Eng Inf

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BBC Engineering at IBC 86

The BBC stand at IBC 86

The 11th International Broadcasting Convention was held, once again, in Brighton at the end of September. The convention had outgrown the Metropole Hotel, so this year's event expanded into the recently re-opened Grand Hotel and the Brighton Centre. It would be impossible to describe all of the new products and techniques on display, although HDTV, digital processing, and lightweight camera-recorders were high on the list of exciting exhibits. The BBC stand in Hall 6 of the Metropole Hotel was packed with the latest research and designs techniques, and the following pages describe them in more detail.

The cost of electricity required to operate the transmitters of the BBC's domestic MF networks is substantially in excess of £1m p.a. even after the installation of modern transmitters with high conversion efficiency. Various means of further improving efficiency whilst maintaining the quality on the reproduced programme have been considered from time to time, and the BBC is currently investigating a system which operates by regulating the output power of the transmitter dynamically according to the level of the modulating signal. In this system, termed 'Dynamic Carrier Control' (DCC), the amplitude of the radiated signal is compressed as modulation levels increase, both carrier and side-bands being controlled to maintain the modulation index. Virtually all receivers contain an automatic gain control (agc) capable of compensating for this compression introduced at the transmitter.

A compressor using digital signal processing has been designed and constructed for use in conjunction with a

Continued on page 10.

OB vehicles on the promenade at Brighton

UHF Multi-Tone Generator

The GE4P/17 UHF Multi-Tone generator is a UHF signal generator capable of providing up to four unmodulated carriers, as required for measuring the intermodulation performance of Band IV and V television transposer equipment. These four carriers correspond to the vision, sound and stereo sound carriers, and the colour subcarrier. As the equipment is intended for use by transmitter mobile maintenance teams, particular emphasis was placed during the design on portability and convenience of operation. To ensure the latter, the frequencies and relative amplitudes of the carriers are accurately defined and clearly indicated.

Any combination of carriers may be selected, but for convenience, a preset combination or vision carrier alone at O dB, may be selected by single switch operation. The colour subcarrier frequency may be altered, if desired.

The absolute level of the test signal is continously variable from -60 dBm to O dBm, and a useful additional facility is the "response tilt" control. This enables correct relative levels of carriers to be obtained at the output of the equipment under test, should it not have a flat frequency response.

Each of the four carriers is generated by a UHF voltage-controlled oscillator (vco), the frequency of which is stabilised using phase-locked loop techniques. The frequency reference used is an 8 MHz temperature-compensated crystal oscillator providing a stability of $\pm$ 5 parts in 10^6.

The VCOs are followed by an accurate levelling circuit which ensures that the relative levels of the carriers remains correct over Bands IV and V . These outputs are then passively combined to provide the required test signal at a level of - 20dBm. The cross-loss between the carrier generators is sufficient to ensure that negligible intermodulation is introduced in the combining process. An amplifier is included to increase the output level to a maximum of OdBm when required.

Static logic and linear power supply regulators have been used throughout this equipment, thus reducing the risk of spurious outputs to a minimum. The frequency and amplitude stabilising circuits are continously monitored, and a warning given should a fault develop.

R Poole (Tx D) checks the 4-tone generator

Transmitters Opened

The following transmitters have opened or changed since June :

UHF Television

Avoch	Highland
Burgar Hill	Orkney
Edginswell	Devon
Greystoke	Cumbria
Haughton Green	Greater Manchester
Hele	Devon
Kirkby Stephen	Cumbria
Lochinver	Highland
Moffat	Dumfries & Galloway
Norden	Greater Manchester
Peterlee (Horden)	Co. Durham
Poolewe	Highland
Sorn	Strathclyde
Tomich	Highland
Torquay Town	Devon

VHF Radio

Caterham	Surrey
Dartford Tunnel	Kent
Kenley	Surrey
Sandale	Cumbria
Tacolneston	Norfolk
Winter Hill	Lancs

Local Radio

R. Bristol	Bath
R. Cumbria	Kendal
R. Lancashire	Winter Hill
Radio Nottingham	Colwick Park

The EBU-SMPTE remote controller (in operation)

As a major user of a wide range of production equipment, the BBC benefits greatly from the standardisation of equipment interfaces. This is of particular significance in the rapidly growing area of remote control. System designers frequently require the ability to introduce equipment from different manufacturers to particular remote control systems. In the past this has often led to the need to generate interface units which match the control signals produced by the system controlling device, to those required by the device being controlled. Such interface equipment is often costly, inconvenient, particular to one device, and not entirely transparent in terms of system performance.

