ENG INF

The quarterly for BBC engineering, technical and operational staff

SPRING *1993* *No* 52

BBC Radio now on Astra

Radios **1,4** and 5,.along with BBC World Service in English are now available in mono on the Astra satellite system. Starting on page 3, Henry Price describes how these new services are transmitted and what is required to receive them.

Astra Marketing Ltd

Graphical illustration of Astra satellites lA, lB and 1C in orbit

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ENGINF

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As *Eng Infis* an internal BBC magazine, it would be appreciated if no reference was made to it in articles, magazines etc, published outside the BBC.

Stories for the Autumn issue should be forwarded to the editor by Friday 20th August, 1993.

Transmitter News

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

New TV relays

Farleigh	Kent
Farningham	Kent
NeathAbbey	West Glamorgan

New FM stations

Barnoldswick	N Lancashire
Croeserw	West Glamorgan
Penmaen Rhos	Clwyd
Rheola	West Glamorgan

Radio 1 on FM

Kirkconnel	Dumfries & Galloway

Radios 1 and 4 on FM

Campbeltown	W Strathclyde
Girvan	S Strathclyde
Llanfyllin	Powys
Llanrhaeadr-ym-Mochnant	Clwyd

Local Radio

As featured on page 21, Radio Carlisle has moved into new stereo-equipped premises. The transmitters now broadcasting Radio Carlisle in stereo are Sandale, Kendal, Morecambe Bay and Windermere.

Further information from **EID** on White City (07) 25040.

Radio Romania calls on BBC expertise

Following a request for assistance from Radio Romania, JeffBottom of Radio Projects has made three visits to Bucharest since last August.

According to Jeff: *"The Broadcasting House in Bucharest was built in the early 1950s and many of its facilities are from that original installation by Siemens. The building is H-shaped (similar to our BH EXT), with the transmission studios and CTA in the lower floors of the centre section. However, the structure of their building suffered severe earthquake damage in* 1978, 1986 *and again in 1990. As it cannot be repaired or strengthened while still occupied, and further earthquakes could cause a total collapse, a replacement facility is the only way forward."*

Assisted by Roy Newrick (previously of Radio Projects), Jeff has assessed the situation at first hand and reviewed various alternative strategies for the future. *"The concept of separate project management staff has been introduced and a project team has begun work on a brief for consultants to prepare a feasibility study. An existing partially-completed museum building has been transferred to Radio Romania, as a way of speeding up the provision of new broadcasting facilities that are not subject to earthquake risk. A lot of time has been spent transferring knowledge gained from experiences in the BBC to the local staff who, although highly qualified and technically competent, have not had the opportunity to do any project work.*

While in Bucharest, Jeff was able to operate his own hand-held Amateur Radio equipment on 2 Metres FM, using the call sign *YO/G3SDG* under a permit from the Ministry of Communications. Many contacts were made in the Bucharest area, mainly using the repeater on channel RI (input 145.025 MHz; output 145.625 MHz) which resulted in Jeffbeing invited to operate on HF frequencies using local amateur stations.

Jeff leaves the BBC in July but discussions are in hand to determine the future of this cooperation with Radio Romania.

Display Screen Equipment

Now that the *Display Screen Equipment* regulations are in force, all computer workstations in the BBC will have to be assessed for Health and Safety.

There are over 900 screens within the former Engineering Directorate and a Project Team has been recruited - comprising Les Davis, Tony Dent and Paul Kinsey - to assess these work-stations by the end of the year.

Not only are the obvious parts of the workstation (such as the degree of flicker on the screen) under scrutiny: incorrect posture can lead to Upper Limb Disorder, Repetitive Strain Injury (RSI), backache etc. Thus, properly chosen and correctly-adjusted chairs are critical to avoid these risks.

Martin Nutt
Safety Services
Engineering

STOP PRESS...

Further to the article *inEng InfNo* 51 on the LS5/8 and AM8/20, Development Group now announces the AM8/21. This is effectively a stereo AM8/20 and comprises: one power supply, four amplifier channels and two cross-overs - all in a 3D 19" case with convection cooling. The price should be about *IV2* times that of the AM8/20 (ie, equivalent to *two* mono AM8/16s).

