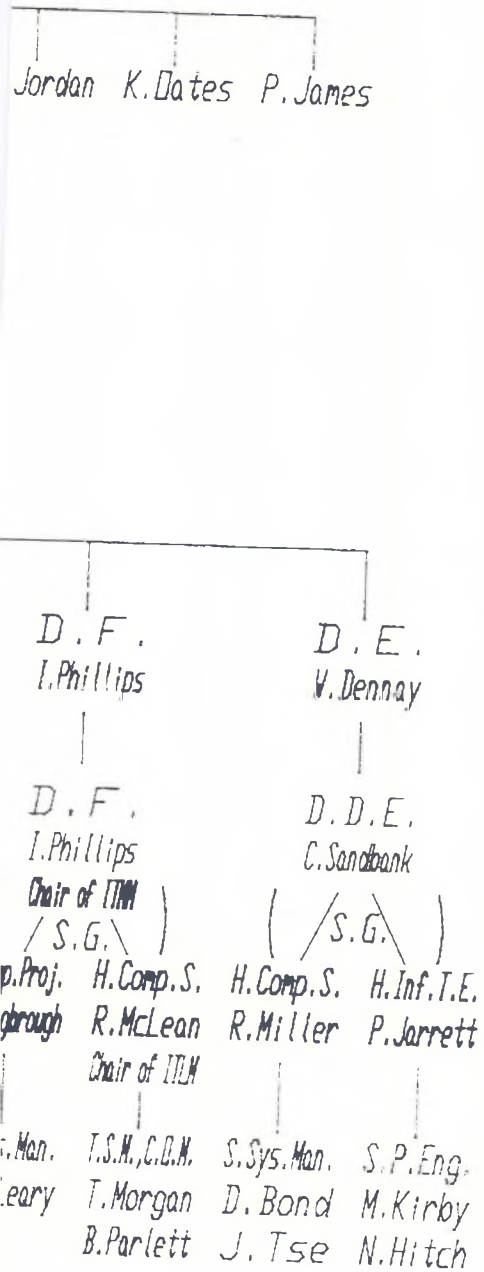
Nash Kalirai:
BBC Enterprises Limited in Marylebone High St., Woodlands and Sulgrave House.

Pio Reindl:
Finance Directorate including the Computer Centre at Sulgrave House, Salaries, Pensions, Cashiers etc.

Nigel Brown:
Corporate Affairs Directorate (including Information Services and International Relations), Planning & Policy Unit (including Management Section and Broadcasting Research Department), Educational Broadcasting and Regional Broadcasting.

Glyn Storey:
Co-ordination of all aspects of data communications across all Directorates, and Liaison with Transmission Department.

Full details and names of members of the individual teams are shown in the organisation chart overleaf.



Specific major schemes — which in some cases involve all Operational Teams — are co-ordinated and managed directly by the Senior Systems Planning Engineers. Current and recent examples are the Bull (Honeywell) computer system for Caversham monitoring service; and the Electronic Newsroom System (ENS) for the Regions. The latter is spread across fifty-two sites in the UK; is linked to the large News & Current Affairs newsroom System in London, and has direct connections to the New York office.

Administration and Help Desk

An efficient administration and support service is an essential feature of any busy Department.

Barabara Usher-Rawlinson manages a small clerical and secretarial team which administers all aspects of this service, from the validation and preparation of contracts and orders, to the maintenance of leave records; the planning of training courses in consultation with senior staff in the Department; and most importantly, to the processing of expenses claims!

Anna Clarke, the Administrative Assistant, is the primary point of contact for calls to the Department's Help Desk. She is responsible for the allocation of incoming calls for help to the appropriate Operational Team, and for ensuring that such customer requests for support services are actioned in the most efficient and timely manner. She also ensures a regular feedback of progress to a client in respect of work in progress. This service is gaining in popularity, particularly because of the growth of PC networks — an area in which the Department specialises. Anna would be very pleased to discuss your requirements; she can be reached on the Help Desk, telephone number TVC 2264.

The Future

In order that Inf Tech Eng be made aware of the future requirements of its customers, at the earliest possible stage, and also to co-ordinate IT implementation as far as is possible under the constraints of the present multi-vendor situation, I have been invited to participate (in an advisory capacity) in the work of each of the Central Directorates' Steering Group Committees. I am therefore able to cross-fertilise ideas, as they arise, with the long-term objective of systems convergence. This can be in terms of hardware conformance — mainly possible in areas that have no present hardware installed base — and in terms of software packages (word processing, for example) where agreement across the Directorate boundaries would have distinct advantages.

It is my profound hope that the next few years will show a big increase in the use, by manufacturers, of International Standards in Information Technology: in particular, in the migration of all suppliers towards Open Systems. These are systems which conform in all respects with the OSI (Open Systems Interconnection) model, proposed by the International Standards Organisation.

The use of OSI and, more specifically, 'Gosip' — Government Open Systems Interconnection Profile — has provided the BBC with an opportunity to achieve the degree of connectivity described by DDE as 'interoperability'; in other words, the ability of workstations on one system to be able to interwork with nodes of processing power on other systems. The adoption of the CCITT X.25 packet-switched network, and of the X.400 range of document interchange standards, by ITPG, makes this a real possibility within the non-too-distant future.