To overcome such problems, the European Broadcasting Union (EBU) and the Society of Motion Picture and Television Engineers (SMPTE) have worked closely to produce a serial remote control standard designed to meet the requirements of programme production equipment. The hardware and software aspects of the standard are defined in the EBU Technical Document Tech 3245-E; with details of common control messages, messages for generic pieces of equipment (e.g. VTRs, ATRs, switchers) and system service messages, published as a series of supplements. The supplements dealing with common control messages and system service messages (supplement 1) and with VTR messages (supplement 2) are now ready. Supplements dealing with other types of equipment are in preparation, with support from manufacturers with the relevant interest and expertise. User-defined messages permit the enhancement of established message sets enabling new features to be added to equipment.

The standard defines a local area networking system based on a bus, the ES-bus, a name reflecting its EBU and SMPTE origins. The standard is based on the concept of distributed intelligence, with controlled equipment able to respond to high-level commands from the controlling device. This approach enables complex systems to be implemented while minimising bus traffic.

The standard was attracting keen interest from broadcasters and equipment manufacturers when, early in 1985, the requirement for a particular video tape recorder (VTR) remote control system arose within the BBC. The requirement was to provide each of the studio areas at Television Centre with the facility to record and review their output using VTRs housed in a central machine area. This area became known as the Record Bank.

Although VTR manufacturers were committed to supporting the standard, none at that stage had produced a commercial VTR in compliance with it. The set of commands associated with VTRs was, however, nearing completion. Various remote control options were considered for the project. It was judged however that the practical experience that could be gained from using the new standard should not be missed. Hardware and software, which fully complied with the standard, were produced to meet the operational requirement of the system. An interface was produced to enable a currently available VTR, the Ampex VPR6, to be interfaced with the ES-bus.

The Record Bank remote control system does not exploit the full power of the EBU-SMPTE Remote Control Standard. It has however, given the BBC strong evidence of its practical value and has met a real operational requirement in a reliable and cost-effective manner. It enabled the BBC to take part in successful compatibility tests with equipment manufacturers. The BBC is committed to support the standard further, and future developments will, whenever possible, be based on this standard. In particular it will form the basis of a fully fledged VT editing system with a specification currently being defined.

The ES-Bus in operation

DATV Research Concept

Digitally Assisted TeleVision (DATV) is a concept, pioneered by Research Dept, which has many applications in broadcasting. One of these that is of particular interest at the present time, is bandwidth compression of High Definition Television (HDTV) signals. Such signals have a very large bandwidth at the studio. This bandwidth will inevitably cause difficulties in transmission not only for terrestrial and satellite broadcasting but also for signal distribution through other media such as videotape, videodisc and cable. Some form of bandwidth reduction for transmission is clearly required, if HDTV in the home is to become a reality.

One method that shows promise is the use of adaptive pre-filtering and sub-sampling. The basic idea of this method is to reduce the required transmission bandwidth by removing, before transmission, those parts of the original signal which cannot be readily assimilated by the viewer or which carry very little information. Much of the previous work in this field has assumed that the human observer requires less spatial detail in moving areas than in stationary areas. The extent to which this effect can be exploited when the observer's eye follows an area of moving detail has, however, been shown by investigations to be severely limited. In addition, the loss of moving detail arising from previously suggested implementations, has proved to be particularly objectionable when sources and displays capable of resolving the full potential resolution of the transmission channel are used; this is a condition which would not arise in the early years of a new HDTV system but would become quite an embarrassment as the performance of cameras and displays improved.

In order to investigate further such bandwidth reduction techniques and the long term consequences of their adoption, an experimental system has been developed which allows the effects of pre-filtering, sub-sampling and post-filtering to be examined in a fully programmable manner, allowing a wide range of sampling structures and filter sets to be implemented with a single instruction. The equipment operates in real time but at an input data rate commensurate with normal definition television. This allows the unknowns of adaptive filtering and sampling structures to be investigated

Nick Tanton (RD) explains HDTV standards

with fully developed sources and displays. The experimental results can therefore be extrapolated, with care, to indicate the performance of a fully evolved HDTV system rather than being constrained by sources and displays whose performance is limited by short/term practical constraints.