Further details can be obtained from Graham Whitehead at Avenue House. Tel: (036) 4273

ASTRA SATELLITE
BBC Radio Services now available

In early April, four of the BBC's radio services - Radio 1, Radio 4, Radio 5 and World Service in English - began transmissions in mono on the *UK Gold* channel of the Astra satellite. Henry Price gives some background to the Astra system and describes how to receive these satellite-delivered BBC radio services.

The Astra satellite system is owned and operated by the Luxembourg-based company SES (Societe Europeenne des Satellite). Presently, two satellites - Astra lA and 1B - are used to transmit thirty-two television services and a similar number of radio channels to most of Western Europe. A third satellite - Astra 1C - was launched in mid-May 1993 and is expected to come into operation in July/August, increasing the capacity of the system to forty-eight television services in total. Additionally, 1C has two channels intended for cable television distribution which are outside the frequency range normally covered by domestic satellite receivers.

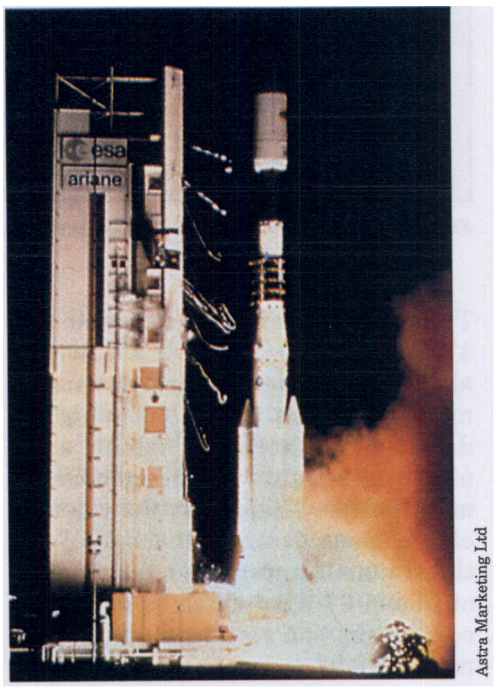
The satellites are located at nominally the same position in space: 19.2 degrees east on the geostationary orbit (about 36,000 km vertically above Zaire), so that a single dish antenna will be able to receive all forty-eight channels. The three satellites, which each weigh up to 2.7 tonnes and are about the size of a double-decker bus, are all located within a 70 km cube. Their position is closely controlled from SES headquarters at Chateau Betzdorf, Luxembourg, to ensure that they do not collide or block one another's view of the earth.

The three satellites operate within the fIxed services satellite (FSS) band as follows:

Satellite	lA	11.20 to 11.45 GHz
Satellite	1B	11.45 to 11.70 GHz
Satellite	1C	10.95 to 11.20 GHz

(The two cable channels operate just below 10.95 GHz)

The frequency range 10.95 to 11.70 GHz was originally intended for telecommunication satellites; not for broadcasting, which ~as been allocated the range 11.7 to 12.5 GHz. As a result, Astra was not subject to the original European Community satellite broadcasting directive, introduced in 1986, which required all direct broadcast satellites (DBS) to use the MAC transmission system. Hence, broadcasters using Astra have been able to operate in PAL or MACas has suited their purposes.



