ENG INF

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The BBC Stand at IBC 84

In this edition of ENG INF

BBC Engineer wins top IBC Award

Dr Geoffrey Phillips, Head of Radio Frequency Group at Research Department has been presented with the first ever IBC Award in recognition of his internationally acclaimed work over thirty years in fostering the efficient use of the radio spectrum.

The IBC Award was initiated to mark the 10th International Broadcasting Convention. It will be presented at each IBC in recognition of an outstanding contribution over any period of time by a person, or a group of people to broadcasting research, design, development, manufacture, operational practice and management, which has not already been recognised by the presentation of another award.

The presentation of the award, together with a cheque for £2,500, was made by John Tucker, Chairman of the IBC Management Committee before a large gathering of delegates, exhibitors and guests at the IBC 84 reception in Brighton, on 22 September. In accepting the award, Geoffrey Phillips paid tribute to his colleagues, both inside and outside the BBC, who had contributed to the many international meetings that he had attended.

Thirteen UK and overseas nominations for the award were received by the IBC Awards Panel under the chairmanship of Dr G B Townsend MBE. The final adjudication was made by an international panel of fifteen IBC corresponding members from twelve countries, resulting in a considerable majority for Dr Phillips.

Designed by John Tribe, a graphic designer at London Weekend Television, the award is in engraved glass form using the classic Greek Golden Section to symbolise the marriage between technology and artistic creation in broadcasting.

Geoffrey Phillips (left) receives the IBC Award from John Tucker.

Editorial

How pleasing it is to report on page one that a BBC Engineer, Geoff Phillips from Research Department, should be the first recipient of the IBC Award. Details of the Award winner, which can be likened to an Oscar for engineering, were kept a closely guarded secret until the announcement was made. When one considers the likely contenders, not only from UK Industry and broadcasters, but also from similar organisations world-wide, the prestige of the Award can be seen in its true light. How fitting also, that it should be presented shortly prior to Geoff's retirement when he will be able to reflect that his dedication to his work did not go unnoticed. Congratulations, Geoff, from all of your colleagues in BBC Engineering.

Whilst on the subject of IBC, details of which fill most of the pages of this edition, may I publicly thank all those who contributed to the event. From the cheerful handymen and others at Kingswood who helped erect the "acoustic cabin" before the exhibition started, to the engineers and technicians who helped install the equipment and made it work, to the authors of papers who exposed their work to public scrutiny, and to the many other departments who supported our efforts by lending equipment or know-how, thank you all. Without your help and understanding the Convention would not have been the undoubted success that it was.

405-line television

I have written before in this column about the impending departure from the broadcasting spectrum of the 405-line television service. One of the problems faced was that of how many people were actually dependent on these transmitters for their television, and would therefore be deprived of the service when they closed.

To try to assess the number of viewers was a difficult task, since no distinction is made between the 405-line and 625-line monochrome licence. The television trade, both dealers and manufacturers, could only speculate on the number of 405-line receivers that were still in use regularly, and our own figures based on public complaints were likely to be 6 dB out either way!

Thus the decision was taken to caption all of the 405-line main transmitters in turn, inviting viewers who could not pick up BBC 2 (and thus uhf television) to write to the BBC for help and advice. This was implemented from September 1983 to May 1984.

The results of the captioning are quite interesting since they provoked only 960 enquiries, which on further investigation revealed only 278 households who were outside the reach of uhf transmitters.

Perhaps this was to be expected when one hears the story of the senior citizen in Croydon who had been in hospital when the captioning started. Seeing the caption when she returned home she asked her friend next door what it meant; the friend, who was watching on 625-lines, said that there must be a fault with the set since she had not seen anything. The tv dealer was duly called to repair the faulty set. By this time the captioning had been removed, so the poor old lady suspected Murphy's Law (the fault never persists when you try to fix it). Fortunately the tv dealer recognised the symptoms, and sold the lady a new (625-line) television.

If this story has been repeated throughout the UK it is hardly surprising that the figures are so low.

Anniversaries

The past few months have seen three anniversaries. The Droitwich transmitter station celebrated 50 years with a special dinner on the 6th September, and nearby in Bristol a special 50th anniversary exhibition opened the following week. More recently Northern Ireland has celebrated 60 years of broadcasting to the Province with two concurrent exhibitions in the Belfast Arts Council Gallery and Ulster Museum, followed by smaller exhibitions in Enniskillen and Derry. Congratulations.

Alan Lafferty

Licence Agreements

The BBC has signed a licence agreement with two British companies, Spendor Audio Systems Ltd., and Swisstone Electronics Ltd., which allows them to manufacture the medium size, high quality, LS5/9 studio monitoring loudspeaker described elsewhere in Eng Inf. The agreement will enable these two companies to market the loudspeaker worldwide.

The Band II power amplifier bays AM14/51 and AM14/54, and associated transmitter drive equipment have been licensed to SPT Communications, and Rank Cintel have signed a licence agreement for the Digiscan shot change detector RP3/511.