Investigations to date have concentrated on a system which enables a highly detailed image to be transmitted in both stationary areas of the picture and those areas containing well correlated motion. The remaining areas contain poorly correlated information such as revealed detail, shot changes and erratic motion. These areas are transmitted at a lower definition since the human visual system genuinely requires less detail when image detail is poorly correlated from field-to-field. The reduced bandwidth signal consists mainly of analogue sub-sampled picture data, but also contains a digital control signal which has been found to be crucial to the success of this type of system. The digital signal carries reliable information about the motion content of the transmitted image and details of which coding method was used for each moving area. DATV is the name that has been given to the combination of analogue and digital signal components in this way.

THE EDITOR REGRETS....

My apologies for the wrong caption which appeared on page 2 of Eng Inf no.25. The person in the picture was, of course, John Keeble, Director of Business Administration, BBC Enterprises.

Alan Lafferty.

HDTV Field Rates

The term 'High Definition Television' (HDTV), is used to describe television systems designed for large-screen display at viewing distance of around 3 times picture height (3H). Such viewing conditions greatly increase the viewers' involvement in the programme but, to achieve acceptable results, the horizontal and vertical resolution used for an HDTV system must be greater than those standards commonly encountered today. The necessary increase in resolution implies a considerable increase in the bandwidth of the studio HDTV signal and, in much of the intense study that has been carried out worldwide on the parameters of an HDTV system, the inevitable compromise between the goal of 'transparent' picture quality and realistic bandwidths must be made.

The choice of display field-rate is influenced by the need to keep large-area flicker to a low level. Visibility of flicker increases as the display size increases because a greater proportion of the screen is viewed in peripheral vision. Conversely, flicker visibility decreases as the field-frequency is increased because the human eye/brain combination has a low pass temporal characteristic which results in a reduced sensitivity to higher temporal frequencies. Recent experiments indicate that display field frequencies of around 80 Hz are required to reduce display flicker at the viewing distances and peak screen brightnesses likely to be encountered in a practical HDTV domestic viewing environment. Upconversion would therefore be needed for large, flicker-free HDTV displays if source field-rates are significantly lower than 80Hz.

The demonstrations at IBC used a programmable stills-store, synchronizing pulse generator and an HDTV monitor to demonstrate the effect of display field-rate on the visibility of large-area flicker and of inter-line twitter on a still picture.

The demonstration was supervised by a small computer which also provided pages of explanatory text on a second (standard) monitor. At appropriate moments throughout the demonstration visitors were given the opportunity of selecting between different field-rate displays using a switch panel. This allowed them to compare the effects of different field-rates with a menu on the text display to assist them.

Direct (instantaneous) switched comparison between pictures displayed at different field-rates is practical only with monochrome images due to the architecture of the equipment used. However full colour images on each scanning standard were available: they were individually loaded into the stores from the Winchester disk bulk-storage.

The total analogue bandwidth required for an HDTV signal is of considerable interest both for transmission of HDTV to the home and in practical display circuitry. In these comparisons the analogue signal bandwidth was kept constant and, as far as possible, the vertical bandwidth of each picture was tailored to represent what may be achievable or desirable in real HDTV sources or display. For practical reasons the display scan line-frequency was kept approximately constant; thus as field-rate increased the number of lines capable of being displayed was reduced.

C Clark (RD) shows stereo-sound with TV

Stereo Sound with TV

At the IBC 84 Exhibition, the BBC gave demonstrations of an experimental system to provide two additional high-quality sound channels within the existing UK terrestrial UHF television transmission System I. Since then steady progress has been made towards the determination of the parameters of a complete proposed system. A technical specification has been agreed between the BBC and IBA, and has been accepted by the UK Department of Trade and Industry as basis for a UK standard.

Throughout the period of the 1986 Convention, broadcast signals conforming

with this agreed specification were on air from the BBC 1 and BBC 2 transmitters at Rowridge, and these signals were received off air and decoded on the BBC Stand. (Because of the experimental nature of the system, the stereo sound thus conveyed was music that was unrelated to the television programme.)

The outline characteristics of the proposed system for digital stereo sound with System I television are given below. An important feature of the system is that the digital sound signals are conveyed in a format which has much commonality with that of the MAC/packet family of systems agreed for European DBS transmissions. This is expected to lead to economies in the receiver because the same circuits might be used to decode digital sound signals from DBS and from terrestrial transmissions.

