

# E N G I N E E R I N G

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## New Director of Engineering looks ahead.

"I am pleased to have this opportunity to reflect upon what I see lying ahead for engineers and engineering in the BBC over the next five years.

The real world of broadcasting in the United Kingdom sees RDS immediately upon us in its first phase of infancy, with a significant impact anticipated on listening habits so desperately needed to coax the listener to VHF-FM; similarly we have an early opportunity to incorporate the benefit of stereo sound with television. In the more speculative areas the technology of Digitally Assisted Television (DATV) is just around the corner; whether the broadcaster uses it as quickly as technically possible remains a more sophisticated non-engineering argument.

BBC engineers are seen once again demonstrating that they are at the front of the queue in developing a further new era of technology to the benefit of Broadcasting in general, and the BBC in particular. It remains important in my opinion for this situation to continue, and not to allow a situation to develop where the BBC is merely reacting "post hoc" to the impact of new technology. This is particularly important given a situation where the broadcasters are not wholly convinced of the benefits of the new technology.

Whilst providing the engineering climate within which programme making can be developed in the most cost effective way, our technical standards should not be allowed to fall. BBC engineering continues to lead in the field of broadcasting research and development, and both our engineering excellence and our operational standards in Radio and Television set an example which is envied by broadcasters the world over. It will

be a testing time over the next five years, given the overall environment within which the Corporation will have to work, but there are no grounds to suggest that there is any incompatibility between this environment and the commitment to further the excellence of engineering.

The development of the White City site, which to many people must seem a slow process, will be a dramatic event for those involved both in managing its execution and its occupation. The profile of the project is heightened since it offers for the first time the opportunity to build a centre that will incorporate the latest technical advances in the fields of radio, television and business communication media. Whatever broadcasting use is finally realised on the site the techniques used will have the capacity for expansion and to carry the BBC into the next century.

In contemplating the next five years we must not forget the sterling work of transmission engineers, whose efforts so often go unnoticed. Theirs is a remarkable success story of using technology to advance transmitter operation and automation to a very high degree of refinement. After all, without a reliable transmission network viewers and listeners' alike would become disenchanted with the service however excellent the programme material.

Finally, on a personal note, I would like to say a sincere thank you to all who were kind enough to send their best wishes on my appointment. I can do no more than hope you will continue to give me the level of support you have so readily given to Bryce over the past years."

**Bill Dennay**

# Editorial

Congratulations

I am sure that all engineers will join me in congratulating Bryce McCrirrick on the award of the CBE in the recent Birthday Honours list.

Deadline

Copy date for the Autumn edition of Eng Inf is September 4th, and I would welcome any stories, articles or material by then. If you feel that your job, department, project or new facility deserves a wider audience, why not contact me on LBH 5432 or "Room 707, HWH.

Alan Lafferty

# Licence Agreements.

The following licence agreements have recently been granted.

The DIGITAL AUDIO WAVEFORM GENERATOR, GE7S/21, is available from Pro-Bel Ltd. of Reading. This unit provides left and right signals, either independently or locked together, to the AES/EBU 48 kHz format; several spot frequencies are provided in either sine, square or ramp waveforms, and discrete output levels are selectable.

BAL Components Ltd. of Nuneaton have signed up for the component video MATRIX AMPLIFIER, AM23/521, of which four versions are available. Conversion between RGB and YUV can be achieved in either direction, and at either standard PAL amplitudes or 700 mV weighted. (EDI 10531 refers).

Another, licence which has been recently agreed, is for the Radio Data System transmitter, CD4L/21; this is available from both VG Electronics Ltd. of Hastings and Eddystone Radio Ltd. of Birmingham. The equipment was described in some detail in Issue 26 of Eng. Inf. (Autumn 1986), and includes all the hardware and software required to be able fully to utilise the RDS methods of operation.

Details of these licences are available from the Liaison Engineer, Peter Jefferson, 108 Western House, LBH extn. 4345.

