ENG INF

The quarterly for BBC engineering, technical and operational staff

SUMMER 1993 No 53

BBC Weather Centre wins RTS award

Earlier this year, the BBC Weather Centre won the Royal Television Society's award for Technical Innovation in operational systems.

This new bi-media facility at Television Centre now allows the same "well known" BBC Weather Forecasters to present both the radio and television broadcasts from a single purpose-built site. From here, some 47 bulletins are broadcast each day, via Network Television, South East Regional Television and World Service Television, as well as Network Radio and SSVC (ie British Forces Broadcasting).

Starting on page 3, Nigel Jackson gives the reasons for building the new centre, and describes the facilities which have been provided for the BBC Weather Forecasters.

BBC Weather Centre

Rob McElwee delivers a weather forecast from the new Television Studio

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ENG INF

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Stories for the Winter edition should be forwarded to the editor by Friday 12th November, 1993.

Transmitter News

The following services have opened, changed or closed since our last issue:

New TV relays

Assendon	Oxfordshire
Beddgelert	Gwynedd
Cyfflliog	Clwyd
Edmonton	NE London
Grimsby	Humberside
Kimpton	Herts

Addition of Nicam Stereo

Blaenplwyf	Dyfed
Hannington	Hampshire
Llanddona	Anglesey
Oxford	Oxfordshire
Sudbury	Suffolk

New FM stations

Conwy	Gwynedd
Deiniolen	Gwynedd
Hastings	E Sussex
Hutton	Avon
Mickleham	Surrey
Newton	Northumberland
Rosemount	Tayside

Radio 1 on FM

Ballycastle	Co Antrim
Ilchester Crescent	Bristol
Pendle Forest	Lancashire

Radios 1 and 4 on FM

Brougher Mtn	Co Fermanagh
Kirton Mailer	Perth
Larne	Co Antrim
Llandinam	Powys
Rostrevor Forest	Co Down
Rumster Forest	Highland
Stranraer	Dumf & Galloway

New LR fillers on FM

Bincombe Hill	BBC Dorset FM

The next five stations

The uhf television network presently comprises 51 main transmitting stations and around 960 relay stations, serving about 99.4% of the UK population.

On 31st August 1991, the BBC started its NICAM stereo sound service on BBC 1 and BBC 2, following a period of extended tests from Crystal Palace in the London area. This new NICAM service reached some 73% of the UK population from the following ten main transmitting stations and their 380 or so relay stations:

Belmont	North
Black Hill	Scotland
Crystal Palace	South East
Emley Moor	North
Mendip	West
Pontop Pike	North East
Sandy Heath	East
Sutton Coldfield	Midlands
Wenvoe	Wales
Winter Hill	North West

Since then, a further nine main transmitting stations have been converted to NICAM, extending coverage to around 84% of the UK population:

Blaenplwyf	Wales
Divis	N Ireland
Durris	Scotland
Hannington	South
Llanddona	Wales
Oxford	South East
Rowridge	South
Sudbury	East
Waltham	E Midlands

(A NICAM stereo service — on BBC 2 Scotland only — has also been provided at Sandale in Cumbria.)

At most main stations, the BBC equipment cannot readily be modified to carry the NICAM stereo service: it is not a simple case of "bolting on" the NICAM equipment. Instead, it normally requires the installation of completely new transmitting equipment, which is being provided as part of the normal replacement programme as equipment reaches the end of its useful life cycle — approximately every 25 years.

Fortunately, however, nearly all the relay stations are transparent, which means they pass on the stereo sound incoming from the parent station without requiring any modifications.

Current plans provide for the extension of the NICAM service to 88% of the population by the end of 1995, as a result of major re-engineering work at the following five main stations:

Bilsdale West Moor	North East
Caldbeck	North
Caradon Hill	South West
Craigkelly	Scotland
Tacolneston	East

(Of these five stations, the NICAM work at Craigkelly and Tacolneston should be completed by the end of this year.)

For the latest information on the progress of NICAM, please refer to page 698 of BBC 2 Ceefax.

Peter Lonsdale
Head of Liaison Section
EID

Correction

In the Engineering Division family tree which was published in the previous issue, Dick Storey of Research Department was wrongly called Bob Storey, and the line linking Research Department to the division was missing.

Also missing was the Engineering Safety team of Brendan Skelt and Martin Nutt.

Our apologies to all concerned.

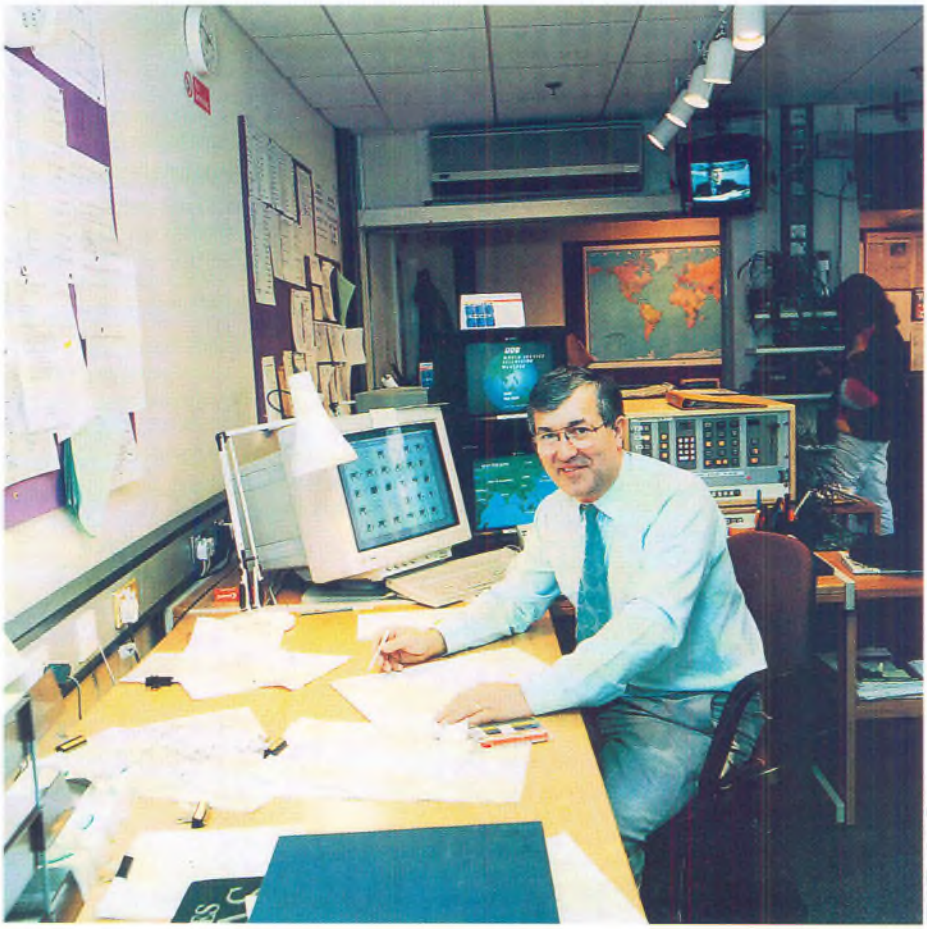
New bi-media Weather Centre at TC

Nigel Jackson gives the reasons for building a new bi-media Weather Centre at TC and describes the facilities provided.

The new Weather Centre has, for the first time, allowed Radio and Television forecasts to be broadcast from the same site. Radio broadcasts began on 1st September 1991 and Television broadcasts on 17th November that year. However, the main on-screen impact of the new area was seen progressively through 1992, as new control software was released by the Computer Graphics Workshop.

The Weather Centre provides bulletins for Network Television, South East Regional Television, Network Radio, World Service Television and SSVC (who are responsible for British Forces Broadcasting). This adds up to 47 broadcasts every day, 24 hours a day — a level of broadcasting that could not have been supported using the old facilities in the Weather Office and Presentation Studio A.

The new centre has allowed extra office space to be created for additional Weather Forecasters, as well as a new Radio Studio; it has also released Studio A for full-time presentation use. The facilities are all self-operated (under computer control) by the Weather Forecasters and require minimal technical line-up, which makes it easier to provide a cost-effective 24-hour-a-day operation.



BBC Weather Centre

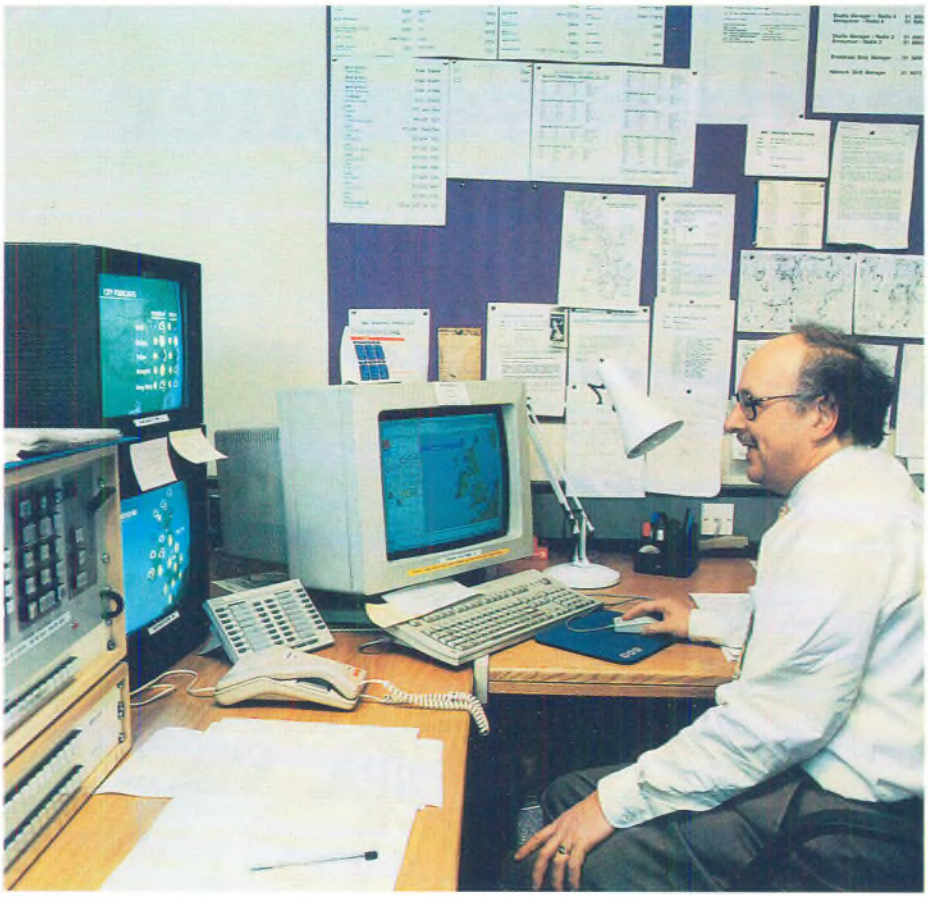
Bill Giles in the Forecast Office

The benefits of providing a dedicated Weather Centre on one site are numerous:

- ☐ The well equipped Forecast Office gives the Weather Forecasters a much more efficient environment in which to put together their forecasts.
- ☐ The close proximity of the Studio gives more time for forecast preparation as less time is spent getting to and waiting in the Studio.
- ☐ The new Studio now allows all forecasts to be presented standing in front of the maps, which is the preferred method of presentation.
- ☐ The provision of a second Paintbox and computer interface gives a greater capacity to do forecasts for different areas.
- ☐ The Weather Centre now provides additional broadcasts for World Service Television, Breakfast TV and South East Regional TV.