Considerable international interest has been aroused by the experimental system. Broadcasters in Hong Kong, which uses the same System I Television Standard as the UK, have undertaken a successful test of the experimental system, using equipment loaned to them by the BBC.

Broadcasters in Sweden have performed independent tests of a similar experimental digital system applicable to System B/G television, and discussions and tests are in progress to investigate the feasibility of harmonising the details of these System B/G developments with the proposal for System I. Although neither the BBC nor the ITV companies have yet announced firm plans to provide a stereophonic TV service, the BBC, at least, is taking preliminary steps to make its television sound transmitter and programme distribution networks capable of conveying digital stereo sound signals.

Summary of the Characteristics

1. Specification of the digitally-modulated carrier:

i) Carrier frequency: 6.552 MHz above vision carrier

ii) Carrier Level: -20 db with respect to peak vision carrier.

iii) Modulation: Differentially encoded Quadrature Phase-shift keying (DQPSK)

iv) Spectrum Shaping: (Overall with ideal receiver) 100% cosine roll-off split equally between transmitter and receiver (overall bandwidth of digital signal approximately 728 kHz)

2. Level of primary fm sound carrier: -10 db with respect to peak vision carrier

3. Overall bit-rate: 728 kbit/s

4. Sound Coding Characteristics:

i) Pre-emphasis: CCITT Recommendation J.17 (6.5 db attenuation at 800 Hz)

ii) Sampling frequency: 32 kHz

iii) Initial resolution: 14 bits/sample

iv) Companding Characteristics: near-instantaneous, with compression to 10 bits/sample in 32-sample (1 ms) blocks

v) Coding for compressed samples: 2's complement

vi) Number of coding ranges: 5

Signalled by 3-bit scale factor

vii) Number of protection ranges: 7

viii) Error Protection: One parity bit added to each 10- sample to check the six most significant bits parity modified for scale- factor signalling.

ix) Scale-factor Signalling: (3 bits per sound coding block, two blocks per frame). By modification of 9 parity bits per scale factor bit, detected by majority decision logic.

5. Bit Interleaving: 45 x 16 Frame alignment word not interleaved.

6. Energy Dispersal Scrambling: By addition, modulo-two, of a pseudo random sequence of length $2^9 - 1$ bits, synchronously with the mulitplex frame. Frame alignment word not scrambled.

7. Frame Format: 728 bits frame length (in 1 ms) with 8-bit lumped frame-alignment word.

RDS
Radio Data System

In March this year BBC Radio announced firm plans to implement a Radio Data System (RDS) service on all its network and local radio VHF stations in England by September 1987. RDS will help the listener, with suitably equipped receivers, to find the station or programme of their choice more easily. For example, RDS receivers with small built-in electronic displays will indicate the name of the service to which the receiver is tuned. And RDS can help to completely automate the tuning process, thus freeing the listener from the need to be concerned with frequencies. Car radios equiped with RDS will be able to re-tune automatically as they move from the service area of one transmitter to another.

RDS comprises an inaudible data signal which is added to the sound-programme signal at the VHF-FM transmitters. The specification of the RDS system was developed under the auspices of the European Broadcasting Union (EBU) and is based upon an earlier radio paging system developed in Sweden. The BBC however, carried out a great deal of development work and, with other broadcasters, contributed towards the RDS Specification, which was agreed by the EBU in 1984 and became a CCIR Recommendation in May 1986.

The RDS Specification allows considerable flexibility in implementation thus permitting the broadcaster to best match the needs with the resources available for RDS on particular transmissions, whilst still maintaining compatibility with all RDS receivers. The proposed BBC Radio implementation of RDS will include the following features:

John Riley (RD) demonstrates RDS

Programme Identification (PI)

This helps the radio set to find automatically the chosen service and always select the strongest signal. This short code uniquely identifies a particular service, Radio 4 for example.

Programme service (PS)

This is a longer code comprising up to eight text characters which may be displayed on the set to show the name of the service, "BBC Radio 4" for example.

List of Alternative Frequencies (AF)

These codes inform the radio set of the other frequencies where the service can be found - to which it can switch if it finds a stronger signal. LF and MF frequencies can also be given.

Clock Time and Date (CT)

These codes broadcast clock time and date. It is, therefore, always correct, and automatically takes care of local time variations, eg from summer to winter.