Ariane launching an Astra satellite

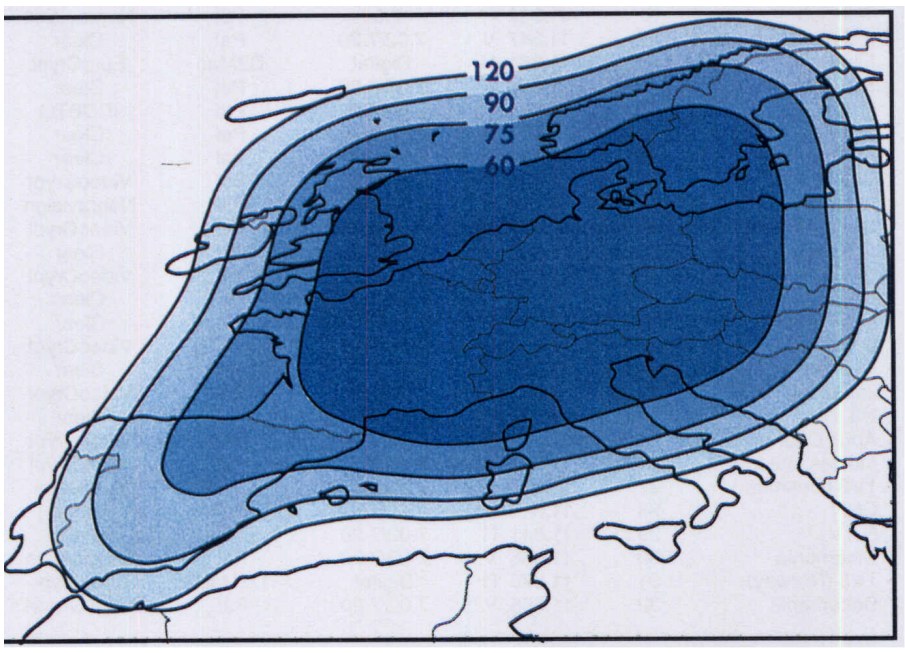


Fig l: the footprint of Channel 23 on Astra lB (UK Gold), showing the antenna diameter required (in centimetres) for direct-ta-home reception

The satellites are powered from solar cells which are backed up by batteries. These come into play during the spring and autumn equinoxes when the satellite passes into the Earth's shadow. Over a period of22 days, the eclipse builds up to a maximum of around 70 minutes at the equinox (about 22.10 to 23.20 hours GMT), then falls away to zero over the next 22 days. During the eclipse, the batteries have to provide the 2 kW of power the satellite consumes.

- Astra **Satellite** -

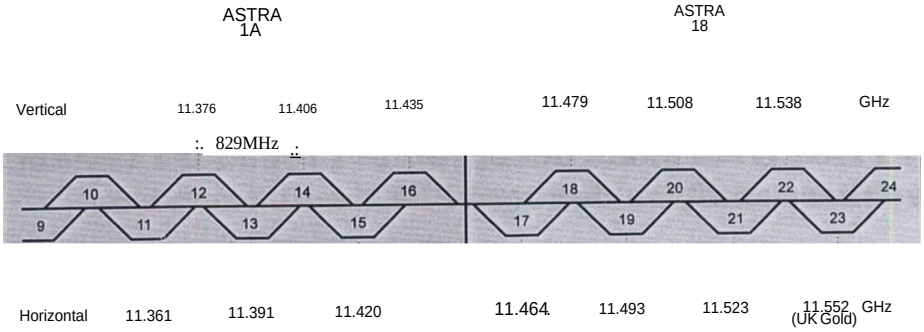


Fig 2: *frequency allocation in the region between satellites* lA *and* lB

Transponders on lA are rated at 47 W, while those on 1B deliver about 63 W. The signals are transmitted towards Earth via highly-directional antennas, which are aimed at roughly the French/German border. The erp at the centre of the beam is about 54 dBW, so the transmit antennae have a gain of about 37 dB (which is roughly equivalent to a standard 60 cm domestic dish).

The satellite coverage area comprises most of the low countries, Germany, France, Switzerland, northern Spain, northern Italy and the UK - with a total population of some 240 million people. Fig 1 shows the footprint of the *UK Gold* service on Astra 1B (which is similar to the footprints of the services on lA and 1C).

Astra has standardised on a transponder bandwidth of 27 MHz, compared to the 36 or 72 MHz transponders used on many other telecommunications satellites. Each Astra satellite has eight transponders operating on horizontal polarisation and eight on vertical. Fig 2 shows how the frequency is allocated in the region between satellites lA and lE. As can be seen, the spectrum from adjacent transponders overlaps very significantly - interference-free reception is thus very dependent on the receiving antenna being able to discriminate between the two polarisations. In practice, this seems to cause little problem - provided the receiving dish has been correctly aligned during installation.

Five ofthe 32 transponders presently in operation carry D2-MAC transmissions; the rest carry PAL television services, many of which are scrambled. All the services aimed at the UK use PAL, either in the clear or scrambled with the *VideoCrypt* system. Table 1 gives an up-to-date list of the television services presently on Astra.

The VideoCrypt System

When Sky first started broadcasting scrambled services on Astra in 1989, it standardised on the *VideoCrypt* system. This is an active-line-rotation scrambling system which only scrambles the picture; it does not scramble the sound. Although the picture is scrambled, the line and field syncs remain intact as does any teletext signal. So a television receiver fed with a VideoCrypt-scrambled signal continues to operate normally - there is just no sensible picture!