The new facilities

The new Weather Broadcast Centre was built on the 2nd floor of Television Centre, using previous office accommodation and part of the Technical Stores. It consists of a Television Stu-



BBC Weather Centre

Michael Fish in the Forecast Office

BBC Weather Centre

Bill Giles in the Radio Studio

dio, a Radio Studio and an Apparatus Room on one side of the corridor, and the Forecast and Production Offices on the other side.

One of the main challenges faced in building the studios was to provide adequate acoustic isolation whilst giving enough headroom for the lighting. Richard Westcott (Project Architect) and Richard Cole (Acoustic Architect) from BDMS designed the area using some new lightweight acoustic isolation techniques which have given good acoustic results whilst leaving enough room to light the Weather Forecasters adequately.

Radio Studio

The Radio Studio has replaced a facility at the London Weather Centre in Holborn, which was due to close. It is relatively basic with a main and reserve microphone chain, switchable on the line to BH, a control line and a cue feed. A countdown timer is provided for timing the broadcasts and logging facilities are used for recording every broadcast.

Television Studio

When the Television Studio made its first broadcast, the facilities and on-screen Presentation were the same as used in Studio A. The images are made on Quantel Paintboxes, software driven from Microvax computers. These images are either generated directly from information sent from the Met Office's Bracknell computer (eg, rainfall radar, satellite pictures) or from information entered by the Weather Forecasters (symbol charts, rainfall/sunshine hours tables). The Weather Forecasters produce their charts and the whole bulletin on an Apple Macintosh which is linked to the Microvax. The backup for this system is provided by stills recorded on a SlideFile.

The Forecast is done in front of a back-projected image of the Weathermap, flooded with blue light. This blue image is then used to chroma key the Weathermap behind the Weather Forecaster.

As all the devices used by the Forecasters work in component video, the opportunity was taken to install the new studio in component video throughout, the coding process taking place on the output of the area to CAR. One of the main benefits of this was the improved quality of the chroma key gained by using components.

The area was designed around a component matrix and GVG 110 component mixer, with Sony laser disc players and recorders provided to allow moving sequences to be used. The GVG video mixer and Pro-bel Audio mixer can now be used under computer control to provide the transitions between the various devices or to bring the Weather Forecaster in and out of vision. The software to do this was written by the Computer Graphics Workshop and was released during 1992.

As the Weather Forecaster is the only person present in the Studio during broadcasts, all the facilities are either preset, or set up by the Forecaster. Remote control of the lighting levels and microphone output are provided in the fourth floor Central Vision Apparatus Room. The facilities provided in this area allow Network staff to monitor the Weather Studio output and adjust as necessary.

Other facilities in the TV studio include talkback, cue feeds, control line and red lights. A countdown system is provided which can be set locally or from the Network Control rooms.

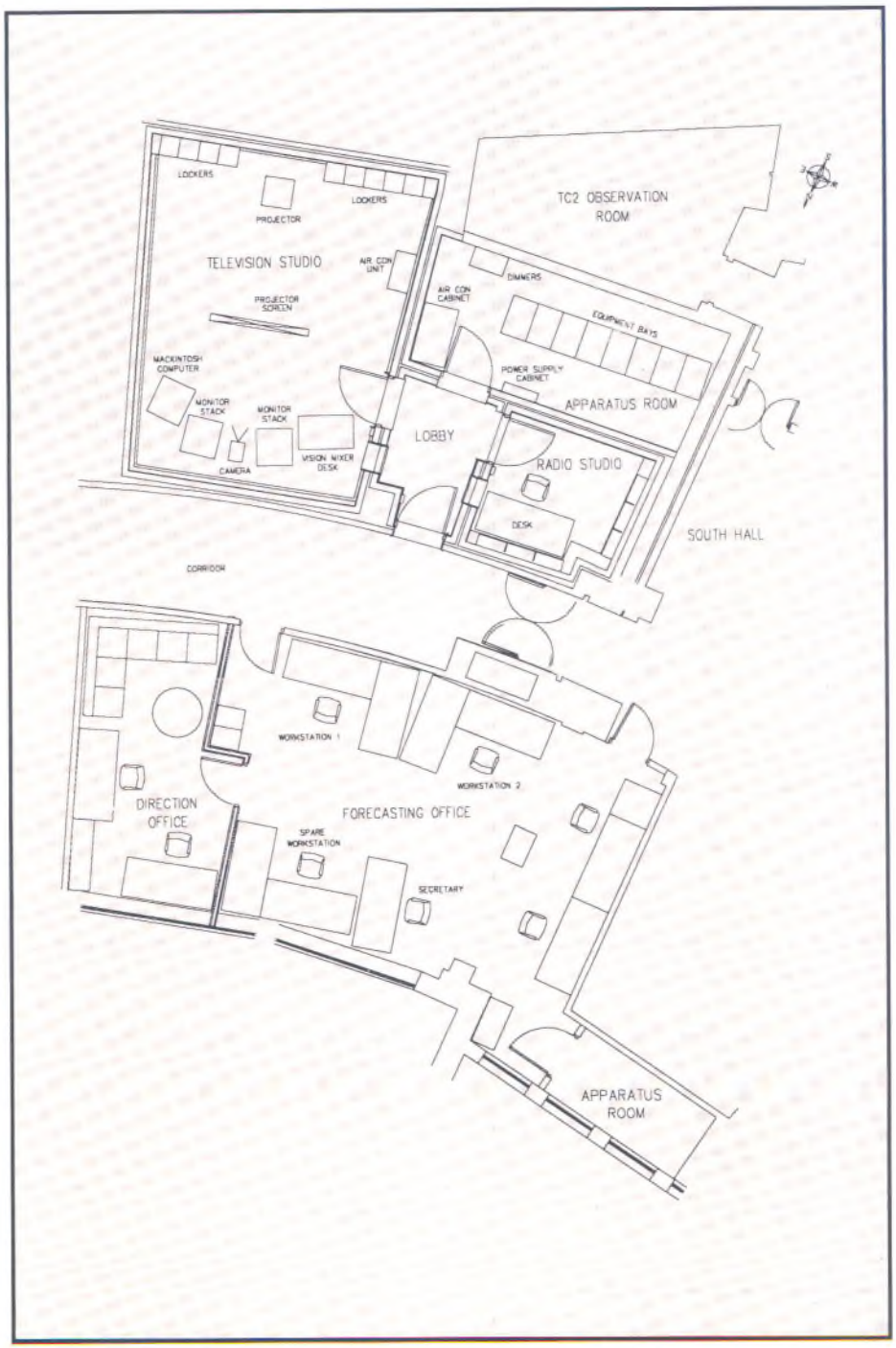
Forecast Office

The Forecast Office not only provides office accommodation for the Weather Forecasters but also houses the workstations where they put together their forecasts. This requires comprehensive communications with Bracknell Weather Centre to give them the most up-to-date forecast information. From the workstations they can build the forecasts on the Macintosh and preview the output of the charts on the Paintbox. Control of a SlideFile is available to record backup stills from the output of the two Paintboxes. The forecast office also has comprehensive monitoring and recording facilities.

Credits

The Weather Centre was jointly designed and specified by John Teather, (the Weather Producer), Roy Bertram (from Television Network), BDMS and TE & PS. It was installed by Frances Hill (project engineer), Kieran Morgan (engineer), Chris Przeslak (installation supervisor) and Clayton Ward (wireman), while the power wiring was specified by Bob Smith and the lighting by Mike Hall, all of TE & PS. Richard Westcott, Peter Ong-Seng and Stan Stone of BDMS provided the building and mechanical services. The changeover was achieved in a weekend with valuable assistance from Network Engineering staff.

Nigel Jackson, Project Leader
Distribution Systems
TE & PS



Plan view of the Weather Centre

Current Eureka and RACE projects

Henry Price and Andrew Oliphant summarise the current European* Eureka *and* RACE *projects which involve the BBC.

The BBC is involved in two basic types of European collaborative R&D projects: **Eureka** Projects, which can be partially funding from individual European Governments, and **RACE** Projects which are 50% funded by the EC.

These are the current projects involving the BBC:

John Barrett, RD

PAL Plus equipment undergoing lab tests at Kingswood Warren, with Jeff Judd

Eureka 95, HDTV

This project aims to develop a European HDTV system encompassing the whole broadcast chain from studio to home, with delivery from satellite. A studio television standard (1250-lines, 50 fields/s and 16:9 aspect ratio) and a large range of broadcast equipment has been successfully developed. A multi-channel sound system to accompany the HDTV display is still under development. The HD-MAC standard for delivering the signal to the home via satellite is probably the best known aspect of the project.

Phase II of the project, which lasted three years, was completed at the end of 1992. Phase III started in January 1993 and the BBC is participating in this phase mainly to continue the development of HDTV studio systems for both vision and sound.

Eureka 637, PALplus

This project aims to produce a wide-screen television system based on, and compatible with, present-day terrestrial PAL television.

The work is mainly concentrating on producing a new signal format that can be transmitted through existing transmitter networks. Existing viewers should see more-or-less the same quality of picture but in letter-box format, while people who opt to buy PALplus receivers will see an improved-quality picture in wide-screen. The BBC work is concentrating on examining ways that the existing PAL studio equipment and recorded material can be used to best effect with PALplus and other enhanced television systems.

The present three-year project finishes at the end of 1993. The BBC's work is being partially funded by the DTI.

Eureka 147, DAB

This project aims to produce a digital radio system that will provide reliable and consistent reception to a new generation of portable, mobile and static receivers, with a sound quality comparable to the compact disc. The work is concentrating on developing the new transmission system to be available by 1996.