# Transmitter News.

The following transmitters have opened or changed since March:

UHF Television

Brixham	Devon
Cilycwm	Dyfed
Durness	Highland
Easdale	Argyllshire
Holyhead	Gwynedd
Singleton	W.Sussex
Southend	Argyllshire
Tayvallich	Argyllshire

VHF Radio

Belmont	Lincolnshire
Les Platons (R3)	Channel Isles
Wenvoe	S.Glamorgan

Local Radio

Redruth	R.Cornwall
Isles of Scilly	R.Cornwall
Exeter	R.Devon
North Hessary Tor	R.Devon
Okehampton	R.Devon

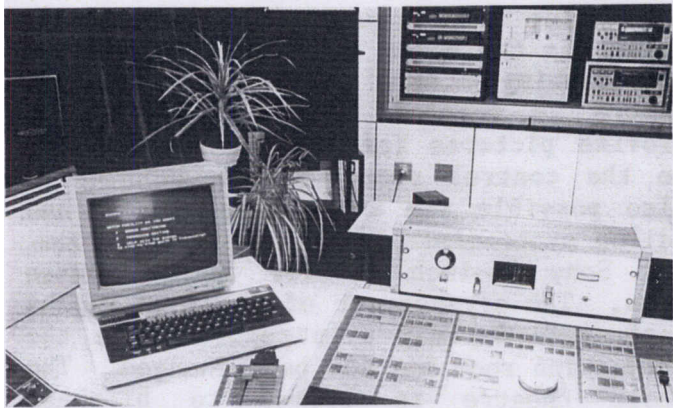
RDS

RDS codes are being radiated from the following:

Sutton Coldfield~	R1/2,3,4
Wrotham	R1/2,3,4
Peterborough )(	R1/2, 3,4
Tacolneston x	R1/2,3,4
Wenvoe	R1/2,3,4
Lancaster	R.Lancs
Hameldon Hill	R.Lancs
Winter Hill	R.Lancs
Mendip	R.Bristol
S.Benfleet	BBC Essex
Sandy Heath	R.Beds
Crystal Palace	R.London
Swingate	R.Kent
Heathfield	R.Sussex
Sandale	R.Cumbria
Sutton Coldfield ...	R.Derby, R.WM
Peterborough x..	R.Cambridgeshire
Tacolneston X..	R.Norfolk.

Codes are PI,PS,AF,ON & CT

# New digital editing suite for TRU.



The TRU digital editing suite.

The advent of digital recording techniques into audio areas has in some cases revolutionised operating practices, despite the fact that much of the hardware is based upon modified video equipment. For about four years, Transcription Recording Unit have been using the Sony F1 format/B-max video cassette system as the mainstay of their 2-track audio recorder complement for monitor-mix recording at live concerts. Apart from the obvious quality advantages, it has also meant big savings in line-up time and tape costs. Digital recordings also foresee the future requirements and technical format of programmes distributed to Transcription Service customers.

However, TRU have encountered some problems when it comes to editing material in this form. To this end, TRU acquired the Sony PCM1610/DAE1100 recording and editing system, which uses modified NTSC U-matic video recorders, and in order to enable transcoding (conversion) from the F1 system to the 1610 system to facilitate editing, they also acquired an "Audio and Design" modified PCM701 processor. It became evident that a dedicated work environment for the editing system was needed and this has materialised as TRU Digital Editing Suite, believed to be the only dedicated facility of its kind in the BBC.

The Editing Suite is equipped with a pair of Sony 5850 U-matics, a PCM 1610 processor, a DAE 1100 editor, an F1 system comprising an A & D professional PCM 701, and C9 Betamax, A & D Ad-mix processor which can interface with the 701, and auxiliary 701 for the addition of reverb. A Neve 10 into 12 analogue sound desk enables monitoring and mixing from analogue sources, and a video switching

unit interconnects all the components of the system in its various modes.

In reality, the Digital Editing Suite is two rooms; a working area and an apparatus room. A large window with sliding double-glazed units links the two rooms, behind which, in the apparatus room, the system hardware is positioned whilst being acoustically and thermally isolated from it. The working area contains a purpose-built console which encompasses the control surface for the editing system, an analogue mixing desk and a computer used in conjunction with the editor for TRU's own development: "Transcode Editing".

In practical terms this has removed much of the system hardware from the listening environment, leaving only the control surfaces and monitoring system. This reduces background noise to a minimum and offers easier monitoring of the quiet passages of digital recordings which is more important in view of the improved signal-to-noise ratio available.

To keep costs down most of the installation work was done in-house. The control surfaces are mounted in a TRU manufactured customised console, the analogue desk was purloined from Radio Training when they left the Langham. The glass screen behind which the rest of the equipment is positioned was fitted by House Services. The acoustic treatment of the control room is a little bright, but should improve when heavy drapery curtains are fitted.