The system uses a combination of smart card and over-air addressing to

Television Service	Ch	RF Carrier (GHz) + P	Sound Carrier (MHz)	Coding	. Encryptlon
RTL2	1	11.214 H	*7.02f1.20*	Pal	Clear
RTL Plus	2	11.229 V	7.02	Pal	Clear
TV3 (Sweden)	3	11.243 H	Digital	D2Mac	EuroCrypt
Eurosport/Quantum	4	11.258 V	7.02	Pal	Clear
VOX	5	11.273 H	*7.02f1.20*	Pal	Clear
Sat 1	6	11.288 V	*7.02f1.2*	Pal	Clear
TV1000	7	11.302 H	Digital	D2Mac	EuroCrypt
Sky One	8	11.317 V	*7.02f1.20*	Pal	Clear
TV Asia	8	11.317 V	*7.02f1.20*	Pal	Clear
Teleclub	9	11.332 H	7.02	Pal	Nagravision
3 Sat	10	11.347 V	*7.02f1.20*	Pal	Clear
FilmNet	11	11.361 H	Digital	D2Mac	EuroCrypt
Sky News	12	11.376 V	*7.02f1.20*	Pal	Clear
RTL4	13	11.391 H	*7.02f1.20*	Pal	IRDETO
Pro 7	14	11.406 V	*7.02f1.20*	Pal	Clear
MTV Europe	15	11.420 H	*7.02f1.20*	Pal	Clear
Sky Movies Plus	16	11.435 V	*7.02f1.20*	Pal	VideoCrypt
Premiere	17	11.464 H	*7.02f1.20*	Pal	Nagravision
Movie Channel	18	11.479 V	*7.02f1.20*	Pal	VideoCrypt
ARD Eins Plus	19	11.493 H	*7.02f1.20*	Pal	Clear
Sky Sports	20	11.508 V	*7.02f1.20*	Pal	VideoCrypt
DSF	21	11.523 H	*7.02f1.20*	Pal	Clear
MTV Europe	22	11.538 V	*7.02f1.20*	Pal	Clear
UK Gold	23	11.552 H	*7.02f1.20*	Pal	VideoCrypt
Children's Channel	24	11.567 V	*7.02f1.20*	Pal	Clear
Japan Sat TV	24	11.567 V	*7.02f1.20*	Pal	VideoCrypt
N3	25	11.582 H	*7.02f1.20*	Pal	Clear
Adult Channel	26	11.597 V	*7.02f1.20*	Pal	VideoCrypt
Movies Gold	26	11.597 V	*7.02f1.20*	Pal	VideoCrypt
TV3 (Denmark)	27	11.611 H	Digital	D2Mac	EuroCrypt
CNN	28	11.626 V	7.02	Pal	Clear
N-TV	29	11.641 H	*7.02f1.20*	Pal	Clear
Cinemania	30	11.656 V	*7.02f1.20*	Pal	Nagravision
TV3 (Norway)	31	11.670 H	Digital	D2Mac	EuroCrypt
Documania	32	11.685 V	*7.02f1.20*	Pal	Nagravision

Table 1: *the television services currently available on Astra*

control access to the service. A subscriber's smart card can be updated over the air, either to remove the ability to receive services or to extend entitlement.

VideoCrypt can also operate in a so called "soft-scrambled" mode. This means that the signal is scrambled, but that a VideoCrypt decoder can descramble the signal without a smart card. The *UK Gold* service is operating in this mode at present.

In the early days of the *BSkyB* Astra service (it was just *Sky* at that time), a separate satellite receiver and VideoCrypt decoder were required to receive the scrambled pictures. Today, most satellite receivers sold in the UK have the VideoCrypt decoder built in and are known as IRDs (Integrated Receiver Decoders). In continental Europe, however, most PAL receivers will not incorporate a VideoCrypt decoder, as BSkyB channels are only intended for UK residents.

People often remark that it is quite astonishing that a transmitter with the power of a standard domestic light bulb is capable of being received 36,000 km away on Earth. The physics of the situation is no less astonishing. In effect, the 50 Watts or so of power from the satellite is spread fairly uniformly over the whole of the western half of Europe, an area of some 5 million square km. The resulting average power flux density from the satellite ~s, therefore, about -110 dB(W/m). This is about 7 dB lower than the DBS power density specified at WARC-n.