Phase I of the project, which developed and demonstrated the basic system, was successfully completed at the end of 1991. The present Phase II lasts until the end of 1994, and aims to bring the system from the drawing-board to the point where services can be launched. The BBC has not received external funding for this project to date.

Eureka 625, VADIS

The aim of this project is to develop a method of turning a normal definition television picture into a low bit-rate digital signal, for a wide range of domestic and industrial applications. Digital video equipment is available today, but the signals use a large amount of data (up to 216 million bits/second).

It would be impractical to broadcast television using such high data-rate signals, as too large an amount of radio frequency space would be needed. The aim of the project is to

cut the data required by at least a factor of 40, so that the signal will use between 5 and 10 Mbit/s, while keeping the picture quality at least comparable with that available to viewers at present.

From a broadcaster's point of view, this would enable the space occupied by each terrestrial television frequency channel to carry at least one digital television service. Each satellite channel could be used for at least two services.

Phase I of the project finishes at the end of 1993 and the BBC work, again, is partially funded by the DTI.

RACE Project, HIVITS

Also a project on digital TV, this is aimed at setting the standards and developing the equipment for distributing digital television signals (both normal 625-line definition and HDTV) between studio centres, and from the studio to the transmitter. This RACE project, which has been 50% funded by the EC, was completed at the end of 1992.

In most countries, television distribution links are supplied and operated by Telecom Operators such as BT. These companies are moving rapidly towards all-digital transmission systems. In general, the charge they make for the transmission of a signal is related to the amount of data it requires.

It makes financial sense for broadcasters to reduce the data-rate of the video signal, providing its quality can be maintained. Also the very high data-rates of the source signals (216 Mbit/s for 625-line, and just over 1 Gbit/s for HDTV) can make their transmission very difficult over standard distribution channels, making it necessary to compress the data.

The project has successfully produced a reduced-data digital TV signal at 34 Mbit/s for 625-line qualty, and at 140 Mbit/s for HDTV, while still maintaining the very high picture quality necessary for signals going between studio centres.

RACE 1036, WTDM

The aim of this project was to produce a technology demonstrator to show that all aspects of the technology — electrical multiplexing to 2.5 Gbit/s, wavelength multiplexing with wavelength channels separated by 4 nm, and network control — were feasible. In November last year, at the Research Department demonstration days, we demonstrated a network comprising three local routeing centres (LRCs) with 2.5 Gbit/s multiplexers partially equipped with video and audio signal interfaces, plus a further eleven lasers modulated with 2.5 Gbit/s test sequences to represent additional LRCs. The control system allowed us to select between two PAL signals carried in a 2.5 Gbit/s multiplex on the same wavelength, and between signals carried on different wavelengths; it also kept a record of connections and monitored alarm signals from components of the network. The demonstration thus showed that the project had achieved all its aims.

RACE 1081: BUNI DEMONSTRATOR

The broadband ISDN that is being developed by network operators will have a user-network interface (UNI) at 155 Mbit/s with a set of complex protocols. This project aimed to validate the specification of this broadband UNI by bringing together several realisations of it and demonstrating the transmission of signals including video and compressed HDTV between them. The BBC contribution was a customer premises network (i.e. the customer side of the BUNI) based on the R1036 demonstrator, for which we had to develop interfaces between broadcasters' standards and telecomms standards.

The BUNI Demonstrator was successfully assembled at PTT Research at Leidschendam near The Hague and public demonstrations were given in March and April. This was the first time that the R1036 network had been shown carrying HDTV signals.

RACE 2001: WTDM PILOT

R1036 has shown that WTDM technology is feasible; R2001 aims to develop the technology to the stage of a pilot installation. The project produced a specification for a complete installation at Cardiff, but a pilot installation on that scale turned out to be too expensive. The project is now looking for a site for a small installation, particularly one that will show the advantages of optical transmission — high bitrate, low losses and freedom from interference.

RACE 2065: COBRA

The WTDM system of R1036 and R2001 offers a capacity of about 40 Gbit/s. However, this would soon be used up if we had to route large numbers of HDTV signals at 1.2 Gbit/s each. Coherent detection of optical signals allows 2.5 Gbit/s optical carriers to be spaced much closer, giving virtually unlimited bandwidth on optical fibre. COBRA aims to develop this technology and to show that it offers a compatible extension of an installed WTDM network.

Andrew Oliphant
Systems & Recording Section
Research Department

The four RACE projects involving Optical Routeing

RACE Optical Routeing Projects

The BBC is involved in four RACE projects which between them form a family aimed at developing a method for distributing signals around studio centres using optical fibres. The BBC is the project leader of two of these RACE projects — 1036 and 2001.

The basic idea is that all the studios in a centre (such as BBC Television

Centre) could be connected to a fibre-optic highway which can carry literally hundreds of television signals. This would allow each studio to have access to all the signals on the highway, thus doing away with the central switching system and the huge amounts of wiring that are presently needed.

In order to make it relatively "future proof", the system is designed to be transparent to the type of signal it is carrying. Thus it could easily cope with a change from normal definition television to HDTV or to a mix of both. In the long term, such a system should be cheaper to install and operate than a conventional wire and switch system.

The four RACE projects involving optical routeing are described in the box on page 7.

RACE Project, TRANSIT

This project is looking at ways in which domestic television display systems are likely to change in order to cope with all the different types of picture sources that will become available in the future. The aim is to develop a method of converting the various picture standards in such a way that they can all be shown in high quality using the same display. The BBC is interested in this project as it involves developments in a "key" technology which could generate significant spin-offs in studio applications. The project started in Jan 1992 and runs until Dec 1994.

RACE Project, MONA LISA

This project is investigating the possibility of generating background studio scenes by computer and then adding them electronically to the picture. Instead of having to construct a studio set physically, the background scenery could be designed on a computer. The background could then be added to the picture of the actors with suitable adjustment and correction to take account of the camera angle, focus etc. The project started in Jan 1992 and runs until Dec 1994.

RACE Project, MBS

MBS (mobile broadband systems) is a RACE project which aims to develop high-quality reliable dial-up programme contribution links for television OBs or news. At the remote location, the picture will be converted into a digital signal and sent on a radio signal to the nearest point on the main telecommunications network. The signal will then be carried back to the studio centre over normal digital telecommunications circuits. Such a system is likely to be operationally very efficient and cost-effective.

Henry Price
Engineering Adviser (Ext Liaison)
Policy and Planning

News Programme Branding

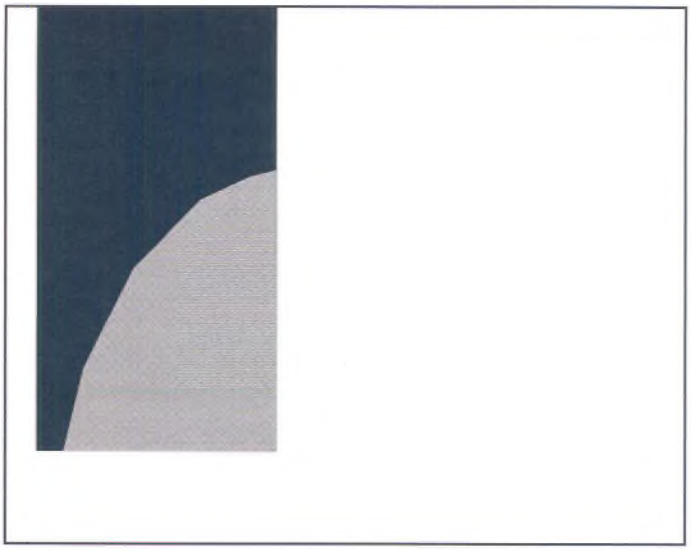
News Programme Branding (NPB) was launched from Studio N2 earlier this year.

Here, Chris Nicholls presents an overview of the facilities which have brought these improvements to our screens.

News Programme Branding was the culmination of some two years work by a team of designers, directors, operators, and programme editors. However, it represents more than just a new house-style: it provides a basic style that is common to all the BBC's daily news output and has introduced new graphics equipment that will enable greater automation to be used for the creation of house-style graphics.

The proposals for the studio, produced by the NPB team during November 1992, required fairly extensive changes to the vision systems in Studios N1 and N2. The main element of these changes was the addition of three video effects chains to produce colour separation overlays containing studio cameras, graphics and video disc players as sources to the existing CDL vision mixer.

The proposals for the graphics, produced in January 1993, recommended the introduction of a Silicon Graphics VGX computer — previously used for 3-D animation work — for the production of standard still-frame graphics in an automated system. An additional Quantel Harriet animation system was also required.



The photograph on the left shows presenter Martyn Lewis with graphic insert. On the right is the mask signal required to control the keying. The grey area allows CSO keying where the presenter's shoulder is likely to overlap the graphic. The black area forces the graphic through regardless of the backing and the white area forces the presenter and backing through.

Studios N1 and N2

Timing

Since the studios were last refurbished in 1982-4, all vision sources other than the local cameras have been asynchronous, with synchronism being restored by six decoding synchronisers embedded in the vision mixer at bank level. The requirement to mix graphics and cameras before the vision mixer made it essential to make the graphics area (previously only synchronous to TC2) synchronous to N1, N2 and TC2.

This was achieved by equipping all three studio outputs to CAR with 360° Isophasers, removing the local DPS equipment, providing all areas with a common reference, and moving the timing of N1 and N2 into Network, to that of a late source. Isophasing amplifiers recovered from Lime Grove were installed in N1 and N2 to ensure complete synchronism of graphics in all areas. Provision has also been made for later acceptance of the fourth floor Videotape Transmission Areas as synchronous sources, but further work is required on the fourth floor to provide suitable references and working practices.

The Studio Set

This consists of a semi-circular desk behind which is a full-height illuminated screen. The screens are rear illuminated by fluorescent tubes with high frequency dimable ballasts controlled from the lighting desk. The screens can be changed to allow the different programmes to have individual identities.

Desk effects

The NPB style requires the presenters to sit at a desk with graphic inserts occupying only part of the background. The graphic insert is required to appear to be behind the presenter but in front of the backing. The method chosen to ensure that the presenter was in front of the graphic is *Colour Separation Overlay* (CSO) using the blue of the backing to generate the key. There are however complications.