Thus F1 material can be transcoded to 1610 format, edited, announcements added, and reverse-transcoded back to F1. However, this process is very time-consuming; a 3-hour programme requires continuous monitoring to ensure that there is no data corruption. To reduce the man-hours spent monitoring tapes, Gareth Watson from TRU wrote a computer programme for a BBC Micro that enables editing directly from F1 to 1610, basically by "fooling" the DAE1100 editor into thinking it has a U-matic across its input when in fact it has a C9 Betamax machine sitting there, this process being known as "Transcode Editing". This innovation drastically cuts down the time taken for the whole programme which enables the monitoring

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## Film dubbing at Lime Grove.

The film dubbing theatre at Lime Grove has recently undergone a major refurbishment by PID Tel using minimal outside contractors. A new control desk and small studio have been installed and the working arrangements transferred to forward projection from the old back projection system. The new area has a similar desk to the new Manchester theatre.

The old type C desk, which had to be constructed in the mixer room when the theatre was built, has been replaced with a Calrec desk offering twenty-eight channels that can be mixed down into four stereo groups. Gone are the old quadrant faders associated with the Type C and in their place will eventually be special motorised faders driven by linear motors. The desk will soon be fitted with computer control, the software for which has been specially adapted for BBC use from the music industry standards. Associated with the desk are AMS digital reverb and delay units and two Klark Technics graphic equalisers re-installed from the old theatre. LS 5/8 loudspeakers are used for monitoring.

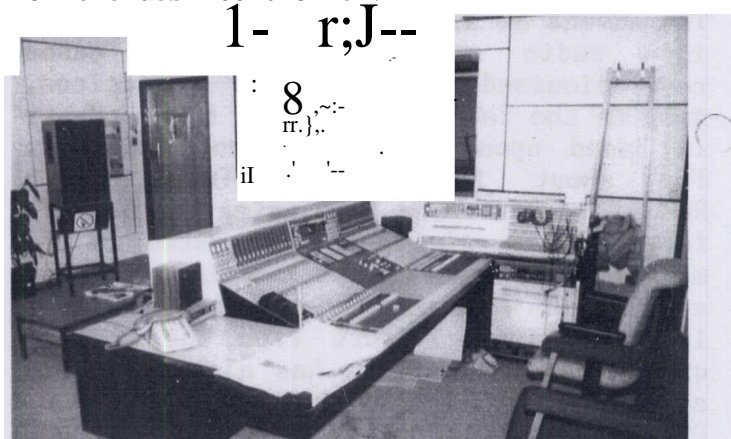
The sound effects area remains unchanged with four Technics gram decks fitted in SCPD bases, two Studer B62 reel-to-reel tape machines, two Soniflex cartridge machines and a Philips CD player. An extensive gram library completes the set-up. The projection room also remains substantially unchanged, except that the two Albrecht PB42 projectors

TRU Digital Editing Suite  
continued from Page 3

equipment to be set up in a quiet period overnight and by morning the computer provides an error-status readout of both the 1610 and F1 cassettes; the tape can then be accurately checked at any 'error points' for audible degrading.

Roland Allen, who planned and built the Editing Suite said: "Our main objective when we set out to design the suite was to make it as convenient in use as possible whilst accepting that this facility would be somewhat experimental by nature. It has now been working successfully for four months and is processing all our serious music output".

no longer have the complicated optics for back projection. Normally only one of these is used, in a forward mode, projecting to a conventional 1 metre wide screen in the mixer room over the head of the dubbing mixer. A Sony DXC101 CCD camera is coupled to the projector to provide pictures for the new studio next to the control room. Video dubbing is also possible via a BVU 800 U-matic and Editon synchroniser in the projection room, and Sony 26-inch monitor in the mixer room. The arrangement of the four Duplex Perfectone Rapimag film recorders in the projection room has not been changed. The whole theatre is locked to bi-phase pulses, which are converted into time-code for the desk controller.



Lime Grove dubbing theatre mixer room

An unusual part of the refurbishment is the new dubbing studio. A prefabricated galvanised steel acoustic cabin was purchased from Sound Attenuators Limited. This was constructed by them on top of a concrete screed laid by Building Engineering Services at Lime Grove. Sound Attenuators were also responsible for all of the electrical work, air-conditioning and decoration of the cabin/studio. Being the first medium-sized studio to use this arrangement, Ian Hare from Film Unit, PID Tel, who was project leader for the refurbishment, was pleased to find that it fully met operational requirements, including the 0.1 second reverberation time. He said, "Using a prefabricated studio was a much quicker and cheaper alternative to conventional practice, and without all of the normal building disturbance".