On show at Woodlands

The following manufacturers will be exhibiting in conference room 1 at Woodlands on the dates shown. Further details can be obtained from Bob Simmons ITPS Room A2047, Woodlands:

7 Nov	Olson Electronics (Power Distribution)
8 Nov	Hameg
14 Nov	Highland Electronics
21 Nov	Technical Projects Ltd.,
27 Nov	Barco
28 Nov	Coutant Ltd.,
5 Dec	Schroff (UK) Ltd.,
11/12 Dec	Hayden Labs Ltd.,
16 Jan 85	Rittal Ltd.,
23 Jan 85	R.S. Components Ltd.,

Transmitters Opened

The following uhf transmitters have opened since July:

Llanengan	Gwynedd
Llangernyw	Clwyd
Newnham	Kent
Parkend	Glos
Trefilan	Dyfed
Ynys-Pennal	Dyfed

The following vhf transmitters have opened or changed:

Holme Moss	W.Yorks
Douglas	I.O.Man

The following Local Radio transmitters have opened or changed:

Duxhurst	R.Sussex
Holme Moss	Rs. Leeds, Manchester and Sheffield
Mendip	R.Bristol
Rusthall	R.Kent

IBC 84 TENTH INTERNATIONAL BROADCASTING CONVENTION

BRIGHTON
21-25 September 1984

September saw the tenth International Broadcasting Convention, once again held in Brighton. The BBC was well represented, with engineers presenting nineteen papers on topics ranging from DBS to digital systems. In the accompanying exhibition, Research and Designs Departments displayed some of the latest, and complex, engineering technology. Their exhibits are described more fully elsewhere in Eng Inf.

Other exhibitors had much to offer on their stands, although most visitors would agree that the four and a half days of the Convention was too short to absorb all of the new ideas and equipment. The highlight of the show must be the demonstrations of high definition television (hdtv). Those clever young men from Sony chose the Grand Hotel, Brighton as the location for their demonstration. In the Metropole, besides the BBC exhibit, Ikegami had an hdtv camera and monitor with a 5:3 format that looked very good on their slow-moving demonstration scenes. Barco were showing a similarly formatted monitor with a static picture. The monitor retails at about £22,000 and can be made available if you can wait nine months for delivery.

On the British Aerospace stand was a useful demonstration showing the effects of the weather, receiving antenna size, and head amplifier gain on signals for DBS reception. They favour a 60 cm diameter antenna, but, except at beam-centre, this looked rather noisy.

A quieter moment on the BBC stand at IBC.

Thorn EMI were displaying pictures from the SKY satellite music channel. They explained that the poor picture quality was due to the satellite receiving dish being on the promenade, and an unequalised 500 m cable connecting the signal to the stand. They also suggested that this was why the sound signal was distorted, and had a poor stereo image.

It was interesting to see BBC originated equipment on commercial companies stands. Rank Cintel with "Slide File", GEC-McMichael with the "ACE" standards converter and "clock logo", VG Electronics with the "Zone Plate Generator", and many more.

For those whose tastes run to real-ale, the Probel stand were demonstrating a "Glass Valley Mixer" mounted in a 4u crate and 19 inch rack. A 6800 microprocessor had been programmed to produce operator-indicators of the source material, which turned out to be a choice of Wethereds, King and Barnes, Worthington E, or Ruddles. Application of a digital input to the appropriate button produced an analogue stream of the appropriate brew via an 'N' Type angled connector marked "CAMRA OUTPUT". Needless to say this exhibit attracted a lot of attention.

Alan Lafferty (EID) explains the BBC policy on aerial purchasing to three Italian salesmen on the stand at IBC. Behind, two visitors critically examine the hdtv monitors.

New waveform monitor

Since 1960 the BBC has used waveform monitors in vision and lighting control rooms to assist operational staff in the control of electronic cameras.

In any installation a number of waveform monitors are mounted in a rack together with picture monitors. To provide adequate visibility it is necessary that the monitors have a large display.

The original monitors were single channel instruments and when YRGB displays were introduced four monitors were required for a single camera.

A new large-screen display waveform monitor is under development which will provide four displays simultaneously on a single screen. The new monitor also includes a colour signal decoder to enable a composite input signal to be accepted.

Stereo sound with television success

The demonstrations of stereophonic sound with uhf terrestrial television were given in an acoustically treated cabin on the BBC stand, and illustrated recent work in this challenging area. Three broad aspects were covered in these demonstrations:

1. Excerpts from programmes produced by BBC Television as part of an exercise in the use of stereo sound with television production techniques.

2. A dual channel sound-in-syncs system developed by Designs Department to convey the stereo sound signal from the studio centre to the uhf transmitters.

3. An experimental digital system, devised by Research Department, to carry two high-quality sound channels on the existing television transmission System I.

Stereo Programme Excerpts

The relatively small size of a conventional television display compared with the width of a conventional stereo sound-stage poses special problems in the production of television programmes with stereo sound. Production techniques are being developed by BBC Television which help to overcome these and other difficulties, and the programme excerpts shown demonstrated the effectiveness of stereo sound with television for a variety of different kinds of programme.

Stereo Sound-in-Syncs

For more than a decade now, mono television sound has been distributed in the BBC network by a sound-in-syncs system in which pulses inserted into the television synchronising waveform convey the sound signal in digital form.

To provide for the needs of stereo sound with television, Designs Department is developing a two-channel sound-in-syncs system. This system also featured as a separate exhibit on the BBC stand, and is described elsewhere in Eng Inf.

Experimental Stereo with Terrestrial Television System

Research Department has, for some years, been investigating the feasibility of developing a method of adding stereo sound to existing television services. During the period when various analogue options were being considered, a number of opportunities were arising for the application of digital techniques to domestic equipment. In particular, the intention to use digitally coded sound for DBS television leads naturally to the consideration of the possible adoption of digitally coded sound for terrestrial television.