The standard 60 cm receiving antenna now intercepts about 0.3 square metres worth of this signal (-115 dBW) and delivers some 60% of it (-117 dBW) to the receiver. A "standard" low-noise block (LNB) on the dish, with a 1.8 dB noise figure, will result in a carrier-to-noise ratio of some 13 dB at the receiver's input which gives a reasonably noise-free picture and sound.

Incidentally, the WARC-77 DBS plan assumed a 90 cm dish, an LNB noise figure of 8 dB and a carrier-to-noise figure of 14 dB.

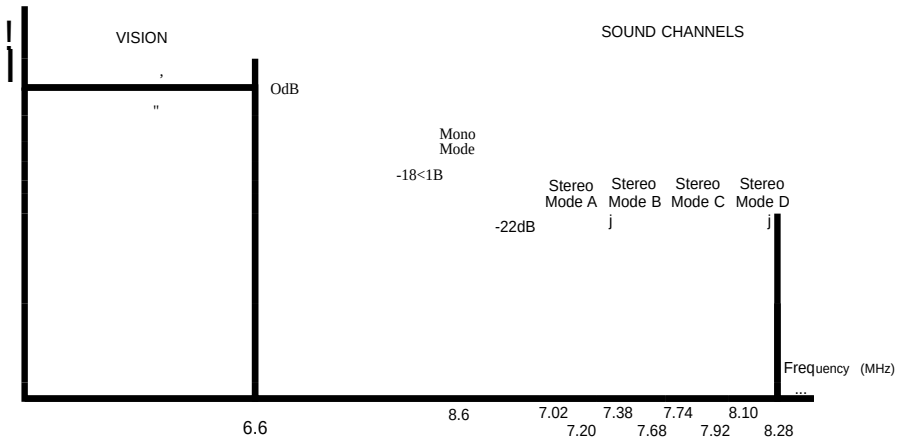


Fig 3: *Panda* 1 *arrangement of FM sub.carriers above the vision signal*

Radio Services on Astra

The transponders which carry PAL services can also carry several radio channels, in addition to the normal television sound. In fact, each television signal could in theory be accompanied by up to nine or ten sound signals although, in practice, no channel carries more than seven at present.

The sound signals are modulated onto high frequency FM subcarriers which are added at baseband to the video signal. On Astra, the lowest frequency subcarrier - located at 6.5 MHz -.always carries the television programme sound in mono with a deviation of 85 kHz and a pre-emphasis of 50 118. As this is a relatively high-level subcarrier, the sound is not compressed.

For the rest of the sound signals, nearly all the channels on Astra use a particular sound multiplex and compression system called *Panda* 1, developed by the Wegener Company. Referring to Fig 3, this system can carry multiple FM subcarriers spaced 180 kHz apart, starting from 7.02 MHz. Because these subcarriers are injected at a relatively low level, the sound is compressed at the up link and expanded in the receiver in order to provide an adequate signal-to-noiseratio. The peak deviation of these subcarriers is 50 kHz.

Not all receivers use the proprietary Wegener Panda decoding system, and in some cases this can result in the sound quality being less than ideal. Receivers which use licensed Panda decoders can be identified by the "Panda" symbol (see Fig 4) which is usually displayed on the front of the equipment.

Fig 4: *the "Panda" symbol*

The subcarriers can be used separately to carry mono sound signals or grouped in stereo pairs as follows:- 7.02/7.20, 7.38/7.56, 7.74/7.92 and 8.10/8.28 MHz. With a mono television service, the 7.02 MHz subcarrier is usually used for the programme sound. If the programme sound is stereo then the 7.02 and 7.20 MHz subcarriers are used.

Table 2 lists the radio services that are presently available on the Astra satellites.

BBC Radio Services

The BBC's radio services are carried on *UK Gold* using the Wegener Panda 1

- Astra Satellite -

system, on the following subcarriers above the normal video signal:

6.50 MHz	TV Sound mono
7.02 MHz	TV Sound Stereo (left)
7.20 MHz	TV Sound Stereo (right)
7.38 MHz	World Service in English
7.56 MHz	Radio 4 (as on FM)
7.74 MHz	Radio 1
7.92 MHz	Radio 5

Modern satellite receivers are usually able to receive all these sound channels. However, some early receivers (in particular the Amstrad SRX100 and SRX200 models) could only receive the 7.02, 7.20, 7.38 and 7.56 MHz subcarriers. These receivers will not be able to receive the Radio 1 and Radio 5 services. However, upgrade kits are available to enable them to operate over the full range of subcarrier frequencies, but their installation is very much a job for a trained technician.