The new studio features a small range of sound effects equipment such as a re-deployed gravel tray, as well as Neuman, AKG and ECM50 mics. A Sony monitor is coupled to the CCD camera in the projection room for dubbing, and an LS3/7 speaker is provided for sound foldback.

# Research Department demonstrate digital audio editor.



Demonstrations of the disc-based digital audio editor, which is in its final stage of development at Research Department, were given to senior engineering management and operational staff at Broadcasting House on 22nd May.

During the demonstrations, a news bulletin was recorded from the ring-main and then edited to show the capabilities of the equipment. The order of the news headlines was changed and a mistake by the news-reader was corrected.

The equipment uses two Winchester discs on which nearly one hour of stereo can be recorded. A 68000-based computer control system allows the operator to replay recordings from the discs and identify the sections which will be needed in the final programme. These sections can then be arranged in any order to build up the

required programme which can be replayed immediately.

By turning a wheel on the control panel, the operator can 'rock and roll' through a recording in the same way as spools of tape are rocked by hand so that edit points can be identified accurately whilst hearing the programme material.

A powerful feature of the equipment is that edits are performed non-destructively as the programme is replayed. As a result edits can be adjusted and rehearsed any number of times until they are precisely correct and, if necessary, material previously discarded can be re-inserted into a programme.

Installation of the Digital Audio Editor at Broadcasting House is planned for later this year when work on the Digital Transfer Suite is completed.

# PCM re-engineered bit by bit.

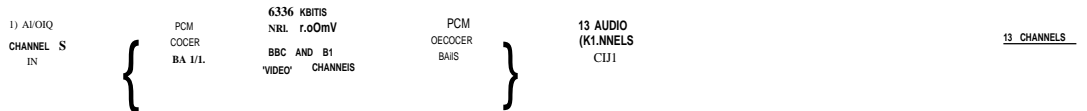
The first phase of PCM re-engineering has very nearly been completed. This article gives a technical overview of the present system, outlines the development of phase one and looks at stations which will be PCM-fed in future.

The major building block of PCM is the BBC-developed NICAM system (ref 1,2) which (among other arrangements) can code six high-quality audio channels into a CCITT standard 2048kb/s (2Mb/s) digital multiplex package. This equipment is in widespread use in the BBC, and is made commercially under licence by ST&C.

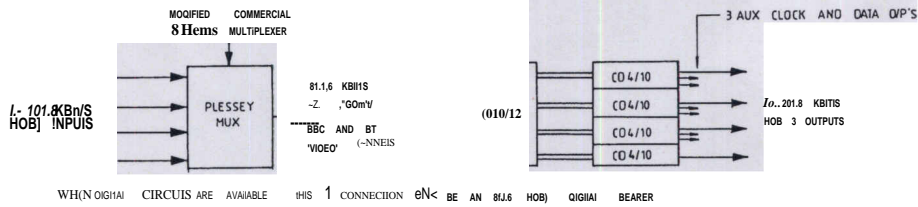
However, the necessary supporting equipment to allow economically-phased National PCM development, is just as important. The CD4M/6 and CD4/11 are transcoders which have been designed to split twelve channels of the linear PCM system into three 2Mb/s multiplexes, and then recombine them into 6336kb/s "linear PCM". Other Multiplexers and Demultiplexers are used to form the 8448 kb/s distribution signal and then separate the various 2Mb/s tributaries as necessary.

The way the PCM re-engineering has

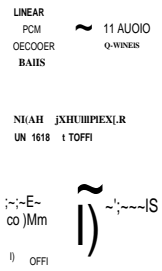
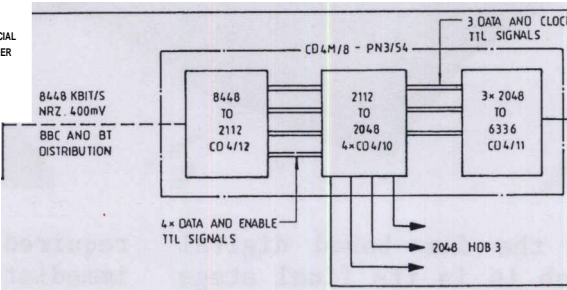
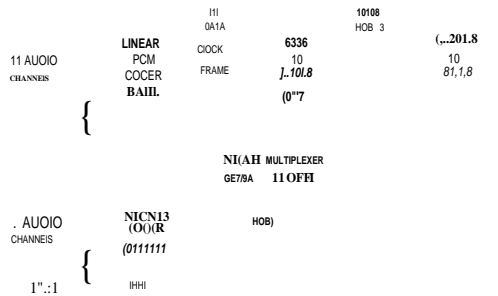
6336 KBIT/S HIGHWAY FOR LINEAR PCM(14-2)