I expect Inf Tech Eng to be able to make a significant contribution to these exciting developments, and I also look forward to the time when Eng Inf can be prepared, edited and distributed electronically, on-line, to all of its many customers — regardless of Directorate!

Paul Jarrett
H.Inf.Tech.Eng.

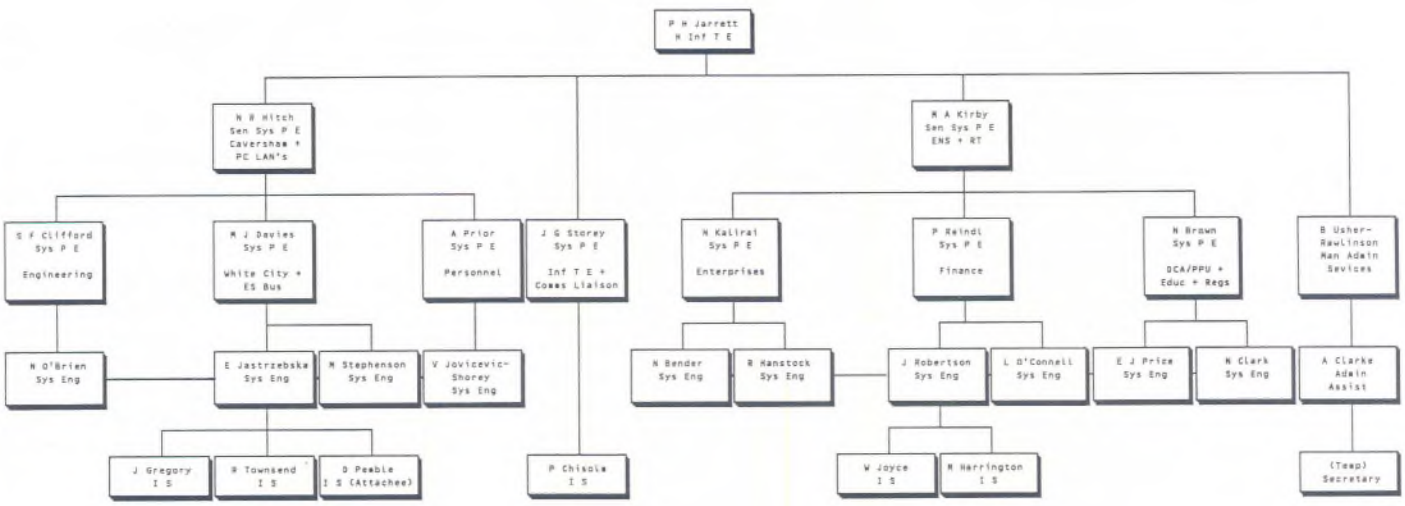


Figure II: the present structure of Information Technology Engineering

CAVERSHAM — new listening room

A new Listening Room came into operation at Caversham on the 22nd of October 1989, replacing the old area which had been in use for some 18 years. It also replaces many of the transcribing cubicles which were at the eastern end of the building.

The new room has fifty-four monitoring desks. Half of these have double workstations, for audio monitoring, while the other half have single workstations for video monitoring — giving a total of 81 positions. Each workstation has two audio cassette recorders (Continental Defence Electronics), an audio transcriber, and audio selection and control facilities. In addition, each video monitoring position has an 11-inch tv and a vcr; monitoring and recording of satellite-derived foreign tv programmes is also possible at these workstations.

A typical audio monitoring desk at Caversham

Each Monitor is able to select and record, any one of up to thirty-two off-air programmes for translation into English. There are five separate matrices for different groups of languages. The old method of working entailed Monitors typing up their translations which were then manually transported to the Newsroom and Editorial Department for processing. In 1990, the Monitors will enter their translation directly into the memory of a large publishing computer, by means of a visual display terminal, for retrieval and processing by the relevant departments.

A console area provides facilities for central monitoring, emergency overplugging and control of remote receivers, both in this country and abroad. All incoming programmes are recorded in this area on Racal multi-track recorders for operational and archive use. The console operator also has access to a bank of audio cassette machines which can be set to start recording at any pre-determined time.

In the spacious new Apparatus Room, a Patek Philippe clock system is synchronised to MSF Rugby and provides automatic time-change in the case of the BST clocks whilst retaining the operational ones on GMT. This facility even extends to the large analogue clock which was once a feature of the stable-yard (now the Atrium).

David Daborn
Project Engineer
Projects & Planning, WS

CROWSLEY PARK
— new 11m KU-Band Antenna

Transmission Engineering Department recently installed a further 11 metre antenna at Crowsley Park, to augment the satellite-receiving system installed in 1988 (see Eng Inf No. 33, page 14). Whereas the earlier system operates over an extended C-Band range of frequencies (3.625 to 4.20 GHz), the new system covers the KU-Band (10.95 to 12.75 GHz). Also included in this phase were five more receivers for television signals.

The antenna is of almost identical design to those previously supplied except for the feed which is designed for KU-Band and is for X & Y linear polarisations

WOOD NORTON
— demo unit for digital audio

The Technical Services Unit at Wood Norton has developed a device which demonstrates the effect of changing various parameters of digitally-encoded audio signals. The unit is now being used in qualifying and specialist courses at Wood Norton, as an aid to teaching about digital audio and pulse code modulation.