The first is that the graphic insert is not necessarily wanted everywhere that the backing is blue; it is often to one side of the presenter. Secondly there are areas of the backing where the graphic is wanted that are not actually blue and will not generate a usable key signal. The Breakfast News and Nine backings have orange areas and the One and Six have almost white areas. These problems are overcome by using a three-level (black, grey, white) "Mask" signal that modifies the key signal. Firstly the key signal has its negative ex-

Jeff Overs, NCA Photographics

View of the real Nine o'clock News set. Note the floor monitor showing the presenter plus graphic insert.

cursions removed. These all represent non blue colours and is particularly relevant to the Breakfast News and Nine backings. Secondly the Mask signal is added to the clipper potential and the result passed to a conventional key clipper.

The net result is that where the mask is grey, normal CSO is allowed. Where the mask is black, the background (graphic) is forced through regardless of the CSO key and where the mask is white, the foreground (the presenter and backing) is forced through. The masks can be either generated digitally using two D&ED *DOGs* each containing four patterns each, or can be stored on one of the four Sony Videodisc players installed in each studio. The graphic inserts are generated to register accurately with the mask positions and size.

View of the virtual computer-rendered model studio with the real presenter matted in. Only the real presenter's desktop immediately in front of him is real.

Three identical desk effects chains have been provided. These allow rapid cutting between the two presenters and also inclusion of a wide-angle shot featuring both presenters, all with different graphic inserts.

A fourth effects chain, in N2 only, has been provided specifically for the title sequences. It includes a single-channel Questech Charisma with a live background and key channel. It is used to key a small area of picture containing a live studio camera shot of the real presenters into the computer generated view of a studio, and to accurately track the motion contained in the animation so that the presenters appear to be part of the animation.

The computer animation is played from a Sony videodisc player. A second player can be used to provide a travelling matte that accurately registers with and tracks the animation, and defines the area of the animation that is to be replaced by the live studio camera. The two disc players are cued in synchronism by the Charisma via a Personal Computer.

Cameras and Robotics

The cameras and mountings in N1 were replaced at the end of 1992. The work to replace the N2 cameras and mountings was carried out at the same time as the NPB work.

A total of ten Thomson 1647S lightweight camera heads and triax basestations have been provided. These can be distributed as required between N1 and N2 up to a maximum of six in either studio.

The camera remote control system has been provided by Radamec EPO. Five fully-robotic RP2 pedestals and five remote pan, tilt and height systems on Fulmer pedestals have been provided. All the systems have full control of lens and camera control functions. If demanded by equipment failure or production requirements, the remote controls can be disengaged and the pedestals and heads manually controlled.

Graphics

There are six graphics lines to each news studio from the fourth floor Graphics area. These are sub-selected within the studio to four "caption lines" (a bit of history) which appear on the vision mixer and the desk effects system. In addition, the desk effects systems have direct feeds of two SlideFile main and preview outputs.

News Programme Branding has brought the Silicon Graphics VGX power series computer into the production of routine daily graphics. One machine has been moved into the fourth floor GR1 graphics production area and is connected by ethernet to a second machine in the first floor 3-D Graphics area. The SGI 4D/310VGX computers are based on the R3000 32-bit RISC processor.

Both systems have 64 MB of memory and have a processor clock frequency of 50 MHz. The operating system is Irix (the SGI dialect of Unix), and the VGX option signifies a Virtual Graphics Engine. This is a hardware rendering engine that is capable of rendering in real time. A Videolab frame buffer that "Pixel steals" from the SGI graphics bus allows the full speed of the VGX render engine to reach the TV format output.

The Silicon Graphics machines run NCA *Automator* and *Mapper* software. The Automator package allows the automatic creation of house-style inset and text graphics and various animations. The Mapper package uses a proprietary world map database to produce accurate maps of any part of the world, and can even produce animated fly-in sequences with full 3-D topography.

A Quantel Harriet animation system further enhances the animation capabilities of the area.

Chris Nickolls, Project Manager
Projects & Planning
RES (NCA)

Digital Audio Broadcasting

Digital Audio Broadcasting may be closer than you think! Here, Richard Eliot of the DAB Steering Group answers some of the more commonly-posed questions on this new broadcasting technology.

What is DAB?

DAB (Digital Audio Broadcasting) is exactly what its name suggests — the delivery of radio programmes direct to the listener using digital audio techniques, with all the advantages of quality, durability and reliability which that can bring. In this instance it also means using totally new broadcasting technology, developed by a consortium of European manufacturers and broadcasters, including the BBC, under the name of *Eureka Project No 147*.

What will I be able to get on it?

In the early stages, the BBC would expect to put on DAB all the programme services currently enjoyed on FM, plus the proposed continuous news service. However, the technology also offers the possibility of carrying services not currently available so, as DAB develops and the number of listeners increases, other services could be added.

What about Local and Commercial Radio?

The AIRC (Association of Independent Radio Contractors) and the Radio Authority are working with the BBC to secure Government approval and frequency allocations for DAB services in the UK. However, while the number of DAB receivers in use is low, the commercial sector may find it difficult to generate enough revenue to launch DAB services.

Once the DAB audience starts to grow, we can expect the commercial stations to be quick to join in. Because of the way the system works, with groups of radio services broadcast together from the same transmitter (see later), it will not be practical to launch BBC-only local DAB services since, by definition, any one area is covered by only one BBC Local Radio station. BBC local services may therefore have to wait for an opportunity to share transmission facilities, before they can get onto DAB.

Will this system be used in other countries?

There is every indication that the Eureka DAB system will be adopted as a European and eventually worldwide standard; work to publish the specification as a European standard is well under way.

What about World Service?

BBC World Service is actively exploring the possibilities for getting onto DAB. Towards the end of 1992 it was announced that World Service was working with three other European international broadcasters — Deutsche Welle, Radio France Internationale and Radio Nederland — to explore the potential of a pan-European public service-based radio network. They are particularly interested in using the Eureka DAB system for this service because, amongst other things, it can offer a service right across Europe without retuning.

What else does it give me?

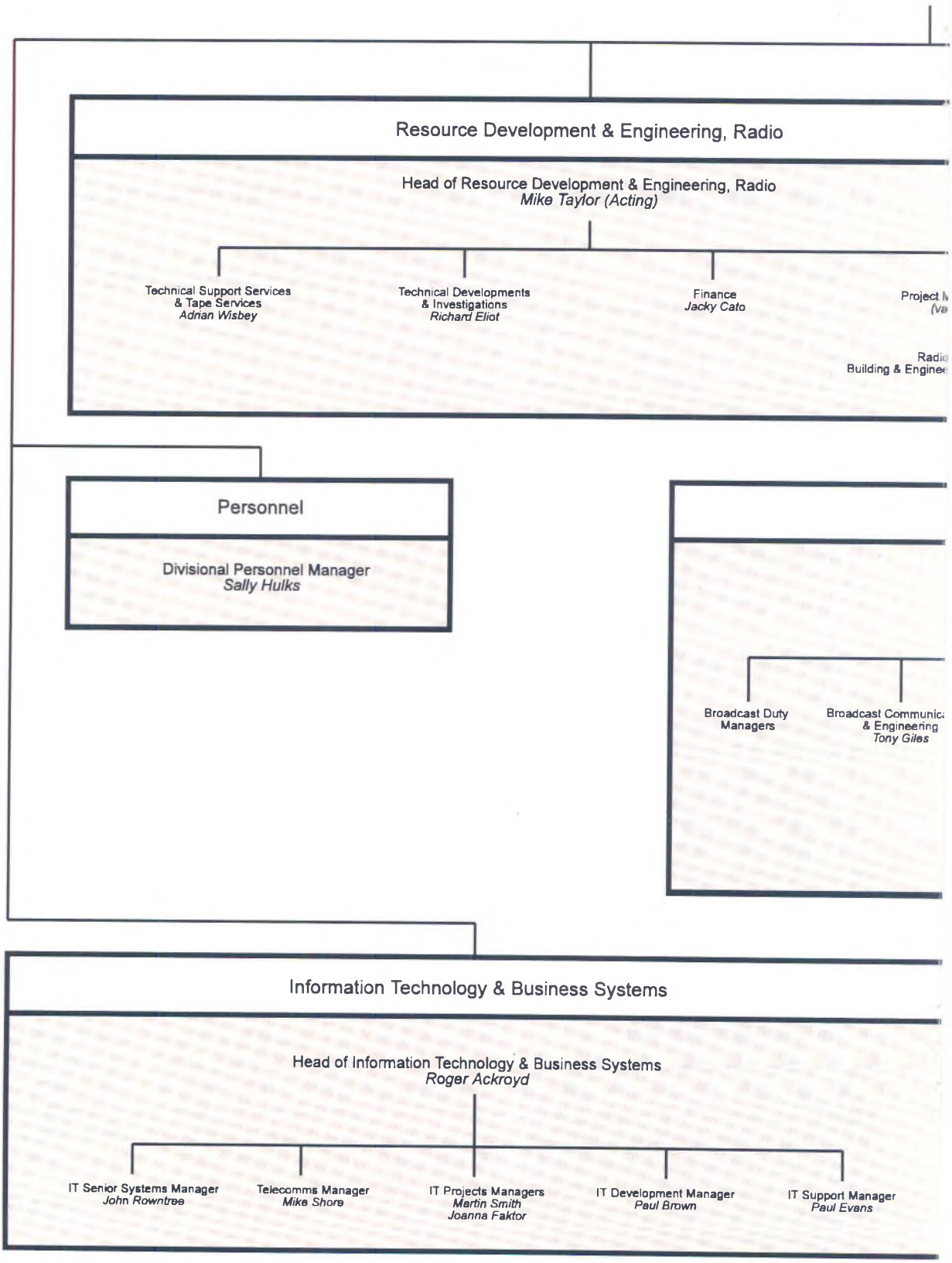
There are a whole range of additional services which could be put on DAB to go along with the main programmes; *audio* such as multilingual services, continuous travel announcements or city news, or *text* such as phone-in or help-line telephone numbers, record catalogue numbers, Radio Times information or even share prices. These are just some of the ideas thrown up by the hooks that have been built into the specification. Like the main programme services, these are all under consideration, but no decisions have been made yet. There is little doubt that, whatever the services available when DAB goes on air to the public for the first time, other services will develop.

But it's not just the range of programmes that DAB offers. It also offers true push-button programme selection; no retuning when you move around the country. The radio can also tell you what you are listening to and what other programmes you could be listening to, without having to switch round to find out. The signal is also very rugged, so not only do you no longer have to retune, you won't suffer from it breaking up or fading as you move about.

Last, but by no means least, you'll get it all in CD quality audio.

continued on page 14 ...