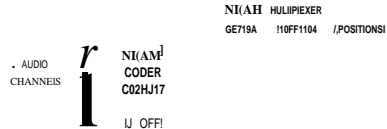
BASIC 8448 HIGHWAY (14-2)



PHASE PCM RE-ENGINEERING 14-31

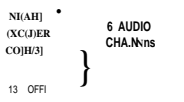
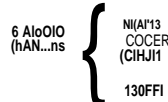
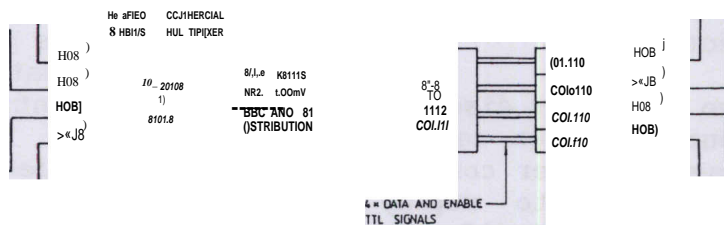
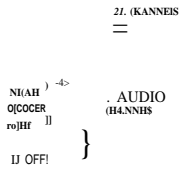


PHASE PCM RE-ENGINEERING (4-5)



LINEAR PCM NOW REMOVED

NICAM MULTIPLEXER UN 1618 (10FF IN 4 POSITIONS)



... MAY BE REPLACED WITH 2 14M 1 NICAM COCER BAYS EACH (10FF) 12 C-NELS.

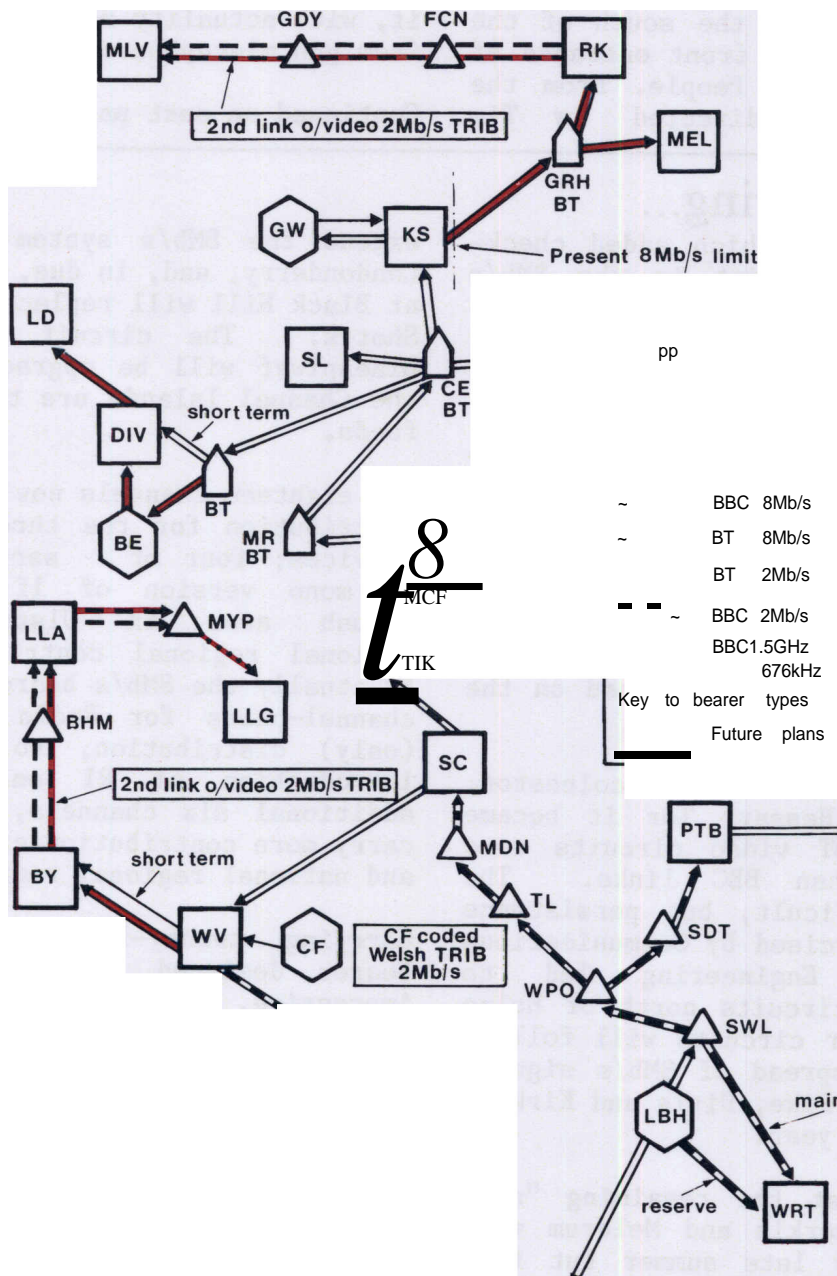
developed is shown in figs. 1 to 4. By the end of the present scheme the equipment in service will be as shown in fig. 3 with decoding at fifteen locations.