When connected to a Sony PCM701ES digital audio processor, the device demonstrates the effect of reducing the number of bits in the sample word from 16 to 1, and dividing the 44.1 kHz sampling rate by a factor of between 1 and 15.

The main display of the unit indicates the bit content of the sample word, switchable between left and right channels. Other indicators show when various types of error correction are operating. Front panel controls allow monitoring of the main digitally-processed signal, or the quantisation error signal. Further controls enable the effect of bypassing the Sony input filters to be monitored.

The pcb design and layout of the unit was generated by the PC-based Seetrax Ranger system. From an input circuit diagram, this system generates and plots out multi-layered pcb layouts, which may then be used as masters in the on-site pcb production facility.

Peter Howe
Technical Services Unit
Wood Norton

TV LIGHTING THE Q2 AND LEOPARD CONTROL SYSTEMS

When Television Theatre, in west London, returned to service in September, its seveneen year old Q-File lighting control system had been replaced by Q2. This is a Q-File look-alike, capable of 2000 channels instead of 240, which occupies just three 6U racks instead of four bays! At the same time, Leopard — a portable lighting effects patching system — was installed for use in TC3 and TC4 at Television Centre. Both systems were designed for Television Lighting department by D&ED and the projects, led by P&ID Tel, took just a year from requirements to delivery.

Background

A new generation of lighting control systems was needed to handle the scale and style of modern television production. Saturation lighting rigs are now used to reduce rigging time, by providing a permanent basic coverage of hard and soft lighting, suitable for the majority of productions. In a big studio, this means a large number of lights and dimmers are required; for example, TC1 has 1084 channels of 5 and 10 kW dimmers. To control this number of lights quickly and accurately, the control panel must be kept simple.

The Q-File has met this need admirably for two decades and is well liked by operators, with its servo faders, geographic mimic display and absence of vdu screens. Current commercial systems can only control 999 channels and they tend to have quite complex facilities. While they are well suited for live theatre where relatively long rehearsals are followed by a run of repeat performances, they can be difficult to drive in Television's rapid rehearse-record environment.

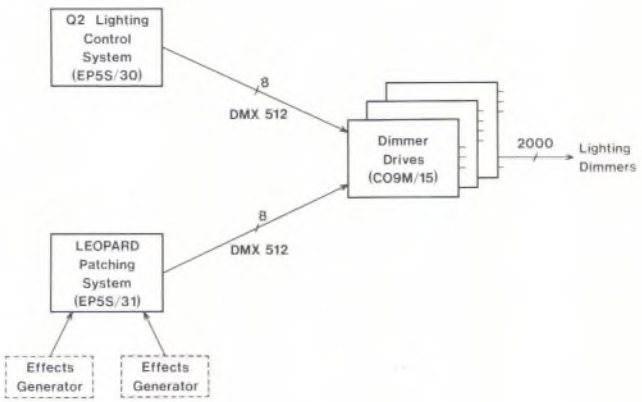
Some years ago, a company was contracted to design a system based on Q-File, with a number of enhancements, capable of controlling a suitably large number of channels. A prototype was made, but it was plagued with a combination of hardware and software problems and could not be made to work reliably. Despite a rescue attempt by another company, the project eventually collapsed.

At this point, two studio engineers — Dan Shaw and Ian McLeod — took up the challenge and demonstrated that a large system was viable. Instead of using the purely-software approach adopted by the previous attempt (and most commercial systems), they designed dedicated hardware to perform all the basic functions, and controlled this with software. Their success revived interest in the project and D&ED's Design Group was asked to turn the concept into the product which became Q2.

The System

While Q2 provides all the basic control for lighting the majority of productions, Light Entertainment shows would not be the same without sound-to-light units, chasers and other special effects devices. At present, these are connected in parallel with the control system via a pin-patch matrix, but even a modest pin-patch for TC1 would have 12,000 crosspoints.

LIGHTING CONTROL SYSTEM OVERVIEW



The other new D&ED system — Leopard — provides an electronic alternative to the mechanical pin-patch matrix. It can route 240 analogue inputs to any of 2000 outputs, under the control of a simple keyboard. Many different patches can be stored in memory, and recalled live during a show — giving impressive results from only a simple effects generator.

Q2 and Leopard are both digital systems and the data for their two thousand output channels is carried on 250 kbit/s serial data links, using the DMX 512 protocol now standard within the lighting industry. This is decoded, by the system's dimmer drives, into the 10V signals which control the thyristor dimmers. The Q2 and Leopard signals are decoded separately, then combined at the dimmer drive output, so that an independent backup for Q2 can be routed to the dimmers through Leopard.

The Projects

The projects were run to a very tight timetable and little of the design was prototyped. The emphasis was to get it right first time, since production had to begin well before any system testing had begun.

All areas of design at Avenue House are now influenced by computer-aided tools. Artemis was used for the project's management and AutoCad proved its value for mechanical design (the Q2 control panel assembled correctly, first time round). Similarly, using Cadnetix CAE/CAD tools — for all electronic design and pcb layouts — gave excellent results. Twenty-five units were designed and laid out in six months, with only trivial errors.