Network Radio Resources



Structure of Resources, Engineering and Services (Network Radio): 27th August

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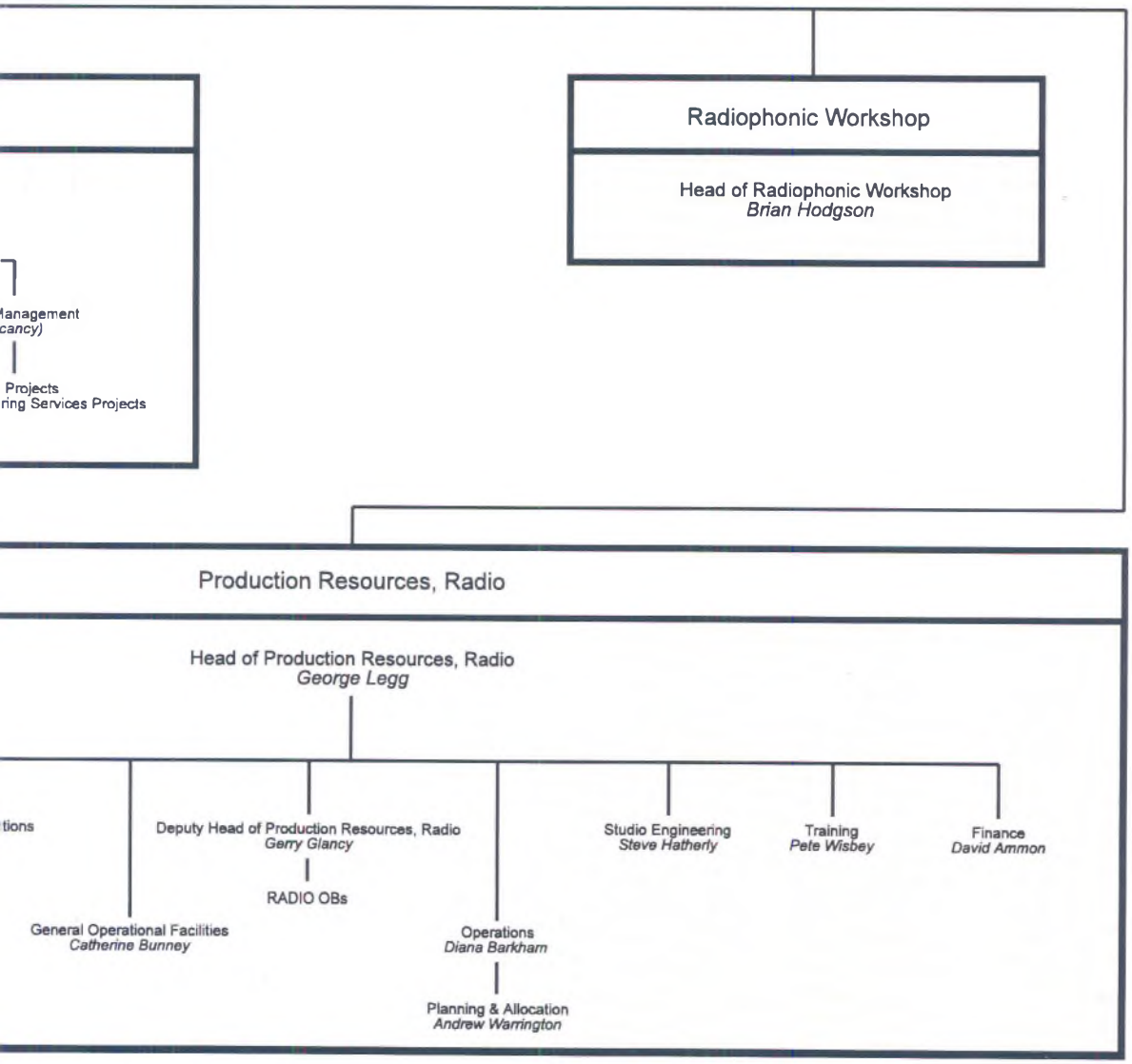


Continued from page 11

Can I use my existing radio or do I need an adapter or a completely new radio?

The technology of DAB is so different to FM or AM that you cannot simply adapt an existing radio to receive it; it would be like trying to make a gramophone play a CD. The first home DAB sets are likely to be HiFi Separates to complement your existing tuner/CD/cassette setup. For in-car use, either separate units similar to car CD players or FM/AM/DAB radios should be released. The BBC is talking with manufacturers about what their DAB radios will do, so that they will allow the listeners to get the most out of the services we will be offering.

How does it work?

The Eureka DAB system is very complex. In basic terms it combines two totally new technologies with existing digital audio and radio transmission techniques.

The first of the new technologies is to do with how the audio signal is carried around in digital form. It uses a technique similar to that used in the new Philips *Digital Compact Cassette* (DCC) and Sony *Mini-Disc* to reduce the vast quantities of information normally needed for digital audio. It does this by not keeping the digital information which relates to things you cannot hear. The information to discard is chosen so that it is either below the threshold of hearing or its absence is hidden behind or masked by other, louder sounds; for DAB the particular system used is known as MUSICAM. Like the systems used in DCC or Mini-Disc, the quality of the final audio can sound as good as CD.

The other technology used goes by the abbreviation COFDM — Coded Orthogonal Frequency Division Multiplex. This is a description of the actual process of radio frequency transmission, rather like FM for Frequency Modulation. The basic principle is that, instead of using a single radio frequency to carry the signal, it uses many hundreds of individual frequencies, in fact about 1500. Each carries a part of the overall signal, some duplicating others.

The real trick of COFDM is in the way the digital information is arranged between these frequencies, or carriers, and the precise relationship of each carrier to the rest. This is done so that the complete broadcast signal can be rebuilt from only part of the original COFDM transmission. Additionally, two transmissions which arrive by slightly different routes — which causes the multipath that is so deadly to FM — can actually combine to help fill in any gaps created by the parts that don't arrive at all!

This collection of transmissions is known as a *Block* or *Ensemble* and the beauty of the DAB system is that you can run as many overlapping transmitters as you like using the same Ensemble and they all add together. Thus, you can cover the whole country, or even continent, without the DAB radio ever having to retune to get the programme you want.

As if this wasn't enough, there is one final level of complication: each Ensemble doesn't just carry one radio programme, it carries several as well as other information services (audio or text). The number of services isn't fixed for all time, it can change from day-to-day or minute-to-minute, so the range of radio programmes available at any one moment could be varied to suit the range of audience.

(See *Eng Inf* No 44 for a more detailed description of how DAB works.)

Will it work in my Car?

Very definitely. In fact the Eureka DAB system was devised explicitly to deal with the problems of interference and signal loss that plague FM reception on the move. Rather than try to filter out the multipath signal reflections that cause much of the problem with mobile FM reception in town, it actively takes advantage of these reflections to strengthen the signal. It is this same technique that means DAB portables will not be as choosy as FM about which bit of the windowsill or kitchen shelf they sit on. The other great advantage to the mobile listener is that, as all the DAB transmitters for a particular group of radio services use exactly the same signal and frequency as each other, there is no retuning as you move around the country. The Radio Data System (RDS) relieves the problem by doing the FM tuning for you; DAB does away with it altogether.

What does it cost?

Like CD, it will not be cheap to begin with. It is difficult to put a figure to it just yet, but £400 has been suggested as a likely price for a home HiFi DAB receiver. However, also like CD, prices will fall as the market grows but unlike CD, a DAB receiver has no delicate, precision moving parts which limit the price reduction. In fact a DAB receiver could be made almost entirely from silicon chip technology. This means that mass production could bring the prices right down (witness the pocket calculators now given away as free gifts with breakfast cereals). It will take some time for DAB manufacturing techniques and the consumer market to reach this level but is does mean that DAB will not remain the preserve of the Hi Fi enthusiast, even if they are the only ones who will pay the prices to begin with.

Will I have to pay to listen?

Under Extending Choice the BBC is committed to the principle of universal access. It is therefore extremely unlikely that BBC DAB transmissions would be entirely subscription based. The technology could easily support pay services and so it is possible that there will be some commercial and additional BBC services available on a subscription basis.

Is this Satellite Radio?

Yes and No. The Eureka DAB system can be used to broadcast by satellite direct to your radio, but it can also use ordinary ground-based transmitters, just like FM. Current thinking is that the first services will be from ground-based (terrestrial) transmitters, although the signal may get to the individual tranmitters for broadcast-

individual tranmitters for broadcasting via satellite. It is also likely that DAB radios will be able to receive both terrestrial and satellite transmissions, although a different aerial may need to be used.

Why does it have to be this new system, why not the NICAM system used on Television?

The NICAM system used for digital television sound works fine with fixed aerials that can get a good look at the transmitter, usually because they are on roof-tops. Because of the quantity of information needed to transmit Digital Audio, there is little room for interference. Experiments conducted in the mid 70s confirmed that it just won't work for mobile and portable radios.

Does this mean I will have to throw away my FM/AM Radio?

No. It will be many years before most radio listening is done on DAB. Until then there is no intention to close any of our existing services on AM or FM just because they are also on DAB.

When will it happen?

Unlike some of the other future broadcasting developments like HDTV, it could happen sooner rather than later. The BBC's DAB Steering Group, under the leadership of Bill Morris, is working with a view to launching a DAB service for the UK at around the same time as those in Europe, ie around 1996. To that end, the BBC has already started experimental transmissions from Crystal Palace, in South London. The receiver industry will obviously follow the broadcasters' plans closely in order to bring their products onto the market to coicide with the start of broadcasting services.

DAB is the future of radio; it is therefore the future of BBC Radio ... and the future is not that far off!