A preliminary experimental digital stereo sound with uhf television system was therefore devised by Research Department and a thorough series of laboratory and field tests carried out. These have all yielded very encouraging results. In particular, field-tests conducted out of normal programme hours from the BBC-2 transmitter at Wenvoe in South Wales gave confidence about the performance of the system when the received signal is impaired by low field-strength or multipath propagation. And tests from the BBC-2 transmitter at Crystal Palace in London indicated that the experimental system is compatible with the widest range of domestic television receivers. (See Eng Inf No 15 & 17).

Further details of the experimental system and these test were given in the paper entitled 'Experimental Digital Stereo Sound with Terrestrial Television' presented at the Convention by Bob Ely.

Throughout the period of the Convention, the experimental digital stereo sound with television system was on-air from the BBC-1 and BBC-2 transmitters at Rowridge on the Isle of Wight, and these signals were received off-air and decoded as part of the demonstration. Because of the experimental nature of the system, the stereo sound heard during the off-air part of the demonstration was music that was unrelated to the programme.

Work on the development of the experimental system continues and, in particular, discussions with the receiver industry, the IBA, and the Home Office are being conducted in order to achieve an agreed UK standard.

Stereo sound will also be available to the viewer by way of DBS, and some degree of commonality between the DBS and terrestrial specification is desirable in the interests of economy in the receiver. This points to a system based on the format of the data carried within the C-MAC/packet structure, with near-instantaneous companding and an overall bit rate of 728 kbit/s. The precise formulation is not essential to an assessment of the main features of the system, and the demonstration made use of the NICAM 3 system that was developed for point-to-point transmission and now forms an essential part of the two-channel sound-in-syncs system.

The stereo sound with television demonstration equipment inside the acoustic cabin.

Flat Plate Antenna for DBS

The design of a flat plate antenna for DBS created much interest at IBC. Here Jonathan Stott (RD) relaxes next to his display during a quiet period.

Direct Broadcasting by Satellite (DBS) provides new challenges in antenna design. While satisfying technical requirements, perhaps necessitating close tolerances, the domestic DBS antenna must nevertheless be suitable for mass production at a reasonable cost. Furthermore it should be easy to install, and preferably be unobtrusive when in position.

Technical Requirements

The DBS antenna must perform two functions: to receive sufficient power from the wanted transmission, and to reject unwanted interfering signals. To turn these two requirements into a specification we must define the required service quality and availability, and also what transmissions are to be received at what locations.

DBS channels, orbit locations and other details for the 12 GHz band have been allocated by international agreement forming an overall Plan. The number of channels available is limited so each channel is re-used many times over the orbital arc, relying on the angular and cross-polar discrimination of the receiving antenna. The Plan for Regions 1 and 3 (Europe, Africa and Asia) was formed assuming that all receivers used conformed to a certain minimum standard. A receiver of this standard is assured sufficient carrier-to-noise and carrier-to-interference ratios when receiving the transmission in whose service area it is located.

Improvement in the noise figure of receiver front ends means that smaller antennas (e.g. 0.6–0.75 m diameter rather than 0.9 m) could provide sufficient carrier-to-noise ratio within the service area but they might not offer enough protection against interference from other transmissions. The United Kingdom is fortunate in this regard in being situated at the edge of the continent of Europe and thus having fewer interfering transmissions to contend with. Nevertheless, it is likely that interference will eventually set a lower limit to the size of a domestic DBS antenna, although it may not be a problem when there are few DBS transmissions. On the other hand, if the antenna size (and hence gain) envisaged in the Plan is retained, any improvements in noise figure will enhance the quality of reception above the planned minimum target. This will become increasingly important as new types of television display with better definition are developed.

Reception of 'overspill' foreign transmissions may require a larger antenna to provide additional gain and also greater directivity whereby interference may be rejected. In this case the interferers could well include those DBS transmissions within whose service area the receiver is situated. If reception from more than one satellite position is desired some method of accurately steering the beam direction will be necessary. The ability to choose either hand of circular polarisation may also be needed.

To assess the quality of reception which can be achieved with a particular antenna/receiver combination, the antenna gain and receiver noise figure must first be determined. From this the receiver figure of merit (G/T) may be derived. Using this in conjunction with a map overlaid with contours of power-flux density for the wanted DBS transmission, the received carrier-to-noise ratio at any location can be obtained. Secondly, the effect of interference must be determined. To do this the co- and cross-polar radiation patterns of the antenna must be known. These can be incorporated into a complicated computer program whereby the equivalent interference protection margin can be calculated, either for spot locations or as a contour map. The carrier-to-noise ratio and the equivalent protection margin taken together define the received signal quality.

Design Options

The 0.9 m parabolic dish antenna assumed in the WARC Plan could be considered visually unattractive in some locations. It may also be difficult to mount so as to withstand wind loading. Some improvements are possible. For example, a dual-offset antenna with the feed at the bottom can give the required angle of elevation while the main reflector remains more or less vertical. However, considerations of appearance and wind-loading generally favour the flat-plate, phased-array antenna approach. Such antennas have been developed for military applications, although in this case the constraints have been different, resulting in a different choice for the most appropriate techniques.