On the stand at IBC was a computer-controlled concept model of an advanced RDS receiver using a touch-sensitive display to control the receiver. This concept model receiver, which has been developed by Research Department was accompanied by a video presentation to illustrate the potential of RDS to give a new dimension to radio listening.

Although some commercial transmission equipment is available, it is not directly suitable for the BBC's network. It is also expected that, in the early stages at least, equipment development will tend to be evolutionary. This has prompted Design and Equipment Department to design RDS data originating and transmitter equipment.

The originating equipment accepts control information at the studio and produces signals in a special update format. This is sent to the transmitters, along with the programme, via the normal distribution network. The transmitter equipment decodes these update signals and converts them into the RDS format.

The output of the equipments, the 57 kHz sub-carrier modulated by the RDS data, is added to the multiplex signal at the input of the transmitter's drive equipment.

Initial implementation of RDS service

Initially, the service will not be using all of the RDS information defined in the EBU Specification. The limited service will consist of: PI, PS, AF, ON and CT.

There may also be experimental implementation of other facilities such as Radiotext (RT) and the Traffic Information flags (TP and TA).

RDS Originating Equipment

The originating equipment for the RDS service will be based on a commercial mini-computer. Initially this will produce a limited range of RDS information for up to four services. The information is generated as four separate RS-232 channels suitable for interfacing to the data port on the NICAM-3 distribution system. Each channel will generate update information at an average rate of about 2400 baud (limited by the transmission channel's capacity). Data entry will be via a single terminal, though the system will be capable of expansion to cater for a considerably more complex system.

This will be able to accept data from a variety of sources (e.g. a number of continuity studios, separate editing terminal for each service etc.) and display status information in a variety of forms on a number of terminals. It is expected that this system will evolve considerably over the early years of the RDS service as it is gradually expanded and its full potential realised.

At first, data for the local opt-out services will be default data stored at the transmitter. But in the fullness of time it is expected that simple terminals will be developed to feed update data to the transmitter via 1200 baud links.

RDS Transmitter equipment

In contrast to the originating equipment it will be expensive and time-consuming if the transmitter equipment design is not right first time - any changes will need to be done to about 200 units! Instead, the full RDS Specification is being implemented and the initial installation is expected to remain substantially un-altered as the service expands. The equipment consists of four basic sub-units:

1. a data splitter - which accepts the data signal from a NICAM-3 decoder and separates the RDS update information from the transmitter control information.

2. an RBS (Re-Broadcast Standby) decoder - which decodes an RDS signal obtained from an RBS receiver and converts this to an update format similar to that used for other sources.

3. an RDS assembler - this takes data from three sources of update data, the data splitter (which is the main feed), an RBS decoder (the reserve feed), and a local source. It formats the selected update channel into the RDS format. Should all update sources fail then the assembler uses a default set of RDS information which corresponds to the most likely data for that transmitter.

4. an RDS modulator - this take the formatted data and provides a modulated 57 kHz sub-carrier. The sub-carrier is phase-locked to the multiplex pilot tone to minimise crosstalk problems. This unit also has a demodulator which can be fed with a return feed of a 57 kHz signal from a check receiver. The demodulated information is passed back to the RDS assembler where it can be compared with the original for monitoring purposes. The equipment can deal with all types of RDS information. Indeed, it even allows for easy expansion of the system to include facilities not in the current version of the RDS Specification!

The RDS concept Model display

Digital Video Effects Mixer

A two-bank digital video component mixer has been designed to be used for the preparation of complex captions. When it is used with a storage device, such as a Slide File, the stored result of one pass through the mixer may be used as a source for a second pass. With repeated passages around this loop, complex montages can be created using relatively simple individual stages.

The final composition may have undergone many passes through the mixer, so it has been implemented with a digital architecture and digital interfaces in order that the signals following the loop suffer no degradation. The digital interfaces conform to the EBU Parallel Interface Specification (EBU Tech 3246-E); two inputs and two outputs are provided.

Since the mixer has the need to interface to traditional analogue equipment, three ADCs and a DAC have been provided, enabling a full complement of video and keys to be processed from RGB components.

The mixer can perform the standard mix/effects functions of cross-fade, mix, insert and keying. The insert shapes are a rectangle, a circle and a diamond. Control of size, aspect ratio and position for all shapes is available.