Richard Eliot, Secretary
BBC DAB Steering Group

Mark Maddocks, RD

Experimental DAB antennae being installed on the Crystal Palace tower, as part of Eureka Project 147

John Barrett, RD

The interior of a newly-equipped vehicle for assessing experimental DAB coverage

Weather-related interference

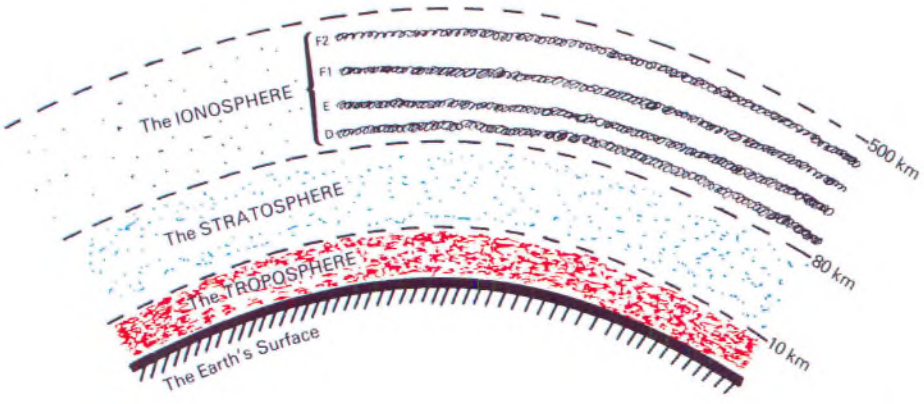


Fig 1: the earth's atmosphere showing the troposphere, the stratosphere and the D, E, F1 and F2 layers of the ionosphere

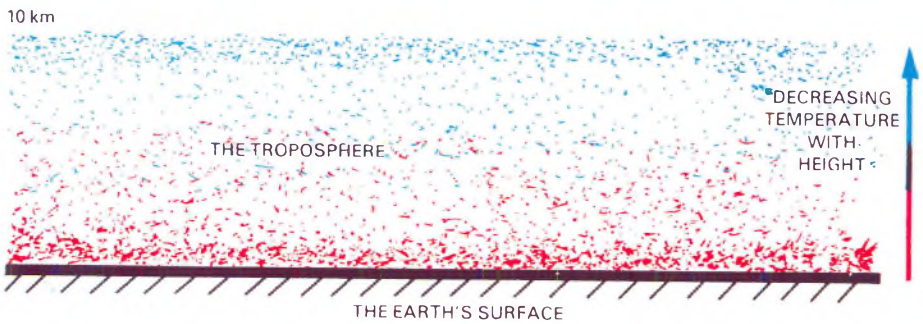
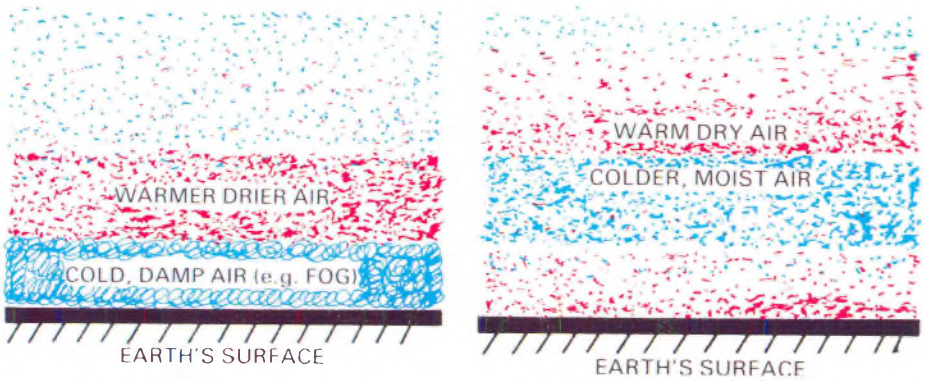


Fig 2: in a normal troposphere the temperature decreases gradually with height



a) a temperature inversion at ground level

b) an elevated temperature inversion

Fig 3: in an abnormal troposphere a temperature inversion can occur

Many readers will be familiar with the interference to TV and FM Radio reception that can occur during abnormal weather conditions. Doesn't it always seem to happen in the middle of Wimbledon fortnight!

Here, Mike Meyer explains what causes this interference and what the broadcaster can do to minimise its effects.

The factors which occasionally enable a distant transmitter to blot out local reception are complex, depending very much on complicated atmospheric conditions over the British Isles.

The Atmosphere

The atmosphere surrounding the earth comprises a lower layer called the *troposphere*, which extends to a height of about 10 km above sea level; a middle layer called the *stratosphere* which extends to around 80 km high and an upper layer called the *ionosphere* which stretches about 500 km or more into space (see Fig 1). The ionosphere is usually sub-divided into layers D, E, F1 and F2.

Although the ionosphere has an occasional effect on FM radio, as discussed later, the troposphere is the most important layer as far as VHF and UHF signals are concerned.

The Troposphere

All our weather occurs in the troposphere and, during normal conditions, its temperature decreases with height as shown in Fig 2.

During *low* pressure (cyclonic) weather, the air mass is rising gently and as it climbs, it cools and any moisture in it condenses to form clouds. Under these conditions, the troposphere is generally well "stirred up" and unsettled.

During *high* pressure (anticyclonic) weather, the air mass is sinking slowly and as it falls, its temperature increases to produce a warmer and drier atmosphere, very often without clouds. Under these conditions, the troposphere is generally very still and settled.

Although temperature normally decreases with height, certain weather conditions can result in a layer of air being formed whose temperature remains constant or even increases with height. In the United Kingdom, such a layer can occur anywhere from immediately above the earth's surface up to a height of around 3km. (see Figs 3a and 3b). This condition is known as a *temperature inversion*.

Temperature inversions mostly occur during high pressure periods as the still air allows stratification of the atmosphere to take place. They have a pronounced effect on VHF radio and UHF television signals, particularly if there are corresponding changes in the humidity.

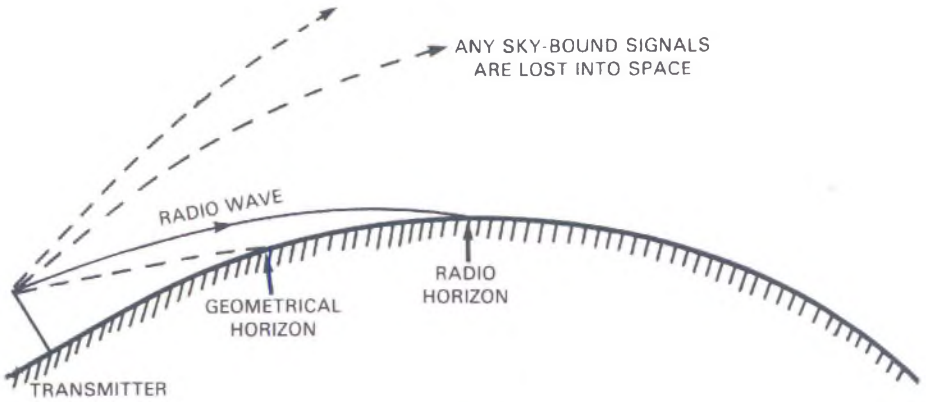


Fig 4: normal propagation of a vhf or uhf signal in the troposphere

VHF/UHF Propagation

VHF and UHF signals normally propagate (ie travel) through the troposphere in a slightly curved path as shown in Fig 4. As a result of this bending, they are able to travel further than the geometrical horizon to a point known as the *radio horizon*. Beyond here, the signals attenuate rapidly and good reception is not generally possible.

The bending of these waves is caused by *refraction* and the extent to which they curve depends on the *refractive index* of the troposphere. This in turn depends on the temperature and humidity of the air. In a normal atmosphere, the temperature (and humidity) generally decrease with height and this produces a steady fall in the refractive index with height. Under these stable conditions, the radio horizon can readily be calculated.

If a temperature inversion occurs, the refractive index can increase dramatically to produce long-range reception as shown in Fig 5. In this example, a sky-bound component of the signal (which would normally be lost into space) is refracted back to earth, well beyond the normal radio horizon.

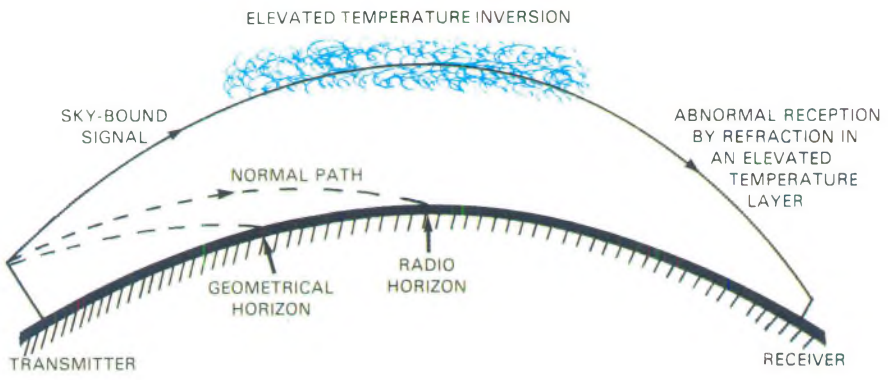


Fig 5: abnormal propagation of a vhf or uhf signal by refraction from an elevated temperature inversion

This type of abnormal propagation is often described as a *tropospheric opening* and, to the radio amateur or DX enthusiast, it is a Godsend. However, to the ordinary viewer or FM listener, it can be a nightmare — pictures ruined by co-channel or adjacent-channel interference; FM reception wrecked by "birdie" interference (warbling, sizzling, frying-type noises in the background).

Temperature Inversions

There are four types of temperature inversion which can lead to abnormal propagation:

1. Subsidence Inversion

Tropospheric openings can occur towards the end of a stable period of high* pressure. A typical system lying over the North Sea is shown in Fig 6. (A large high may have stayed in this

* *Atmospheric pressure is often measured in millibars (mb) and, at sea level, a value of 1013 mb represents the average figure for the UK. However, low and high pressure are only relative terms so that a pressure of, say, 1008 mb could be called a high — if the pressure of the surrounding air masses is considerably lower. A small high like this is insignificant so far as we are concerned; the pressure at sea level would need to be 1030 mb or more to produce the large type of high which can lead to abnormal propagation over a very long path.*