The ultimate flat-plate antenna would mount directly on the wall of a house. The beam direction would be electrically steerable to select the transmissions from the desired satellite. Even if reception from only one satellite position were desired, some method of steering, albeit perhaps pre-set, would be needed to take into account the orientation of the wall. It should be noted that installation of any type of DBS antenna will require more precision than hitherto customary for

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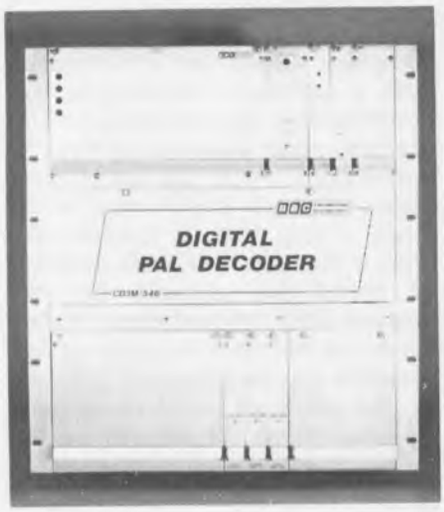
Digital PAL Decoder



A high-quality comb filter decoder for PAL signals which uses digital signal processing to achieve a high and stable standard of performance was on display at IBC.

The separation of chrominance and luminance information is carried out by a combined vertical and temporal comb filter, which totally suppresses fine cross-colour, and gives some attenuation of coarse cross-colour and noise.

This form of comb is fairly tolerant to non-mathematical PAL signals i.e. signals with a colour subcarrier frequency not correctly related to the line frequency. However, if the ratio of subcarrier to line frequency is in error by more than a pre-set amount, the decoder is automatically switched to a simple-PAL mode. If required, the chrominance filters may be set so that the filter bandwidth changes automatically in the simple-PAL mode to reduce cross-colour and noise.

Remote and local control of the decoding mode is provided, together with status indications. Alternatively, the decoder may be set to its automatic mode of working; i.e. colour kill on monochrome signals, etc.

There are no operational adjustments and no routine alignment is required since the performance is inherently stable by nature of the digital processing.

Outputs from the equipment are a digital stream of multiplexed Y,C_R,C_B (C_R and C_B correspond to weighted V and U signals respectively) to the EBU Parallel Interface Specification (EBU Tech 3246-E), together with individual 8-bit parallel digital feeds of both Y,C_R,C_B and R,G,B signals. Analogue outputs of RGB or YUV and mixed syncs are also provided, for subsequent processing or monitoring.

The unit exhibited was a prototype, and occupied three 4U 19-inch crates; however production units will occupy only two 4U crates.

Peter Randall, (back to camera) and Simon Aglionby, from Designs Department, discuss the merits of the digital PAL decoder.

Flat Plate Antenna
continued from page 5.

vhf or uhf television. The beamwidth of the DBS antenna is very small, of the order of 2 degrees. Special instruments (e.g. compass, inclinometer) will be used to point the beam very close to the required direction so that a signal may be acquired and final adjustment completed by optimisation of signal strength.

Beam-steering can be accomplished by shifting the phases of the signals from the various elements of the antenna array. This is a well-known technique in radar. A small angular swing can be obtained using relatively few phase shifters, one per sub-array of elements. Large deflections from broadside will need separate control of the phase of smaller sub-arrays or even individual elements.

At present the parabolic dish antenna is probably the cheapest to make, although suitable mounting arrangements which permit adjustment of beam direction and withstand wind loads will add significantly to the cost. To minimise feed losses it is advantageous for the receiver 'front end' to be an integral part of the antenna assembly.

In contrast, an antenna array mounted flat on a wall suffers less wind loading and can have simpler mounting arrangements. However, such an antenna with its electronic beam-steering arrangements is at present much more costly. If the antenna is made of printed circuit board material, excessive losses will arise unless special, very expensive materials are chosen. Structures using air or foam as the dielectric are therefore to be preferred since they have smaller losses and use cheaper materials; in some cases dimensional tolerances can also be relaxed. These factors give the potential for low-cost mass production although new production techniques will have to be developed.

Current Research

Research Department is involved in studies of various approaches to the flat-plate antenna. Topics include types of array element, polarisation methods and beam steering. Supporting computer analysis of signal strength and interference margins, given particular antenna characteristics, is also in progress. A selection of this work was shown on the IBC stand.

Cuts in digital audio editing not easy

There are already several differing strategies for editing digital audio. The use of helical-scan video cassette recorders has grown in popularity as a low cost medium for digital audio recording and a number of special purpose editors are commercially available for them. As might be expected, the rotating heads and cassette format make transfer-editing a necessity; this limits the facilities that can be provided and leads to time-consuming operations. Most severe is the lack of off-tape monitoring which, for broadcasters particularly, means that back-up recordings must be made.

Stationary-head recorders improve the situation by offering punch-in and out, and cut-tape editing. The tape format is crucial to satisfactory operation and because to some degree error concealment has to be employed at the edit points, the results may be unpredictable. A number of off-line editing systems have been developed in which audio material is copied to a magnetic disc system and edited under the control of a computer. Many new facilities are possible, but the systems are costly, relate more closely to the world of computers than audio and, in general, are not practical for use in a recording studio.

The BBC experimental editor on display at IBC '84 was designed to permit an evaluation of new editing techniques. It satisfies the diverse requirements of both the broadcast and recording industries. It will do 'everything that tape does' in the sense of locating, inserting and removing small sections arbitrarily, or compiling an album master from its various items in the correct sequence. However, it also provides a solution to more challenging applications by providing fast location, full rehearsal and adjustment of edits, and non-destructive editing in real-time.