Most receivers have a number of audio modes. In order to select the appropriate mode, the user usually has to press a button marked 'mode' or 'audio' on the remote control which steps the receiver from one mode to the next. For instance, a typical receiver might organise its audio modes as follows:

Stereo A	7.02/7.20 MHz
Stereo B	7.38/7.56 MHz
Stereo C	7.74/7.92 MHz
Stereo D	8.10/8.28 MHz
Mono 1	6.50 MHz (Tunable)
Mono 2	7.02 MHz
Mono 3	7.20 MHz
Mono 4	7.38 MHz (WS)
Mono 5	7.56 MHz (Radio 4)
Mono 6	7.74 MHz (Radio 1)
Mono 7	7.92 MHz (Radio 5)
Mono 8	8.10 MHz
Mono 9	8.28 MHz

UK Gold's programme sound is stereo, so the receiver should initially be set to Stereo Mode A. If this is the case, then the audio button will have to be pressed *seven* times to get World Service (7.38 MHz), eight times to get Radio 4, etc. Alternatively, the receiver could be set to receive *UK Gold* sound in Mono Modes 1, 2 or 3, in which case the number of button presses will be less!

Radio Service	**RF** Carrier (GHz) + Polarisation	Sound Carrier (MHz)	Mono! Stereo
AsdaFM	11.435 V	7.74	M
BBC Radio 1	11.552 H	7.74	M
BBC Radio 4	11.552 H	7.56	M
BBC Radio 5	11.552 H	7.92	M
BBC World Service	11.552 H	7.38	M
CNN Radio	11.266 V	7.92	M
Deutscheland Funk	11.288 V	7.74/7.92	M
Deutscheland Funk	11.288 V	7.38/7.56	S
Deutschewelle	11.229 V	7.56/7.38	M
Eviva	11.332 H	7.74/7.92	S
Holland FM	11.479 V	7.56	M
IOB	11.538 V	7.74/7.56	M!S
Maxat FM	11.435 V	7.92	M
NDR2	11.582 H	7.38/7.56	S
NDR4	11.582 H	7.74/7.92	S
QCMR	11.376 V	7.38	M
Quality Europe FM	11.435 V	7.38/7.56	S
Radio 538	11.317 V	7.74/7.92	S
Radio Asia	11.597 V	7.38	M
Radio RMF	11.420 H	7.74/7.92	S
Radio Ropa	11.406 V	7.74/7.92	S
Radio Sweden	11.597 V	7.74	M
RTL4	11.391 H	7.74/7.92	S
RTL Radio	11.391 H	7.38/7 .56	S
Sky Radio	11.317 V	7.38/7.56	S
StarSat	11.406 V	7.38/7.56	S
Sunrise Radio	11.479 V	7.38	M
Supergold	11.376 V	7.92	M
Spare	11.508 V	7.38	M
Sputnik	11.464 H	7.38/7.56	S
Switzerland	11.332 H	7.20	M
SWF3	11.493 H	7.38/7.56	S

Table 2: *the radio services currently available on Astra*

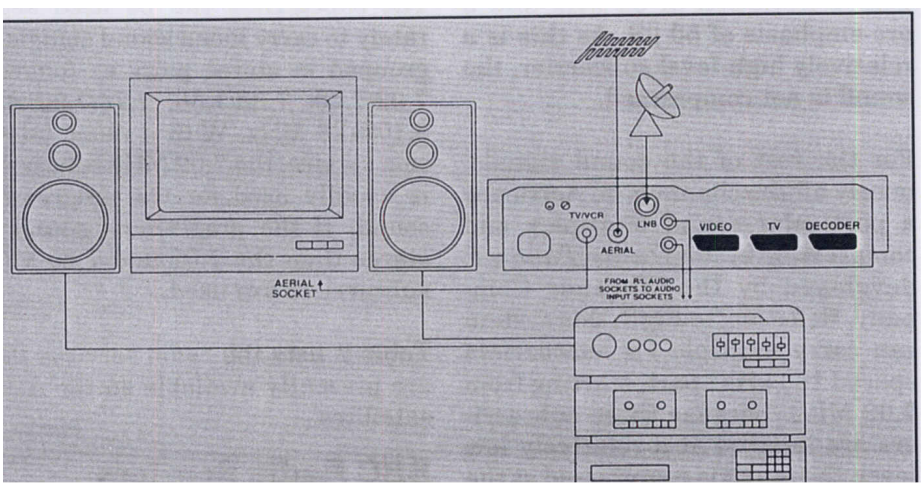


Fig 5: *a typical satellite receiver installation*

Some modern receivers use on-screen graphics menus, both to display and select the required subcarrier frequencies, and to store the appropriate settings. Since such procedures vary considerably from receiver to receiver, the user will need to consult the receiver handbook or their dealer.