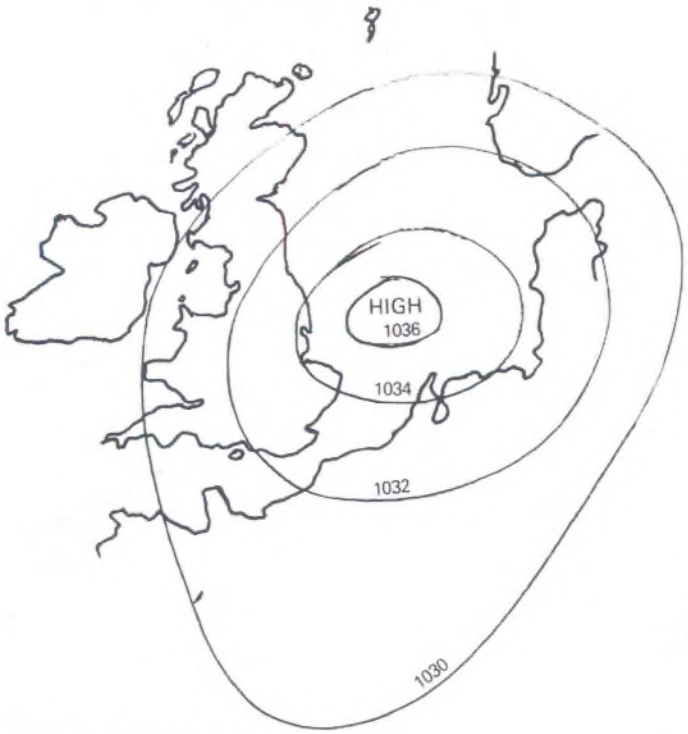


Fig 6: a typical high pressure system

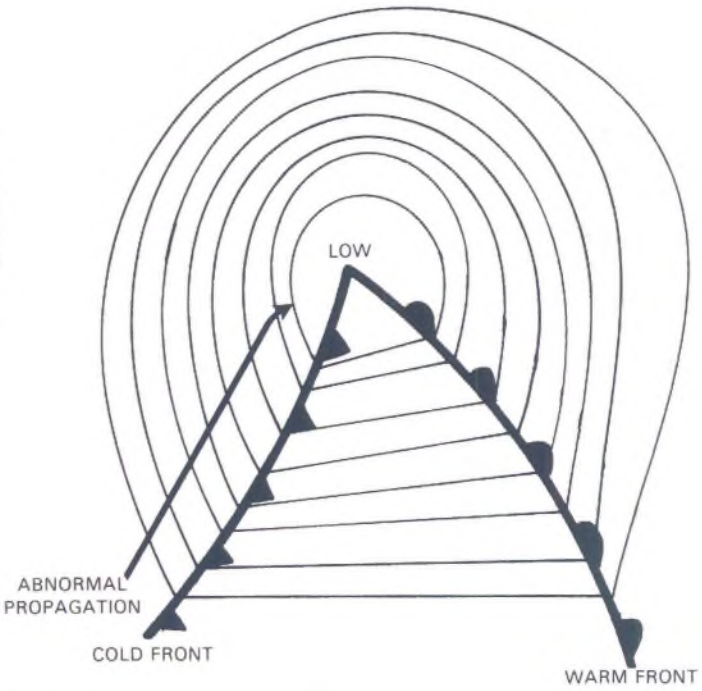


Fig 7: abnormal propagation can sometimes occur behind an advancing cold front

position for several days.) If it eventually moves east, it could allow moister and cooler Atlantic air to move in near the surface — below the subsiding mass of warm, dry air associated with the high.

The sharp contrast of temperature and humidity between the two layers of air produces substantial refraction of a VHF/UHF signal and a tropospheric opening develops. Had the high moved in a different direction, an opening may not have occurred as the temperature and humidity contrast between the two layers may have been too slight.

This type of inversion can happen at any time of the year but is more common in the spring and autumn. It can produce abnormal propagation for extended periods over large distances of several hundred kilometres.

2. Advection Inversion

This type of inversion is caused by an air mass adverting (ie moving) across surfaces of differing temperature.

During many a summer, Newcastle, Norwich and London have been known to swelter in the upper 20s Centigrade for several days on end, while the residents of nearby Tynemouth, Cromer and Margate, respectively, are enshrouded in fog at around 13 to 16 degrees C. Warm dry air above the land masses was being blown over the colder sea to produce a layer of cool, foggy air immediately above the water. This large contrast in the weather has not only upset east-coast residents and holidaymakers; it has also provided the right conditions for long-range propagation over the North Sea which, at the time, would have been extensively covered by a layer of fog.

An advection inversion can also occur over the land during the winter — if warm, moist air from the sea is blown over cold, frosty or snow-covered ground to produce a surface layer of fog or mist.

3. Nocturnal Inversion

This type of inversion can occur after dark, if the land cools more rapidly than the air above it.

During the daytime, the sun heats both the ground and the air and there is a normal fall of temperature and refractive index with height. In the evening, the ground cools rapidly and the layer of air closest to it becomes colder than the layer immediately above. Around dawn, the air in contact with the ground is at its coolest and may also be very moist, resulting in fog or dew.

As in the case of the advection inversion, the sharp contrast between the two layers of air — one cool and foggy, the other warmer and drier — provides the right conditions for long-range propagation of VHF/UHF signals. Nocturnal inversions occur exclusively over the land as the ground can cool much quicker after sunset, than the sea.

4. Frontal Inversion

This type of inversion occurs during low rather than high pressure weather.

Associated with a low there are often warm and cold fronts as shown in Fig 7. Changes in temperature and humidity with height occur at these fronts and abnormal propagation along the advancing front may occur. These conditions generally develop

only for a short time, along a limited path, and are fairly insignificant.

There are certain non-tropospheric conditions which can also affect radio and television reception. These occur in the ionosphere and deserve a brief mention.

The Ionosphere

The ionosphere plays an important part in LF, MF and HF broadcasting (ie long wave, medium wave and short wave radio) but its influence diminishes with rising frequency. In fact it has no known effect on UHF signals and only a very occasional effect on VHF BAND II reception (ie FM radio). Its most pronounced effect was on VHF BAND I signals — the old 405-line television system which closed down in this country during 1985.

As mentioned earlier, the ionosphere is sub-divided into layers D, E, F1 and F2 as shown in Fig 1. These layers have no effect on UHF propagation but under certain conditions, the E and F2 layers can act like a mirror to VHF signals, particularly at the lower frequencies, and reflect them back to earth, well beyond the normal radio horizon. For this to happen, the layer had to become heavily *ionised*.

In the E layer, the intensity of ionisation is seasonal, being highest in June or July. When ionisation becomes abnormally high, known as Sporadic E, VHF signals in BAND I and, to a lesser extent, BAND II can be reflected back to earth up to a maximum distance of about 2400km. In the days before UHF television, it was a major problem with television on VHF BAND I.

Ionisation of the F2 layer depends not only on the season but also on *sunspot activity*, which reaches a maximum every 11 years. Only BAND I signals are known to reflect from the F2 layer and the range covered can be extremely great. During the sunspot maximum period of 1957-58, the Channel 1 television transmission from Crystal Palace was received clearly in South Africa!

Network Planning

In the United Kingdom alone, there are over 4000 television transmitters sharing the 44 UHF channels available for this purpose. In Western Europe, where the same channels are used, the number of television transmitters most likely exceeds 30,000. Similar congestion occurs within Europe on VHF BAND II.

It is obvious that neighbouring countries must co-ordinate their network planning such that mutual interference, even during periods of abnormal propagation, is kept to an absolute minimum. It is impossible to plan a network which is totally free of interference but broadcasters can protect their transmitter service areas for the majority of the time.

... when averaged over several years, TV viewers and fm listeners should not be troubled by weather-related interference for more than 5% of the time ...

This can be achieved by carefully choosing the channel groups and aerial polarisation used at each station. Additional protection can be obtained by using directional transmission characteristics, where necessary, and by using the terrain (ie hills, mountains etc) to maximum advantage. In the case of UHF television, transmission frequencies can be "offset" slightly to minimise the subjective effects of possible interference. Finally, network planning assumes that the viewer/listener will fit a good directional aerial to keep out unwanted signals arriving from directions other than the wanted signal.

As Sporadic E and other ionospheric abnormalites occur very rarely, they can be ignored when planning a VHF BAND II or UHF network. In any case, their effects are usually felt thousands rather than hundreds of kilometres away. Successful co-ordination can only involve our closest neighbours such as Eire, France, the Benelux countries, Germany and Scandinavia. For that reason, only tropospheric abnormalities are usually considered.

As we cannot (yet!) control the weather, we therefore have no influence over the occurrence of abnormal propagation through the troposphere and it is only practicable to plan a network where interference is suffered no more than 5% of the time. To improve on this figure, broadcasters would need to reduce the number of transmitters and that would have a disastrous effect on the national coverage of their services. Consequently, the BBC publishes service area maps, based on minimum field strengths, which show the areas where reception should be protected from interference for 95% of the time.

Unfortunately, tropospheric-type interference is never spread thinly throughout the year. It tends to happen mostly in the evenings — when television viewing and possibly FM listening are at a peak — and it often appears at the same time on consecutive days, then disappears for several months. Some years are worse than others, depending on the prevailing weather patterns. Nevertheless, when averaged over several years, viewers and FM listeners should not be troubled by weather-related interference for more than 5% of the time — provided of course that they lie within the published service area and they fit a good directional receiving aerial!

Mike Meyer
EID

(Based on an article which was originally published in the 1984 Yearbook of the Confederation of Aerial Industries. The author acknowledges the valuable assistance provided by the then BBC Weatherman, Jim Bacon, a keen radio ham, and also his colleagues at the time in EID.)

Building Design and Management Services

Richard Fowler offers a profile of Building Design and Management Services (BDMS) — one of the major sections of the new Resources Directorate. On 1st September, BDMS was transferred from Bert Gallon's Engineering Division to Services Division, headed by Michael Starks.

KeyPhoto

Work in progress on Broadcasting House Extension: a collaborative effort between BDMS and external consultants

Building Design and Management Services (BDMS) can trace its origins back to the 1930s and the BBC's first civil engineer, M T Tudsbury, who is named as the *Engineer for Broadcasting House.*

From those early beginnings, the department was developed to the present day where, having many years continuous experience of the requirements of broadcasting buildings and facilities, it can and does offer a unique, integrated building design service to all parts of the BBC.

During the past four years, BDMS has adopted a "core service" approach which balances in-house design and management skills with input from external consultants. It's an approach which offers the utmost flexibility without tying up specialist resources unnecessarily.

Where consultants are appointed, BDMS brings its wide experience and service commitment to bear on monitoring quality. To control project costs while maintaining the integrity of a design brief, BDMS makes increasing use of value engineering, a specialised review mechanism. Creative and functional analysis of the design identifies non-essential characteristics which can then be eliminated or modified to meet the brief as economically as possible.

Building Design Group

Professional disciplines offered by the Building Design Group include architectural, structural, acoustic and interior design. The range of ex-

perience stems from the design and construction management of a variety of broadcasting and staff facility buildings as well as the day-to-day requirements of more temporary structures for outside broadcast or studio productions.

Building Design Group helps clients to develop an appropriate property strategy by preparing feasibility studies, design options and preliminary cost analyses, and liaising where necessary with local authority planners. After these all-important early stages, additional services are provided which can include detailed design, tender and contract supervision.

BDMS

TC Stage 6 model: commencing 1993

Architectural Expertise

Over the years, a range of buildings has been designed to meet the needs of local, regional and central broadcasting operations.

Particular expertise has been acquired in design/build for new-build projects where conceptual designs, preliminary cost plans and detailed specifications are produced for client approval, before seeking fixed-price tenders for the detailed design and development stages. Today, flexible forms of contract for internal fitting-out and alteration allow a broader measure of control in the face of fast-changing production needs.