Three levels of editing are being investigated. 'Level 1' is the simplest and involves cutting the tape and relying on error correction and concealment systems within the recorder to smooth an electronic crossfade. 'Level 2' is a new method of tape-cut edit in which the cutting-point and edit-point are deliberately separated. Additional formatted information on the tape controls a buffer store permitting a 'jump' over the corrupted data in the area of the splice. 'Level 3' extends this approach in that data in the vicinity of the splice is copied to a disc store and permits full rehearsal and audition before automatically generating the jump control information. If required, all editing can be performed on the disc (if sufficient storage is available) and the final product replayed directly from the disc.

David Meares (RD) demonstrates editing digital audio.

Central to the transfer of audio is a special purpose Real-time Input/Output device (RIO). Its main functions are:-

a. To provide a flexible buffer between the continuous audio data stream and the asynchronous, high speed bursts of data from the disc.

b. To provide real-time processing of the audio as it is 'replayed' from disc, including cross-fades, gain, and equalisation changes.

c. To interleave ancillary data in the form of Labels with the audio for recording on disc or DATR (Digital Audio Tape Recorder).

A separate device generates and interprets control information carried with the audio on an AES/EBU interface, the only connection between editor and DATR. Labels are carried in the user bits of this interface.

Once audio has been transferred to disc, editing and rehearsal are achieved by interaction with menu displays using a 'mouse' hand-held controller. Non-critical editing can be carried out simply and rapidly using only this device. For critical applications a separate control panel is provided. Facilities under development include playing the disc with full quality for accurate location by 'rock-and-roll'; vernier adjustment of edit points while repeatedly playing the audio; adjustment of crossfade parameters; gain profiles across the edit and offsetting of edit points in different audio channels.

An important feature of the equipment is its adaptability. All software is written in 'C' and runs under a Unix type operating system. The menu/mouse is one example of a man-machine interface; the system can readily be changed to other input/output devices.

Demonstrations on the BBC stand included disc-based editing using menus/mouse; all-digital automated transfers between disc and DATR, and an application of Labels as text accompanying real-time audio. Editing thereafter operates simultaneously on both the time-aligned text and audio signals. This can be used for prompting singing with an instrumental (karaoke).

* * *

HDTV on display

There is currently a great deal of interest, in broadcasting circles, in the possibilities of high definition television (hdtv). The main incentive is the desire to be able to produce, in the home, larger pictures filling more of the field of view; the benefits of this, in terms of the viewer's increased sense of involvement, have been clearly demonstrated in the cinema by the move to Cinemascope and other standards. However, simply increasing the size of the display screen is not by itself a sufficient solution; it is also necessary to increase the resolution if the perceivable sharpness of the final picture is not to suffer. Hence the need for television standards with a greater number of lines and a greater bandwidth. There is evidence that a change in aspect ratio from the 4:3 used today in television to a 'wider-screen' format (somewhere between 5:3 and 2:1 for example) is advantageous.

The BBC is conducting research aimed at identifying the most suitable parameter values for a future hdtv standard; it is also actively participating in efforts being made, in several international committees, to try to unify progress throughout the world. The aim is to arrive at a single, worldwide studio standard for hdtv so as to facilitate programme exchange and equipment purchase. The target for spatial resolution has been set at approximately twice the horizontal and vertical resolutions available on today's 625/50 and 525/60 standards. This implies an electrical bandwidth of around four times that used for current standards.

Such high bandwidths present a significant technical challenge. In view of the lack of suitable domestic large-screen displays, it is very tempting to try to cut back on the resolution of the hdtv signal, and hence save bandwidth. This may, in the long term, prove short-sighted however, as considerable research is being carried out by many organisations in order to produce displays of the necessary size and quality. For this reason, therefore, much of the BBC work has used a technique which accurately simulates the use of a large, high resolution, display screen. A quarter of the hdtv picture (one half of the width and one half of the height) is blown up to fit onto a 26-inch diagonal crt. This simulates the use of a 1.3 metre diagonal screen for display of the complete picture.

Electronic news system on show

A Hewlett Packard 3000 computer, plus its associated disc unit, were installed behind the scenes on the BBC stand at IBC. A vdu and keyboard enabled journalists from "Breakfast Time" to demonstrate the Electronic News System to visitors.

The system enables journalists to input stories which can then be corrected or edited as required. The programme editor, who has permanent access to the system, can place the stories in the right running order for the programme, or store them "On the shelf" for future use. A comprehensive diary prompts journalists with details of future events, anniversaries, etc..

Dual Channel Sound-in-Syncs

The original mono 'Sound-in-Syncs' system was developed by the BBC over 15 years ago and since that time has been widely used throughout the world as a means of distributing sound and vision signals together over a single video link.

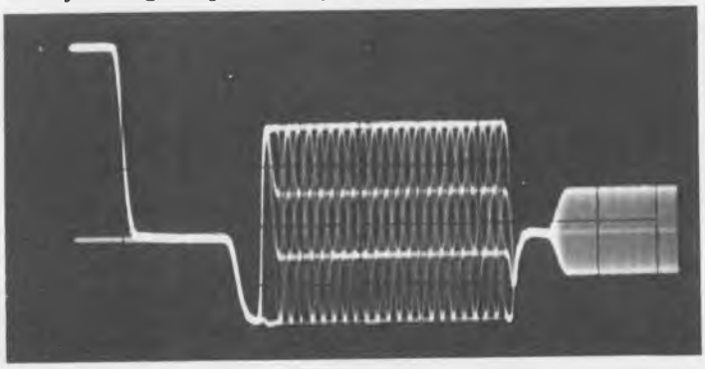
The system provides important advantages of cost saving, convenience and excellent sound quality compared with alternative methods of distribution.