The actual progress of commissioning the 5Mb/s system has been slower than originally envisaged, as often happens with innovatory systems, but in overcoming the various snags a superior equipment has evolved. During proving tests between London BR and Wrotham on the "roof-link", it became apparent that system jitter, caused by the various multiplex/demultiplex processes, was causing linear PCM decoding problems. (It should be borne in mind that the 13-

channel system was in service before jitter was invented!). It also became clear that it was extremely difficult to distinguish between PCM equipment problems and faults due to bearer interruptions.

D&ED investigated the problem and quickly found solutions. First they reduced the jitter in the 5Mb/s bearer to less than the linear PCM could detect. Then they designed subtle modifications for the linear decoders so that they could tolerate much more jitter (to make absolutely sure of reliable working). Finally they designed a Cyclic-Redundancy

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# The Queen's visit to China: Part n.

Barry Luckhurst, from Tel OBs, concludes his account of the technical aspects of the Royal Visit to China, in 1986.

## The Welcoming Ceremony

The Queen arrived at the old airport in Beijing on the evening of Sunday 12th October and the welcoming Ceremony took place the following morning. Television coverage of it was transmitted live to London and recorded for later transmission.

Following the ceremony, "Breakfast Time" links and interviews were recorded.

The CMCR was parked to the south of the steps leading up to the front entrance of the Great Hall of the People. From the CMCR cameramen were directed by Tim



The Shanghai television studios

Marshall through an interpreter. It had four China. Central Television (CCTV) cameras, and one from BBC News linked to it, with actuality sound coverage obtained from gun microphones on the cameras.

Continued on next page

## PCM re-engineering...

Checking (CRC) system which added check-bits at the latest point in the 8Mb/s multiplexer and analysed these CRC bits at an early stage in the 8Mb/s demultiplexer. This separated faults due to the links from those due to the terminal equipment.

Following a systematic series of modification visits and tests by TCPD, the first four stations Wrotham, (Peterborough, Sutton Coldfield and Holme Moss) were converted to 8Mb/s working on 15.1.86 (see fig. 5). The revised equipment reliability was confirmed using a TCPD-designed data-logger, based on the BBC Micro. (Ref. 3).

As TCPD converted Rowridge, Tacolneston, Wenvoe and North Hessary Tor it became clear that some BT video circuits were poorer bearers than BBC links. The situation was difficult, but persistence and persuasion exercised by Communications and Transmitter Engineering led to remedial work on circuits north of Holme Moss; work on other circuits will follow. This allowed the spread of 8Mb/s signals to Sandale, Pontop Pike, Divis and Kirk O' Shotts in May this year.

It is expected that the remaining "new" equipment at Rosemarkie and Meldrum will be commissioned by late summer but this does depend, once again, on BT video circuits. In the near future, it is planned to

extend the 8Mb/s system to Belfast and Londonderry, and, in due, course equipment at Black Hill will replace that at Kirk O' Shotts. The circuit from Wenvoe to Blaenplwyf will be upgraded to 8Mb/s and the Channel Islands are to have two 2Mb/s feeds.