Structural Design

Within the structural team are a number of specialist designers with experience of meeting the particular acoustic requirements of studio design. Records and detailed knowledge of existing BBC buildings provide a framework for feasibility and detailed design work for refurbishment and extensions. Experience of working with programme makers has encouraged innovative solutions to a wide variety of production problems, often within tight programme deadlines. Specialised checks can also be made on the structural aspects of scenery, flying ballet activities and OB operations.

A *Guide to Scaffold Practice* produced by Building Design Group is widely endorsed by scaffold training services.

BDMS

Simulating a rail accident on the set of Casualty

Transmitter Buildings

BDMS staff offer vital support in key areas of transmission activity throughout the terrestrial network. As well as providing new transmitter buildings, existing facilities are adapted or extended to accommodate site sharers. Site supervision for construction activities and advice on building maintenance throughout the UK can be provided by locally-based building works supervisors or site architects. The aim is to ensure that works are carried out with minimum impact on concurrent activities.

Acoustic Practice

Good acoustic performance is a fundamental requirement of all broadcasting buildings; indeed, it forms an increasingly important aspect of the brief for any work space.

Building Design Group has a well-established acoustic team which provides specialist input to all projects while continuing to develop new techniques for high acoustic performance at minimal cost. The team offers a consultancy service directly to clients;

advising on future needs or carrying out analysis of existing facilities.

A BBC *Guide to Acoustic Practice*, produced by our acoustic team, has become a standard reference work in the field of building acoustics worldwide.

Environmental Services Group

The Environmental Services Group, with a core of professional engineers drawn from a range of consultancy and contracting backgrounds, offers rapid and effective action on a wide range of fronts. From the simplest to the most complex building services problem, engineering skills combined with in-depth knowledge of BBC buildings and business acumen provide the complete professional service.

ESG is familiar with the challenges of highly-serviced broadcasting facilities, where maintaining output in the face of change is of paramount importance.

In addition to mechanical, electrical and public health engineering, the group's remit takes in vertical transportation, catering and energy conservation, and their associated health and safety implications. Quality assurance procedures in line with BS 5750 are strictly observed and accreditation under this scheme was achieved during 1992.

Mechanical and Electrical Services

With the advent of new technologies and an increasing awareness of health and safety issues, buildings have become more sophisticated and their occupants less forgiving. Today, building services can account for up to 30 per cent of new-build costs, and even higher proportions in the case of refurbishment.

Against this background, it is more important than ever that clients receive the best possible advice on services installation in order to reconcile quality with cost-effectiveness.

Vertical Transportation

The ability to move people and materials safely, rapidly and conveniently through any building is a fundamental measure of its design effectiveness. ESG ensures that the handling capacity and configuration of lifts, escalators and passenger conveyors are optimised in any proposed development, replacement or refurbishment programme. ESG will also provide a six monthly condition auditing service, plus safety reporting and advice on maintenance.

BDMS

BDMS is currently supervising a two-year lift replacement & refurbishment project in Broadcasting House

BDMS

Recently-completed installation of heating plant at Woodlands

Public Health Engineering

ESG has widespread experience of design, specification and installation implications of public health engineering works. Projects undertaken to date reflect the varied nature of BBC premises, from isolated transmitter stations to city-centre office blocks. In-house expertise offers a full specification, project management and commissioning service for the transportation and treatment of water through the complete usage cycle.

Health and Safety

Regulations under the *Health and Safety at Work Act* and associated food hygiene legislation have an immediate impact on the successful day-to-day management and operation of buildings and facilities. Using specialists in their fields, ESG offers a range of services, from practical advice to formal auditing, which meet the most stringent criteria for all health, safety and welfare issues confronting the facilities manager today.

Richard Fowler
General Manager
BDMS

High-profile demos in Brussels and Montreux

Andrew Oliphant describes two particularly challenging technical demonstrations which took place in mid June, at the TV Symposium in Montreux and at the European Parliament in Brussels.

The TV Symposium at Montreux included a *Future Technology Exhibition* where the EBU had for the first time taken a large stand on which it offered booths to its members. Research Department had agreed to take a booth in this "EBU village" — to demonstrate WTDM optical routeing and extended studio PAL (ESP), which is a way of getting virtually component quality pictures through PAL-based studio equipment such as VTRs and routeing systems. Thomson had a stand opposite the EBU and, with the help of the BBC, were to demonstrate 34 Mbit/s HDTV from the HIVITS project, which they led.

Planning for Montreux was going fairly smoothly when I had a call from an official in the European Commission. The European Parliament was to discuss advanced communications and had asked if there could be some demonstrations of the progress achieved so far. The EC official asked if we could put on a joint demonstration in Brussels of HDTV transmitted digitally by satellite and then through an optical fibre network. He had been most impressed by a demonstration of HDTV with surround sound at Kingswood Warren and was sure it would have the same effect on European MPs.

After a lot of consultation, the BBC and Thomson jointly agreed to participate in these demonstrations, alongside three other RACE projects. Then we were told the date — 9th June. That would be two days before the opening of the Montreux exhibition!

Brussels

Arranging a demonstration in Brussels became a nightmare: large, bright HDTV displays were all committed to Montreux; satellite time was all committed to Bosnia; and vital equipment for the satellite link (to be set up by Tel OB Comms) was scattered around Europe or on its way to Montreux. Although we had enough optical routeing equipment to put on two independent demonstrations, the HIVITS coder and decoder would have to be shipped overnight to Montreux, one from Kingswood and the other from Brussels, risking customs hold-ups because Switzerland isn't in the EC.

Miraculously, all the arrangements worked. The RACE HIVITS HDTV bit-rate reduction codec, jointly developed by the BBC, Thomson and TRT, was used to beam HDTV signals from Kingswood Warren to the European Parliament using a Eutelsat satellite. The HIVITS codec was originally intended as a contribution quality codec operating at 140 Mbit/s. However, in preparation for the Montreux demonstrations, the BBC had designed new interface boards and, along with Thomson, optimised the coding algorithm to allow it to operate at 34 Mbit/s — that is about a 30:1 reduction in bit-rate.

The sound for the demonstrations was conveyed through a six-channel Predictive NICAM coder/decoder, specifically developed for the HIVITS project. This enabled the full surround sound capability of the system to be demonstrated.

The demonstrations to the European Parliament were a great success, demonstrating Europe's lead in vital technologies like HDTV compression to a very influential audience. However, as described in an *Ariel* back-page article (29th June), they came close to disaster because the low-noise amplifier of the satellite receiver overheated in the hot sun. The demonstrations were saved at the last moment by cooling it with aerosol freezer and, when that ran out, with a teapot full of ice cubes!

John Barrett, RD

The now famous teapot!

Montreux

Meanwhile, another team had been setting up the more complex demonstration in Montreux. Perhaps it was fortunate that the tropical weather over Europe gave way to the cold and wet that British equipment expects in summer. But Montreux was not without its problems. To demonstrate the capability of our WTDM optical network, we had agreed to

... *continued from previous page*

carry HDTV signals for our Swedish colleagues, from their HD-DIVINE van on the lakeside to their booth next to us on the EBU stand. When the link was installed it worked perfectly. Then suddenly the screen went blank; investigation showed that the optical signal had dropped 10 dB, bringing it just below the sensitivity threshold of the receiver.

A walk beside the flowerbeds where the cables were laid soon identified the culprit: a Golf GTI parked with its front wheel on the bundle of cables! The driver couldn't be found, but a jack was procured and as the car was lifted the picture came back. The Swedes had also installed coaxial cables as a fallback, but when they tried to connect them they found there was so much more mains hum than picture signal that they were useless — a good demonstration of the advantages of optical transmission.

The ESP demonstration attracted significant interest, both from potential users of the system and from manufacturers interested in exploiting the technique. The demonstration showed 16:9 625-line component-source material, coded and decoded using experimental ESP equipment. The decoded pictures could be compared both with the component source and with normal PAL, allowing the complete absence of cross-colour and cross-luminance effects and the near-component quality of the ESP signal to be demonstrated. It was possible to demonstrate the compatibility between ESP and normal PAL and to show ESP signals replayed from a D3 recorder. It was even possible to route ESP through the optical network!

By common agreement, the EBU village was a great success, with crowds of visitors keeping the stand staff continually busy — so it is likely to be repeated at IBC and Montreux in future.

Nearby, on the Thomson stand, more BBC equipment and programme material was on display. The RACE HIVITS HDTV bit-rate reduction codec was now being used as part of a live demonstration showing the transmission of one HDTV signal plus four TV-resolution signals in a single UHF channel. The output from the HIVITS HDTV coder operating at 34 Mbit/s, along with the outputs from four 8 Mbit/s TV-resolution bit-rate reduction coders, was fed to the Thomson Diamond modem. This is a digital modulator that uses techniques similar to those employed in DAB to squeeze up to 70 Mbit/s into a single 8 MHz UHF channel. This certainly impressed the Americans who are struggling to fit about 20 Mbit/s into a 6 MHz channel for a single HDTV service.

John Barrett, RD

Andrew Oliphant (top left) talking to people attending the Brussels demos

From antennae on the roof of the Future Technology Hall, we were able to transmit our signal on Channel 43. Our live transmissions were received by antennae on the roof of the Main Exhibition Hall and decoded by equipment on a second Thomson stand a few floors below. Here the received HDTV and four TV resolution pictures were displayed side-by-side. Perhaps one of the greatest compliments is that many of our visitors were very happy just to watch Wimbledon in HDTV, completely unaware that any data compression had taken place at all.

Research Department was also involved with the Eureka 95 stand at Montreux. Here, multi-channel sound coding — compatible with the ISO/MPEG standard — was demonstrated using a codec developed by Philips. In support of this demonstration, Research Department provided a compilation of six programme items in HDTV with five-channel "surround-sound". So impressed was Piet Bögels, the EU95 Director, that all his "special guests" had to have the BBC demonstration: the other source material was "not good enough!".

Video compression, wide-screen production, and optical transmission were important talking points at Montreux and examples were to be seen on a lot of stands. The BBC contributions to the EBU, Thomson, and Eurek 95 stands showed us to be among the leaders in the application of these technologies.

The demonstrations in Brussels and Montreux — so close in time but so far apart in distance — gave us a lot of trouble in organisation and a few heart-stopping moments in performance. But they gave us the opportunity to demonstrate to two different but influential audiences the lead the BBC and its European industrial partners have built up in technologies that will be vital to the future of broadcasting.

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(with contributions from David Meares, Graham Thomas and Andrew Cotton, also of Research Department)

Printed by BBC WOOD NORTON