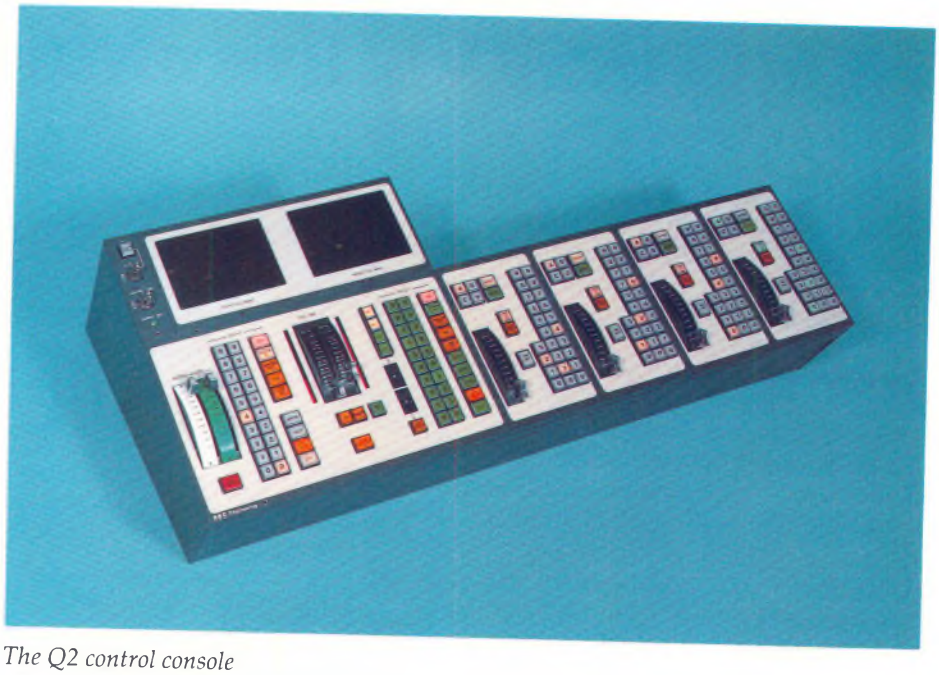
The often hazardous process of software design also succumbed to a more formal approach. The Yourdon Analysis and Design method was used to turn the specification into a set of code structure diagrams, before writing the final Pascal programs. This entailed entering some two hundred diagrams into Excelerator, a software design tool capable of checking that all the diagrams follow the Yourdon rules and are consistent. Coding the programs took six weeks and, after two more weeks of very intensive effort, the software worked on time.

Then came a three month period of progressive system testing, to ensure that it met the specification, paragraph by paragraph. Testing was very much a team effort, with twelve Operations and Maintenance staff putting the system through its paces at Avenue House, in addition to the designers and P&ID Tel. One of the project's

main strengths has been the effort and cooperation the design team received from Television Lighting, Studio Engineering and P&ID Tel.

Installation at TV Theatre was carried out by D&ED during July, and Q2 has been in service since 1st September. Leopard was delivered at the same time and is available for use in TC3 and TC4. Further systems are ready for installation in TC1 and TC6, and a feasibility study has shown that a lower-cost Q2 could be made for smaller studios. There now seems a strong possibility that the designs may be licensed, so there may finally be a commercial successor to Q-File, and the project will have turned full circle.

David King
Control Section, D&ED



The Q2 control console

SOUTH BANK — new broadcast facilities

One of the BBC's main music venues in London is the South Bank Centre, which comprises two main halls — The Royal Festival Hall (RFH) and the Queen Elizabeth Hall (QEH). The RFH was built for the Festival of Britain in 1951 and seats 2900 people while the QEH was designed in the late 1960s and seats around a thousand people. A much smaller hall, The Purcell Room, is contained within the same building as the QEH and is also an occasional source of music broadcasts.

Both main halls had semi-permanent broadcast facilities fitted in the mid-seventies. These were based around the classic Radio OB mixer of the time — the Calrec 'Unitised' — which was a portable 4-group mixer, with separate boxes for the inputs (in 8-channel blocks), outputs and monitoring. The control rooms were designed around twenty-four input channels of the mixer, supplemented with additional channels when required for more elaborate broadcasts. The auditorium cabling, line send amps, etc, were permanent installations.

The task of refurbishing these frequently-used control rooms was given to Radio Projects.

The New Control Rooms

The decision was made to purchase two 24-channel Calrec desks — similar to those fitted in the new Type B vehicles (see Eng Inf No. 32). This is a standard one-piece studio desk: it is impossible to add any extra channels and it is definitely not portable. Thus a new operating principle was required.

For standard-size OBs (most Radio 3 concerts), the installed equipment would be used. However, for larger shows from the RFH (eg, most Radio 2 broadcasts), an OB truck would be rigged. Thus, a hundred and forty mic-level tielines have been installed between the RFH control room and the OB point where large stereo control vehicles (SCVs) can be parked.

Main monitoring in the control rooms is provided by LS5/8s but Auratone 'domestic' check monitors have also been installed — as a result of the recent policy to aim the music balance more towards the home listener. Three self-powered Fostex speakers have been provided for monitoring cue and talkback feeds.

Even though an acoustic architect has gone to great lengths to produce a unique and pleasant sound in both halls, it can never be recreated for the home listener — unless some artificial ambience is electronically added. Both control rooms have thus been equipped with AMS RMX16 echo units, still preferred over more modern units because of its wide audio bandwidth.