The prospect of stereo sound for television has created the need for a two-channel system to replace the current mono system. Designs Department are currently developing such a system.

The new system takes advantage of the important development in digital audio techniques, specifically the use of the near-instantaneous companding system, NICAM 3, to obtain an improvement in audio quality together with efficient use of transmission bandwidth. The audio signal data rate of two channels from the NICAM 3 processor is 676 kbit/s which has to be accommodated in the blanking period of the television signal. The information is contained within the line synchronising pulse interval of the television signal as in the mono system.

The new system is required to carry more than twice the information in the same time slot and bandwidth compared with the mono system. This has been effected by using a quaternary coding system and by using slightly more of the synchronising pulse time slot.

A significant difference from the mono system is that the NICAM sound data rate is not synchronous with the television line frequency. This causes some complication to the design of the equipment to ensure the smooth flow of data but has the complementary advantage that the audio signal can be directly inserted into the television signal in digital form at a downstream point in the signal distribution system.



How the quaternary coded sound-in-sync waveform looks.

Loudspeaker components

Tim Carder (DD) explains how the LS5/9 loudspeaker is assembled.

The small monitoring loudspeaker type LS5/9 was developed for use in locations where space is limited, or where portability is an important consideration. The design objective was to provide, in one quarter of the cabinet volume, as close an approximation as possible to the principal high-quality monitor, the LS5/8. In terms of subjective quality, the approximation is very close; the only concessions to the larger loudspeaker are a reduction in maximum sound level and the loss of half an octave at the extreme of the bass response.

The LS5/9 employs two drive units with a passive crossover and equaliser. The tweeter is a proprietary soft-dome type of 34 mm diameter; the low-frequency unit is a BBC design with a 200 mm polypropylene diaphragm and a high-temperature voice coil. The cabinet is vented, with a volume of 28 litres and provision for both panel and air damping. The crossover frequency is 2.4 kHz, with asymptotic roll-off rates of 18 dB/octave. The filter circuit includes low-frequency equalisation for an approximately flat free-field axial response, and provision is made for compensating relative drive unit sensitivities.

The assembly displayed was equipped with a power amplifier mounted integrally. The whole unit is supported in a stirrup whereby it may be fixed in the installation at the appropriate direction and angle of tilt. There is an anti-vibration brake for mobile conditions.

The single channel MOSFET amplifier provides for peak music programme power of 70 W. It is designed also for rack mounting and this dual configuration is intended to meet all operational needs.

Designs Department involvement in loudspeaker design is aimed at performance consistency for the many years of a design's service life; the key to this is the ability from time-to-time to manufacture in-house. The component parts and assembly jigs of the bass unit were on display. Quality Control is an important aim of acceptance testing methods and the basic approach used was illustrated in the display.

Test card F

Test Card F has been radiated by the BBC during trade test transmissions for a number of years; it is also widely distributed within Television Centre providing a quick and convenient means of confirming the correct operation of numerous items of video equipment. Its future use had become uncertain, partly owing to the difficulty of obtaining high-quality slides, but also because of the need for a dedicated slide scanner. The latter is of course expensive in terms of capital, and requires routine monitoring and adjustment if excellent results are to be obtained.

The digital Test Card F generator displayed at IBC replaces both slide and scanner whilst requiring no routine maintenance. The equipment contains a read-only picture store conforming to the 4:2:2 coding standard (CCIR Recommendation 601), having the luminance signal sampled at 13.5 MHz and the colour difference signals at 6.75 MHz. A single 4U-high 19-inch rack takes mains and pulse inputs to deliver digital and analogue YUV test card together with a PAL signal from an integral coder.

All of the geometric patterns were generated by computer techniques with reference to the original drawings. Edges were both horizontally and vertically anti-aliased to give the most accurate realisation of Test Card F. The central picture of the girl was copied from a slide by means of a YUV 'picture grab', and the resulting data were inserted into the geometric pattern during the computer preparation process. The combination of the real picture and computer-generated patterns provides a stable, high-quality source for a well-known test signal. The original central picture has been retained as it provides valuable information for assessment of flesh tones, overall saturation, luminance-chrominance timing, and picture monitor convergence etc..

The digital Test Card F equipment puts monitors through their paces at IBC.

Rebroadcast receiver on display

The uhf off-air rebroadcast receiver, seen here in the centre of the picture, provided immaculate pictures from Rowridge.

This grade 1 vision and sound uhf receiver is designed to replace an earlier design which has been in service for many years. It is 4U high and designed for bay mounting. In addition to the usual facilities provided in a receiver of this class it has a number of features not possessed by its predecessor.

Synthesized Local Oscillator
The local oscillator may be preset to any channel in Band IV/V, either by internal switches or by external logic levels. The only item specific to a particular channel is the input filter, which is easily retunable. The receiver can be remotely tuned to a number of channels by providing switched input filters external to the receiver and applying suitable voltages to a socket at the rear.