The eighteen channels now in service carry distribution for the three stereo VHF-FM services; four mf services; a special vhf mono version of If R4, to fill a mush area in Ulster; and three national regional contribution circuits. Eventually the 8Mb/s bearer will carry two channel-pairs for Radio 1 and Radio 2 (only) distribution, to cater for the introduction of RI on VHF-FM. The additional six channels, long-term, will carry more contribution circuits and local and national regional radio feeds.

Carrying twenty-four channels on the bearer designed for thirteen may seem impressive, or at least worth waiting for, but after all there are 729,907.2 million bits every day to do it.

Ref 1 Eng Inf Autumn 1984.

Ref 2 BBC Engineering Training Information Sheet: An Introduction to NICAM3.

Ref 3 TCPD Report 1/87 - Findings of the NICAMData Logging Project.



CHINA: continued from previous page

BBC staff rigged a position from which Sue Lawley could give her commentary in a small coach provided by CCTV. The BBC provided the lip microphones that were used. Frank Bough's "in vision" position for the "Breakfast Time" links was covered by cameras three and four. He and his interviewees were provided with stick and lanyard microphones. Communications to personnel other than the cameramen were by means of further radio talkback sets.

The Great Wall, Badaling

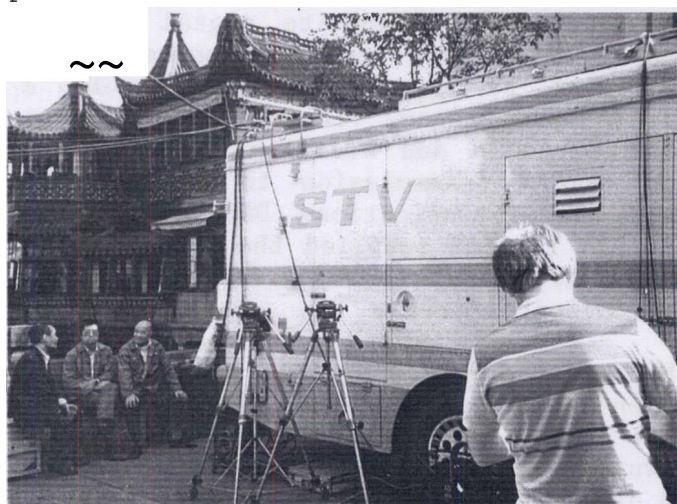
The Queen was taken to the section of the Great Wall at Badaling about 50 miles north west of the centre of Beijing. The Wall is approximately 3000 miles long and much of it is in a state of disrepair, but this section has been extensively restored. Her Majesty was due there on 14th October in the afternoon. We recorded links and interviews for "Breakfast Time" during the latter part of the morning and they were fed to London prior to the live feed of the walk itself.

*Cable de-rigging, Shanghai style*

The China Telecommunications Directorate and British Telecom provided two standby commentary and two four-wire coordination circuits, plus three direct exchange lines.

The vision signal was fed through a stereo sound-in-syncs coder. The stereo sound signal had the BBC commentary on one channel and ITN's on the other. The composite signal, with clean effects (or recorded sound), was fed via a microwave link to the News Hawk and then to London via the Indian Ocean Satellite.

After the end of the transmission we fed some recorded material down the line, and then had to de-rig the BBC equipment. We then moved at some speed to the airport in order to catch the plane to Shanghai, with barely two hours between the start of the derig and the plane's take off. We made it on time thanks to Mark McConnell and Tony Crake of Comms and to Peter Chow and Nick Buckley of News.



*The STV OB van in position in Shanghai*

The CMCR was driven there the day before and parked hard by an arch where the road goes through the wall. ITN had already installed the News Hawk on a high tower on the west going section of the wall about half a mile from the road. It had been lowered into position by helicopter and was powered from a portable generator.

The commentary positions were rigged in a coach as before, with a second one for ITN. An error in the cabling of the feeds led to TV AM getting Sue Lawley's commentary at the beginning of transmission, although the mistake was quickly restified.

The Old Town, Shanghai

The OB team emerged from Shanghai airport at past 10 o'clock in the evening, but we went straight to the Old Town where Shanghai Television had been rigging since 5 o'clock. Apart from a problem of access to the camera positions in Yu Yuan Gardens, everything seemed to be proceeding very well. The main CMCR was parked near the centre of the town overlooking the lake, whilst the second was in a side street near the entrance. The next morning, we recorded and fed the "Breakfast Time" links and interviews. The Queen arrived at about 4 o'clock in  
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