Finally, Fig 5 shows a typical installation where the satellite receiver is linked to both a television set and a hi-fi system. Such an arrangement is ideal if the receiver is going to be used frequently for radio listening.

Henry Price
HEID

NETWORK RADIO

Radio 2's new transDlission suites

John Tidy describes just a few problems which preceded the opening of Radio 2's new transmission suites.

Bankruptcies, lockouts, steam baths and General Elections: not the kind of things you would associate with building three on-air transmission suites for Radio 2 perhaps. But all these had a hand in shaping the story of how Continuities G, Hand J - the rather shabby and tired-looking places where Radio 2 originated half of its DJ programme output - were turned gradually into Transmission Suites IG, IH and IJ: a comfortable comprehensively-equipped production centre for all Radio 2's presenter-led programmes. But first I must set the scene.

In the beginning...

... there were *continuity suites* and there were *studios.* The continuity suites were only used by DJs; the studios were used by, well, non-DJs. Thus you could never be sure where Radio 2's live programme was coming from - especially if, say, non-DJ Neil Kinnock was standing in for a professional self-operator like John Dunn. Things could quite well arrive late or go missing.

Then some clever beggar had a bright idea: why not combine the two functions in one area? And so the concept, then a little later the project, was born. All.that remained was to come up with a control desk that would handle a full set of replay equipment in both the studio (for the DJ) and the cubicle (for an operator to use with a non-DJ). The whole lot would have to be crammed into a space that already seemed quite full with only half that amount of gear. It should be quite straightforward really!

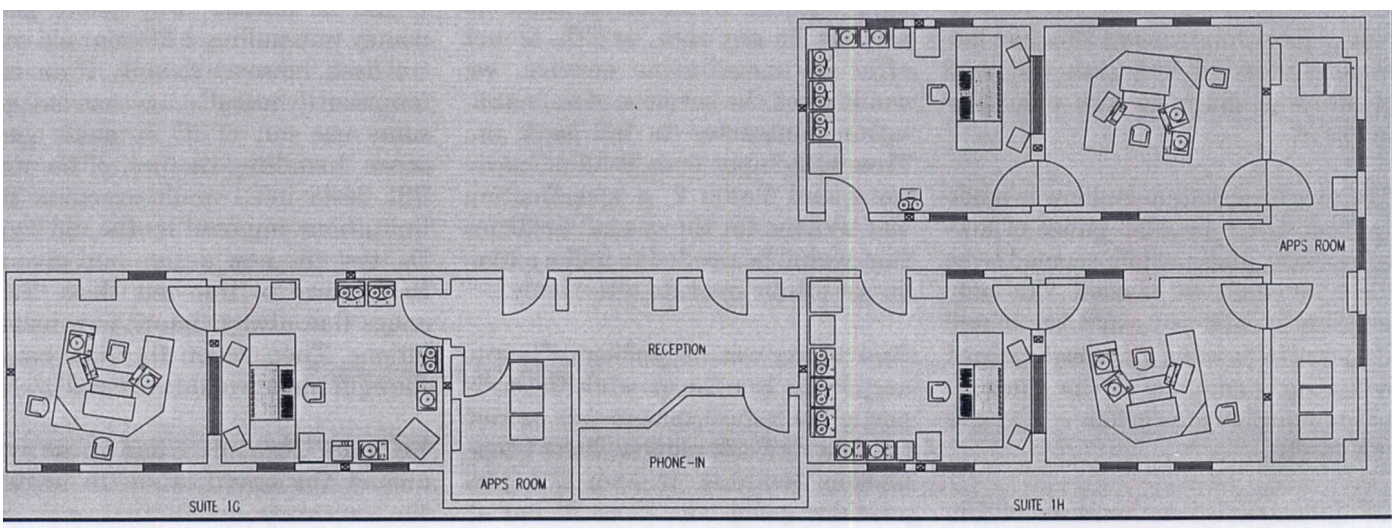
It was soon realised that the only control desk capable of supporting the required facilities was Solid State Logic's SL5000 series, and gradually a satisfactory proposal was worked out between SSL and the technical design team. The job of getting all the equipment to fit exercised many minds but eventually a plan evolved which in general worked, apart from Suite IG's cubicle where a few millimetres error in a drawing meant having to move a tape machine at the last minute to the other side of the door!