The QEH Control Room

Digital Technology

The OB facilities have been designed very much with digital audio in mind; for example, eight fibre optic tielines have been installed to enable the digital control vehicle (DCV) to be used at the site. With its analogue-to-digital conversion equipment rigged in the control room itself, the digital data (rather than analogue signals) can be conveyed direct to the DCV on the fibre optic cables. The RFH is the first OB venue to be equipped with permanent fibre optic links for this purpose.

To further continue the commitment to digital audio, a 1.5 GHz aerial has been permanently installed on the roof of the QEH — awaiting the completion of the Nicam receiving link at Crystal Palace (CP). When in service, received digital signals at CP will be relayed direct to Broadcasting House, using the vision circuits (which carry BBC 1 and 2 to CP) in the reverse direction.

Following successful trials with a portable R-DAT machine, two Technics studio R-DATs have now been installed in each control room, for transmission and backup use. Hence, high-quality recordings are now made on site, rather than at Broadcasting House (via poor-quality rented circuits) as was the case before.

The project was completed using technical installation contractor, Elliott Brothers of Oxford, and building contractor, Handskill Ltd of Newmarket.

David Errock
Radio Projects

WORLD SERVICE — roving publicity bus

World Service Projects and Planning recently responded to an unusual (for Bush House) request — the European publicity department required a double-decker bus for use as a mobile exhibition centre, in their campaign to increase audience figures abroad.

An old Red Routemaster — the definitive London Bus — was originally considered but had to be rejected, as it greatly exceeded the EEC height limit of 4 metres. Later buses, such as the Bristol VR, still exceed the height limit but can be brought 'within tolerance' by traumatic and costly surgery. We therefore settled on an open-top fleetline vehicle which is ideal at 3.9 m high.

The lower deck was completely gutted and rebuilt as a walk-in exhibition stand — with a service counter, display boards, storage cupboards and shelves for brochures, two 27-inch display monitors and two U-matic video players.

The upper deck has been designed as a video viewing lounge. The front four seats were removed to accommodate a 37-inch tv monitor, which is mounted on a heavy duty scissor jack so it can be raised above the profile of the bus for increased viewing range. Extension speakers have been fitted under alternate seats to give an even sound distribution.

A waterproof canvas canopy, supported on a rigid but lightweight frame, provides shade and a degree of weatherproofing. The canopy can be raised and locked into position when the bus is parked, and roller blinds help and provide excellent viewing conditions even in bright sunlight.

The bus has been finished in London Transport red and is decorated with World Service logos; the side panels are decorated before each tour of duty with information in the appropriate languages. The bus has so far seen two major tours — the first to Portugal, where an estimated 15,000 people came aboard, and the second to Greece and Turkey where the response was just as enthusiastic. Finland and Yugoslavia are next on the agenda.

Mike Reynolds
Projects and Planning, WS

The publicity bus in Portugal

SAFETY

New COSHH regulations

On the 1st October 1989, new regulations on the Control of Substances Hazardous to Health (known as COSHH) started to come into effect. These regulations expand the existing requirement — under the Health and Safety at Work Act, 1974 — to provide and maintain safe systems for the use, handling, storage and disposal of hazardous substances. Many control measures already exist within the Corporation and are detailed in various safety instructions.

Each Directorate is currently progressing these requirements, under the guidance of a Directorate Implementation Team, by:-

— establishing material safety data registers
— obtaining hazard data sheets
— assessing and controlling exposure
— monitoring
— training

If there are such substances in your work area, you will be informed — when assessments have been made — and will receive training in any control measures which must be observed for your own and other's safety.

It is essential that you do not introduce new substances into your workplace without authority and a proper safety assessment having been carried out.

These COSHH regulations are designed to make your workplace safer. It will take some time to complete the relevent assessments but if there are any questions which you have about COSHH at the present, please talk to your immediate line manager who will obtain the information you require.

Charlie Sandbank
Deputy Director of Engineering

Dexion Speedframe incident

Some time ago, a potentially serious incident occurred when a heavily-loaded rack, constructed from Dexion Speedframe, overturned. On investigation, a number of factors emerged which are likely to have contributed to the incident: (i) the rack may have been disturbed in the course of routine maintenance work; (ii) the rack stood on eight castors, the load bearing capacity of which was exceeded by some 40%; (iii) the castors were mounted on legs 5-inches long.

The castors were fixed by means of pressure die-cast aluminium joints, hammered into the ends of the square tube; it was these joints which actually failed. Consequently, the following action is recommended:

— Any racks which carry significant loads should be carefully designed to support the load in question (including the weight of the rack), allowing an adequate safety margin.

— Wherever possible, non-mobiles should be anchored to a wall or other support.

— Mobile structures should be designed with extra care to ensure stability. The load should be kept as close to the base as possible and the minimum dimension of the base should be as large as possible.

— Where castors are used, they should normally be fitted to the special reinforced leg unit.

— Existing racks should be checked for compliance with the above.

Mike Reason
Manager, Safety Services,
Television

DIGITAL BROADCASTING — special feature, part I

Over the next three issues of Eng Inf, we will be taking a close look at what is happening in the field of digital broadcasting — both audio and video. To start the series, Richard Lawrence and David Bradshaw of Design Group, D&ED, respectively take us through audio and video signal origination and routeing.