SAW Filters
Selectivity is provided by a specially developed surface acoustic wave filter (SAW), and no IF alignment is needed. This provides the so-called 'Nyquist slope' around the vision carrier and also rejection of the sound carrier (or carriers, see below). It has good group delay response, minimising the delay correction required at video.

Pseudo-Synchronous Demodulation
A second SAW filter extracts the vision IF carrier, the modulation is removed by low phase-shift limiters and the resulting CW is used to demodulate the vision signal. In this way the effects of any incidental phase modulation (IPM) on the incoming signal are greatly reduced because the demodulating carrier has the same IPM.

Digital Stereo Sound
Provision is made for a digital sound output in the form of a bit-stream which is derived from the second sound carrier.

Digital Display
A digital display on the front panel may be set to indicate vision or sound carrier level in dBm or the number of the channel to which the receiver is tuned. If the incoming carrier has a frequency offset, the direction of this (+ or –) is shown automatically.

Construction
The receiver comprises a number of printed circuit boards mounted in alloy extrusions with tight-fitting lids. All except a few non-signal circuits are mounted thus so that the receiver can operate successfully in strong rf fields.

The boards are accessible when the lids are removed so that chassis extenders are not required and they can be changed easily without the use of a soldering iron.

New aerials for lf stations

When the RABC (75) plan for lf and mf was implemented in 1978 in Scotland, both Westerglen and Burghead were required to radiate R1, R2, R3 and Radio Scotland on mf together with R4UK on lf. To accommodate the new services, two 152 m masts were erected on each site to provide main and reserve mf aerials, and between these was suspended a 'T' aerial for lf. No reserve was provided for the lf service.

The 'T' aerial had four pairs of wires in the top section and four 4-wire legs in the vertical section. This produced a low characteristic impedance aerial to improve the bandwidth. However due to the harsh environment at these Scottish stations, this design proved to be weak mechanically, and several failures in various parts of the aerial were experienced.

As there was no reserve aerial this meant breaks of transmission to repair it. It also meant shutting down the mf services to gain access to the halyards. Apart from the difficulty in maintaining the lf aerial, it was also determined that its presence was causing perturbations in the mf aerial radiation patterns.

To overcome these problems, it was decided to develop a new top-loaded aerial to replace the 'T'. Tests of various configurations were tried at Bartley where a 75 m mast was available for test purposes, and half-scale models could be made.

The final loading arrangement was an umbrella configuration using nine wires each 180 m long with an insulator half way down. The lower section was made up with parafil rope. This gave a much reduced reactance with about the same resistance as the 'T' aerial.

To implement the re-designed aerial, one of the 152 m masts at Burghead and Westerglen had to be devoted to the lf service. This meant a new reserve aerial had to be provided for the mf service. To achieve this, a new 64 m mast was erected at Westerglen and a new 76 m mast at Burghead. The original matching networks were re-used after modification to feed these masts.

To improve the radiated frequency response of the lf system, an adjustment was made to the electrical length between the aerial and transmitters so that a symmetrical impedance response at the sidebands was presented to the output valves. This improved the frequency response at 5 kHz from -5 dB to -1.75 dB. Measurements of the polar diagrams showed the patterns to be much nearer the theoretical after these aerial changes.

From PCM to NICAM

The 13-Channel 'linear' PCM system has been in service now for some 12 years, providing high-quality stereo programme feeds to 14 main vhf stations throughout the UK, and carrying the main mf distribution from these sites. However, despite the long life we have come to expect from modern electronics, no equipment stays reliable for ever, and the necessity to plan for its replacement became clear some years ago.

At the same time, plans were unfolding for the development of Radio Broadcasting in the 80's and 90's which were going to require many more channels than the 13 currently available. Research Department therefore began to investigate ways of increasing the channel capacity of the system.

NICAM 3

In 1980, Research perfected a method of coding known as 'NICAM 3' (an acronym for 'Near Instantaneous Companded Audio Multiplex - Mark 3'), which enables 24 high-quality channels to be carried on the same 6 MHz video bearer circuits that are used by the 13-Channel PCM, and the equipment had been developed in Designs Department for its coding and decoding.

The technicalities of NICAM have been described in Eng. Inf. No 2, but a cursory description follows for those who may not be familiar with it.

The system employs the CCITT recommended bit-rates of 2048 and 8448 kbit/sec, which are the international standards for digital telephony. To make the best use of the available bit-rates, some form of 'companding' is required, i.e., audio compression at the sending and expansion at the receiving end. After trial and experiment with different companding systems, the BBC adopted the NICAM 3 method, which employs 14-bit coding of the audio signal compressed by a simple coding law to 10 bits per sample. This enables a pair of high-quality audio channels to be digitised and coded into a bit-stream at an average rate of 676 kbit/sec per 15 kHz channel pair.

The NICAM 3 system allows three of these 676 kbit/sec bit-streams to be multiplexed into each of four 2048 kbitstreams, which are in turn multiplexed into an 8448 kbitstream. By the choice of a suitable transmission format, this can be carried on the existing 6 MHz video bearers.

This system will give the BBC the use of up to twenty-four 15 kHz channels, or an even greater number of lower bandwidth channels, but the great advantage offered is the increased flexibility. NICAM 676 and 2048 multiplexes can be digitally extracted and inserted at various points in the network, enabling the National Regions and Local Radio Studios to insert digital quality programmes between studio and transmitter where necessary. This also avoids the unnecessary coding and decoding of the audio signals which can lead to other difficulties, not least in monitoring.