In the middle...

The whole exercise was taking place in the middle of a complete refurbishment of BH, following the Governors' decision to keep Radio there rather than moving out to West London. So once it became known that BH had a long-term future, it was clear that something had to be done about the general working environment - especially the acoustics, the air-conditioning plant which was slowly rusting away on the roof outside, and the chill wind which steadfastly blew down the back of the DJs' necks.

Working to a brief from Radio Projects, a team from ACED (now BDMS) set about redesigning the whole area and its services - taking account of the requirements imposed by the new equipment and the desire to improve the appearance and acoustic environment, but without making major structural alterations.

Within the boundaries of the existing Camden partitions, a complete transformation was to take place. A complex



Plan view of Radio 2's new transmission suites

arrangement of duct-work around the windows to the outside was designed to enable the removal of the old supply and extract system, while still allowing in natural daylight.

The acoustic treatment was re-designed by Tony Woolf of RDER to allow a slightly longer and more even reverberation time than before, particularly in the cubicle. Diffusers were specified to make up some ofthe wall treatment. In addition the floor around the producer's and operator's positions was required to provide a long-lasting surface for the chairs to run on and to cut down the area of sound-absorbing carpet, the join between the two having been designed to allow a chair to run smoothly across it.

The new observation window is made up from three parallel panes of low-reflectivity glass, which seemed to be ideal for what we needed. The only problem is that you can't see it and it's possible to bang your nose against it leaving a smudge on the glass – not to mention your pride - if you're not carefuL

All lighting has been recessed within the ceiling acoustic treatment, to minimise the possibility of creating distracting reflections. High-frequency fluorescent fittings have been supplemented by dimmable low-voltage spots on tracks.

Although a control desk specification had been agreed with Solid State Logic, and the finance approved for the purchase of three of these desks, this was by no means the end of the technical installation story. We agreed with SSL at the start that their desk would contain only standard equipment: anything they could not supply using catalogue options would be for others to provide. In any case, as SSL do not offer an installation service, we would need the services of an installation contractor to fall back on. Thus with input from Studio Operations and Radio 2, a specification was written for the special facilities that would be needed to make a live-on-air studio operate effectively.

More taxing was the problem of how to keep Radio 2 on the air while the early part of the refurbishment was carried out. The network requires three transmission facilities to keep the programmes going out. Cons H and J, being separated by only a narrow corridor, could not be worked on separately - noise, dust, too many people wanting to come and go, and deliveries of building materials would see to that. However Con G (to be given the treatment last) would be all right, being separated from all the disruption by a room we used to call the Network Supervisory Area which the builders would later transform into a reception area and phone-in room.

This left us with two remaining sets of temporary facilities to find. Suite 1C would be eminently suitable as it was equipped with the same Type D desks so familiar to Radio 2 from the original Cons Hand J. And to complete the temporary facilities, we needed somewhere to act as a temporary home for another Type D package (recovered from the original continuities which were demolished to make way for Radio 5's production suites).

Studio SI was available but, as it was the location of the original Baird-system experimental TV transmissions, it was of special interest to English Heritage. So, when we came to apply for planning consent, we had to be most careful over what we did to it.

A Clever idea....

All good projects have an event which, on reflection, can be seen as the point at which success or failure was determined. Such was the case with the clever idea which someone -I'm not quite sure who - had next. It ran as follows: why spend good money reinstalling a 20-year old control desk, however cheaply, if you can temporarily install a new one and get some use out of it? It made good sense. Installing the first of the new SSL desks in SI would overcome the limitations imposed by the old Type Ds, test the new design and give us the chance to iron out those little snags that always haunt new installations. Then, when the time came, the equipment would be moved to 1G.

Brilliant! Now all I had to do was amend the specification to include the temporary installation work (as it was to be a cheap job) and persuade