DIGITAL AUDIO

Digital Audio Sources

Digital audio sources are now becoming readily available to the broadcast user. Unfortunately, however, they come in a variety of different sampling rates and resolutions. The three main sampling rates currently in use are 32, 44.1, and 48 kHz.

32 kHz is used for signal transmission systems, such as Nicam, while 44.1 kHz is used for Compact Disc (CD). 48 kHz is used for professional studio equipment such as digital mixers, digital audio tape recorders, and digital video tape recorders which have digital sound (eg, the Sony D1 machine).

The inherent coding resolution varies with equipment and use. As a general rule, 14 bits/sample is used for transmission systems like Nicam; 16 bits/sample for CD, and up to 24 bits/sample for 48 kHz professional equipment.

Ideally, 18-20 bits/sample are needed for 'uncontrolled' signals. This is to allow sufficient headroom for unexpected peaks and also to achieve adequate dynamic range before the artefacts of digital coding — quantisation noise and distortion, for example — become significant. At present, most professional equipment works to 16-bit resolution only and compromises have to be made regarding the amount of headroom that is allowed. The first real 18-bit analogue-to-digital (ADC) units are only just becoming available in the market place.

Unfortunately, some digital audio tape formats are limited to recording 16-bit signals only; for example, Rotating Head Digital Audio Tape (R-DAT) machines. This is a limiting factor in their usefulness to the broadcaster.

The non-standardisation of digital source signals has led to various problems for the broadcaster. For example, having to cope with three different sampling frequencies means that sampling rate converters are a necessary evil. Another major problem with digital audio is tape editing. The only effective way to edit R-DAT cassettes, for instance, is to download them into a disc-based editing system. These systems are now becoming available but the problem of high speed downloading of such material has yet to be solved.

AES/EBU Interface Standard

The biggest single step forward for digital audio in recent years has been the creation of the AES/EBU interface standard. This standard defines a serial interface format for interconnecting digital audio equipment.

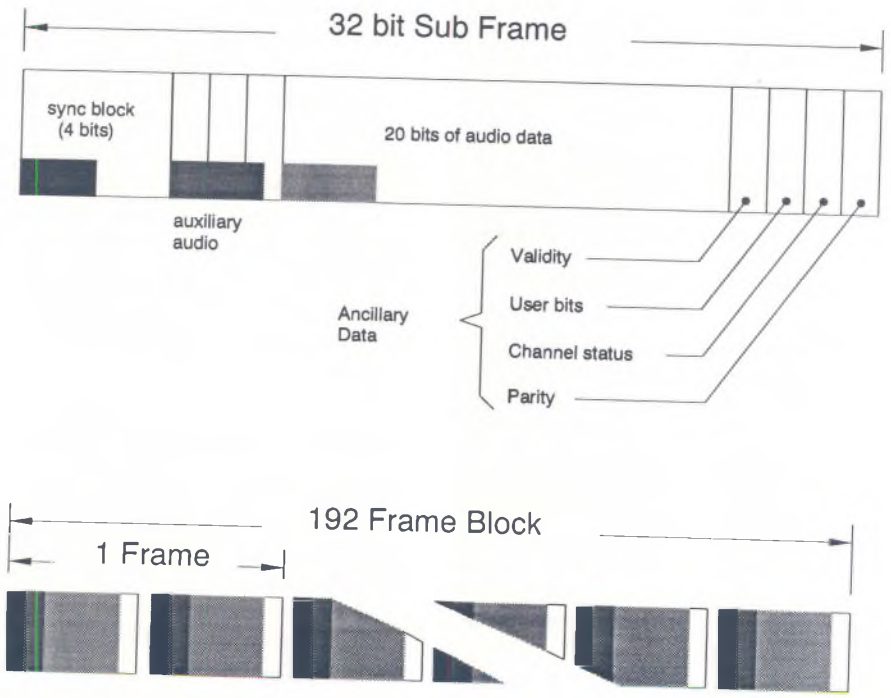
The standard basically defines the way in which two audio channels, with up to 24 bits/sample coding, can be packaged into a serial bitstream with a bit-rate of 3.072 Mbit/sec (when using 48 kHz sampling).

The basic unit of the bitstream is a 32-bit subframe. This comprises a 4-bit sync pattern, 24 bits of audio data and 4 ancillary bits. The two subframes that make up a frame are identified by two unique sync patterns while a third pattern identifies the first subframe of a 192-frame block.

The most important of the ancillary bits are the channel status bit and the user bit. Channel status is used to identify important parameters of the signal such as sample rate, bits/sample, emphasis etc. The user bit provides a 96 kbit/sec data channel which can be used for adding time-code, source labelling or signalling information, for example. Each audio channel has its own dedicated user and data bits. Although the audio data is allowed up to 24 bits/channel, the four least significant bits can be designated for other totally-separate audio data. An example of the use of the auxiliary bits is given in the section on routeing.

The standard specifies that the XLR 3-pin connector is used for interconnection. The electrical format conforms to the RS 422 standard.

The AES/EBU standard is so important to the successful use of digital audio for broadcast systems that Design Group has designed an Application Specific Integrated Circuit (ASIC) for coding and decoding this standard.



The data structure of the AES/EBU audio interface

This ASIC — known as AESIC — provides all the facilities that the professional user needs, with a minimum of external components. It also provides a consistent level of performance which ensures compatibility between equipments.