Clearly, for financial if no other reasons, the 13-Channel system could not be fully replaced overnight, and the method selected for converting to NICAM was as follows:

By 'losing' one of the 13 channels, the linear PCM 6336 kbit/sec bitstream can be transcoded into three 2048 kbitstreams;

These are multiplexed together with one additional NICAM 2048 kbitstream (carrying six channels), to form one 8448 kbitstream;

Subsequently, when more NICAM channels are required, one more of the three remaining transcoded 2048 kbitstreams, carrying 4 of the original 13 channels, can be replaced by another NICAM multiplex;

Finally, the two remaining 2048 kbitstreams can each be replaced by a NICAM multiplex and the 13-Channel equipment removed.

As a result of field trials it was discovered that the British Telecom bearers can have short breaks, or 'holes', with a duration in the order of 100 usec, which were previously unnoticed as they had had little or no effect on either television signals or 13-Channel PCM. However, the effect on decoded NICAM was much more pronounced, due to the time taken to regain synchronisation following an interruption of the pulse train. To overcome this, an urgent development programme was undertaken by Designs Department to produce a flywheel-synchronised demultiplexer which did not suffer from this effect. At the same time, as a result of co-operation with British Telecom, the number of 'holes' has been drastically reduced, but cannot apparently be entirely eliminated.

Following the design of the equipment, the main effort has been the production and installation of enough NICAM units to equip studios and transmitting stations with a means of coding and decoding the first 2048 multiplex of 6 channels, and converting the PCM bearer chain to 8 Mbit/sec operation. This has been a project jointly led by SCPD and TCPD with very considerable efforts from Equipment Department, Designs Department, Communications, Transmitter Group and Radio Broadcasting.

The installations are proceeding now, and will be completed later this year. The 13th PCM channel has already been removed and, after the comprehensive testing which is being carried out at the moment, the way will be clear to convert the bearer to 8448 kbit/sec.

In addition to the work on the 13-Channel PCM network, NICAM equipment is already in use on the BT circuit to Blaenplwyf, and over video-circuits to Melvaig and Radio Devon. More are being built for Llanddona, Llangollen and Bressay.

Other current developments which will affect the future of the NICAM network are: the forthcoming '4th service' on vhf radio, which will need two more 15 kHz channels; the increasing availability of digital BT circuits for insertion and onward transmission of programmes in 2048, or 676 kbit format, giving better quality than analogue circuits; and the availability of cheaper 'black box' shf links which can carry NICAM bitstreams between network nodes, Local Radio studios and transmitting stations.

Eagle Towers re-furbished

The refurbished microwave link towers.

Communication Section of TCPD have recently completed the refurbishment of the first of two 30 m mobile towers used by Tel OBs. These two towers, which are used to support microwave link aerials for Television Communication Systems, were originally constructed in 1972 by Eagle Engineering of Warwick.

Telehoist Ltd., of Cheltenham have completely replaced the tower supporting steelwork and hydraulic system, which includes the hydraulic jacks used for levelling and stabilising the tower.

The new system is far easier and more straightforward to operate than that used previously, and on most assignments no additional load spreading plates are required.

The vehicle includes a technical area, which provides shelves for a number of radio link control units, and permanently fitted test equipment, to allow the links to be aligned, tested and monitored. To achieve increased headroom, the roof of the technical area can be raised by 0.5 m after the tower has been elevated. A complex system of interlocks has been incorporated in the refurbished design to avoid incorrect or unsafe operation of the vehicle and its hydraulic system.

OB vision links

A new generation of mobile OB shf vision links are on order and will start to be introduced into service in the latter part of 1984.

The new equipment is being designed by Microwave Communications Limited, and operates in the 7 GHz band. Over the next few years new equipment operating in the 2 GHz, 5 GHz and 12 GHz bands will be introduced into service.

The new Continental Microwave link equipment.

Wenvoe mast

Balfour Beatty Structural Engineers guiding into position the first section of the new mast at Wenvoe that will carry the VHF/FM aerials for mixed polarisation.

Remote OBs

Programmes derived from regional outside broadcasts are frequently fed by shf links to permanent OB masthead systems at either Holme Moss, Wenvoe, Kirk O'Shotts, Sutton Coldfield, Manchester Piccadilly Plaza, Crystal Palace or Swains Lane in London.

Most masthead OB systems have, until recently, been equipped with 2 shf aerials capable of rotating through 360° and of being controlled from ground level. These aerials were usually mounted at 175 m along with 2 shf receivers, the composite signal output of which was fed via coax to an OB room at the base of the mast, from where it was fed to the Regional Communications Centre by either a BT coaxial tube or by shf link.

Recent re-engineering work carried out by TCPD has enabled the complete OB masthead system to be controlled remotely.

This is accomplished by interfacing TCPD local control systems with Designs Department remote control systems. Re-engineering has already been completed at Holme Moss, Kirk O'Shotts, and Manchester Picadilly Plaza, and is partially completed at Sutton Coldfield and Wenvoe.

The new OB facilities at these sites has increased the number of shf rotating aerials from two to four (two at 7 GHz and two at 12 GHz). Each aerial can now also be used for both transmitting and receiving, as additional waveguide systems (together with masthead low noise amplifiers and waveguide switches) have been installed between the aerials and the mast base OB room.

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