As far as television sound is concerned, it is appropriate to use the AES/EBU interface for equipment interconnection and routeing. The sound part of the television signal is generally handled separately until the signal is ready for transmission. The sound signal is then encoded using the Nicam-728 standard and placed within the synchronising pulses of the tv waveform. The Nicam-728 standard is similar to the Nicam-3 (676) standard used by Radio, as far as the audio companding process is concerned. However, the overall bit-rate is higher, the frame length is reduced from 3 ms to 1 ms and greater range code protection is provided. The standard is compatible with the UK DBS C-MAC/packet specification.

An AESIC device with a 20p coin

Digital Audio Routeing

Initial work suggests that routeing audio signals in digital form will provide an extremely cost-effective solution to routeing audio in a broadcasting centre. The fact that more than just the audio signals can be carried within the AES/EBU interface results in a significant reduction in the number of levels that any matrix system requires. For example, within a single AES/EBU bitstream it is possible to carry:

— 2 full bandwidth audio channels
— 2 low bandwidth (7 kHz) talkback or co-ordination channels
— 2 telephony control circuits
— 2 studio signalling (ie red light) circuits

The two talkback circuits can be achieved by using the bottom four auxiliary bits of the 24-bit main audio channels. The signalling circuits and telephony control can be provided by the user data channel.

The AES/EBU interface signal can be transmitted over ordinary audio twisted-pair cable, up to distances of between three and four hundred metres — provided that straightforward engineering precautions are taken with cable types, terminations, etc.

An obvious advantage to routeing audio signals in their digital form is that they are far less prone to any interfering signals. Parameters such as crosstalk become insignificant. A minus point though is that, like in television, the signals need to be kept in synchronism. This can be achieved by distributing an AES/EBU reference signal to all source and studio equipment. Where the source equipment is not on site, as would be the case with an OB contribution, then a synchroniser is required.

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Head of Audio Section
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DIGITAL VIDEO

Video Coding Standards

The quality benefits of operating with digital video signals, rather than analogue, are well known and will not be elaborated here. But it will be useful to look at the way in which signals are digitised and moved from one equipment to another.

There are two main coding standards to be considered, depending on whether the signal to be digitised is in *component* or *composite* (ie PAL) form. For the best quality of viewed picture, it is desirable to work with component signals. PAL — with its main artefacts of cross-colour and cross-luminance — should be avoided for as far down the signal chain as possible, ideally right to the viewer's receiver! But for the time being, we have to accept that component and composite signals will co-exist.

Digital Component Video

An international standard exists for the way in which analogue component signals are to be digitised: this is CCIR Recommendation 601, generally known as Rec 601 or the 4:2:2 standard. The signals to be digitised are:

— a luminance signal with a bandwidth of 5.5 MHz
— two colour-difference signals, R-Y and B-Y, each with a 2.75 MHz bandwidth.

The sampling frequency for the luminance signal is 13.5 MHz; for each of the colour-difference signals it is 6.75 MHz. The choice of these frequencies results in a simple relationship with the line scanning frequency, and an integral number of samples on each line for both the 625- and 525-line standards.

CCIR Recommendation 601 states that, on each digital *active* line, there shall be 720 luminance samples and 360 samples of each colour-difference signal. (This is the same for both 525- and 625-line signals.) Each sample is taken to 8-bit accuracy.

On each *non-active* line, there are 288 luminance and chrominance samples in the digital 625-line system, but only 272 such samples in the 525-line digital system. Aside from this, there is a good degree of commonality between the two line standards.

The establishment of Rec 601 has led to rapid developments in the area of digital signal processing. In particular, it has opened the way to developing a standard — a digital equivalent of 'one volt and 75 ohms' — for interconnecting pieces of equipment which had

previously required digital-to-analogue and analogue-to-digital converters. Work within the EBU and SMPTE has produced such a standard, now known as CCIR Recommendation 656. You may see equipment described as having interfaces to CCIR Rec 656, RP125 or EBU Tech 3246 — these are all the same, the latter two being the documents produced by the SMPTE and EBU working parties, respectively.

An interface to Rec 656 carries the digital component signal in parallel form through a 25-way Type D connector. The luminance and two colour difference signals are time-division-multiplexed into a single bit-parallel datastream, at 27 Mwords/sec (13.5 MHz + 2 x 6.75 MHz), and each of the eight bits is carried as a balanced signal, at a level compatible with emitter-coupled logic devices. Because the data signal is not inherently self-clocking, a ninth bit carrying a 27 MHz clock signal is also present at the interface.

Special cables have been developed for use with these digital video signals. D&ED designed the first example, PSN18, which has been widely copied! It is slightly thicker than low-loss coaxial cable but no less flexible.

Using this cable, interconnections of thirty metres are possible without any form of equalisation; adding simple fixed equalisation extends the range to 150 metres or more. Being digital, the signal requires only very crude equalisation by analogue standards.

Unfortunately, while the bit-parallel interface is fine for small installations, it is not very convenient for switching. Also, the Type D connector is fairly bulky and relatively expensive to fit to a cable. Consequently, work continued towards establishing a bit-serial interface. Because of the high data-rate of at least 216 Mbit/sec, it was accepted that the serial interface was likely to be more expensive and to depend for its success on the availability of special high-speed integrated circuit devices.

The serial interface which has now been adopted operates at 270 Mbit/sec, which allows either eight-bit or ten-bit data to be carried. (Some suppliers of digital equipment have expressed reservations about the adequacy of eight-bit interfaces, though one suspects a bit of commercial gamesmanship may be at work.) The bit-parallel signal is serialised and passed through a scrambler before being sent to line; the scrambler has the effect of making the spectrum of the signal look more like random noise and it also prevents strings of consecutive 'one' bits appearing in the line signal: this eases the process of clock extraction in the line receiver.

Agreement on a serial interface opens the way to optical-fibre distribution of digital component signals.

Digital Composite Video

One of the disadvantages of digital component operations is the cost of the digital video tape recorder, the D1 machine. This arises largely from the sheer volume of data to be recorded, which stretches to the limit the technology of head design and tape manufacture.

However, the benefits of recording the signal in digital form were clear for all to see and it didn't take long for someone to produce a digital recorder working at the much lower data-rate required by digital composite signals. This machine, known generally as the D2 machine, has spawned interest in digital composite operations in the post-production area, even though it perpetuates all the evils of PAL, including the eight-field sequence!

Digital composite coding is based on subcarrier-locked sampling at four times the subcarrier frequency, ie 17.7 Mword/sec. Ideally, more than eight-bit resolution should be used, though the D2 machine records only eight bits. Interfaces for both digital PAL and digital NTSC have been proposed, both in parallel and serial form — the serial interface is essentially a lower-speed version of the digital component serial interface. The digital composite coding standards have become tagged as the D2 standard, which has led the digital component standard to be called the D1 standard — all very confusing!

David Bradshaw
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Part II of this series will deal with digital *transmission* standards and techniques.

Further reading

'AES Recommended Practice for Digital Audio Engineering — Serial Transmission Format for Linearly represented Digital Audio Data', Audio Engineering Society, AES3 — 1985.

'CCIR, 1986, Recommendation 647. A digital audio interface for broadcasting studios'. Green Book, Vol X part 1, Dubrovnik 1986.

'Digital Television Recording', Chapter 5, EBU Doc. Tech. 3252.

'NICAM 728: Specification for two additional digital sound channels with System I television', BBC EID.

'The EBU parallel interface for 625-line digital video signals', M.J. Stickler, EBU Review — Technical, No. 205, June 1984.

'Routeing, distribution and interfacing in the digital edit suite', M.C. Patel, International Broadcast Engineer, March 1988.

WOOD NORTON — component video area

In mid 1988, the broadcasting world seemed to finally and suddenly make up its mind that Betacam SP would become the lightweight videotape format to replace High-band U-Matic. By recording analogue *component* video instead of coded PAL, Betacam SP introduced a new set of rules for signal handling. Also, new video measurement techniques were produced to evaluate component systems.

At Wood Norton, the Video Engineering Unit had already pledged part of its 1988/89 budget to refurbishing the videotape practical areas. These comprised two VT labs — each housing a VPR-2 C-Format machine — which were generally used separately (mainly for B and C courses but also for practicals/demonstrations, during other courses).

It was decided to remove the dividing wall between the two labs, thereby creating a space with a similar floor area to a normal classroom. Even allowing for two small cubicles to house the old VPR-2 machines, this left a large open plan area to house the new component video equipment.

The primary need was for a Betacam SP Recorder/Player, as an example of a widely used component system, along with access to test signals and programme material in both component and composite form. The SP machines would be a representative addition to our vt training equipment for engineers, particularly as the VPR-2s were nearing the end of their useful training life.

A secondary need was for a trolley-mounted test signal generator and waveform monitor, with YUV picture monitor. This equipment could be wheeled into any video classroom, to enable measurement demonstrations to be given, but could also augment the Betacam SP equipment at practical sessions and in lectures.

A third need was for a vision mixer, which would enable investigations, measurements and fault-finding to be carried out on the component signal chain.

The scheme was designed in August 1988 and building work began in October that year to create the enlarged room and two cubicles. During this period, the VPR-2 machines were temporarily relocated in a corner of the Telecine room, to see us through the Autumn load.

By Christmas, the VPR-2s were re-installed in the new cubicles, where they can still be used separately, or combined for editing purposes (using folding screen doors). The last of the new component equipment — a BVW 75 Betacam SP machine — arrived at the end of March 89.

Course Developments

The benefits of the new area have already spread throughout the various engineering courses at Wood Norton.

- New staff on A (ENG) and DE courses are introduced to Betacam SP principles straight away.
- Staff on B (ENG) courses already study PAL to get to know the problems of coding and decoding. Now, however, they also examine component signal techniques — covering picture origination as well as storage and digital effects. Component techniques used by recorders are also being introduced into the B course syllabus; namely, the fm signal chain and timebase correction.
- At C course level, Part I covers microprocessors and peripherals, so Part II is an ideal time to study micro-based servos — both the transport motor control and the Dynamic Tracking system of the BVW 75 machine.

The preparation work involved in assimilating these techniques into the A..B..C course progression has enabled us to now offer a 3-day course on component video techniques. Further details of the course can be obtained from your line manager, or from Kevern Oliver at Wood Norton (Tel: 210).

Peter Harris, Lecturer
Video Engineering Unit
Wood Norton

The refurbished vt practical area (Room V16) at Wood Norton