The output of the mixer passes through a 'processing amplifier' to ensure its legality and that it is correctly blanked. An output of mixed syncs is provided, co-timed with the analogue RGB components.

This is the second mixer built from a family of video processing modules. A further mixer is currently being developed based on the same modules, but providing more key-processing facilities.

Datacast from Enterprises

The BBC's Datacast Service of data broadcasting was launched in October last year and is now carrying data for customers. Over the coming months, the number of customers using the system is expected to increase further, producing a useful income to the BBC.

Data is sent direct by line to Television Centre where, after being incorporated into teletext-compatible "packets", it is inserted on an allocated line in the vertical blanking internal, thus making further use of the spare capacity in the television signal waveform.

Transmission equipment has been provided by Research Department and a receiving terminal designed by Designs Group has been licensed to manufacturers for commercial sale.

By providing true date transparency, the BBC Datacast system permits the easy impletmentation of a range of encryption techniques, individual user addressing facilities, as well as national coverage. This development represents a major breakthrough in professional data communication methods.

BBC Datacast uses one of the non-displayed packets defined in the Broadcast Teletext Specification of 1976. The implementation of the service was designed with the needs of the professional information technology market uppermost. Hence, the BBC Datacast system is both technically and physically separate from existing field blanking interval services (including CEEFAX and engineering systems). It uses a dedicated computer system, which accepts data from a number of service providers, superimposes a transport protocol with error and continuity checks, time division multiplexes the data in a true packet format, and inserts the resulting packets of data direct into the video distribution network on an independent line.

Over the years, teletext transport systems have been proven to be extremely robust. The addition of cyclic redundancy checks to the CEEFAX output in 1982 to provide for error-free reception of computer software has demonstrated how reliable they are.

In order to meet the requirements of professional data services, it was decided that a truly transparent "byte stream" approach would be adopted, with extremely high data integrity, negligible transmission delay and even greater degrees of error and continuity control. In addition, all elements of the Datacast transmission system contain at least 100% backup. The packet-organised system which has been adopted, offers many advantages over the use of traditional page-based services. Data, in general is not carried in page-format, but as a continuous byte stream. It is, of course, straight forward to transmit videotex pages by this method if required. The packet-based system provides extreme flexibility and ease of use over a wide range of broadcast technologies and includes the following characteristics:

(i) It does not interfere with existing UK teletext decoders, built to the 1976 specification.

(ii) It does not constrain, and is not constrained by, any accompanying teletext service.

(iii) It uses the same transport mechanism as teletext, allowing use of exisiting data acquisition circuitry.

(iv) The system is directly applicable to 525 line/60Hz, satellite and cable signal distribution systems; for field blanking or full field transmission applications.

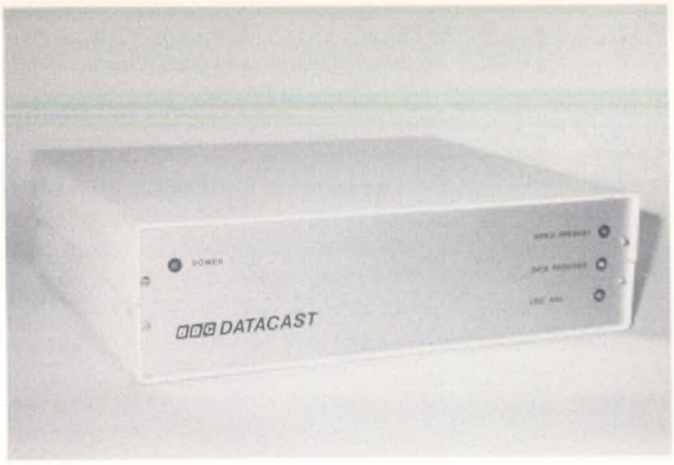
(v) It provides a substantially unlimited number of separate services, which may be combined in any way, subject to the maximum available data rate.

(vi) It provides an indication, with a high degree of confidence, when data for each service has been correctly and completely received.

(vii) If data is corrupted or lost, the location and length of the erroneous or absent data block is known.

(viii) An entire data packet multiplex can be carried within a single data channel.

BBC Datacast provides nationwide access for information services. Data transmission speeds are high: a single line in the field blanking interval can carry in excess of 14 kb/s of usable data. Experiments have shown that data integrity



The D & ED Datacast receiver

is extremely high over a wide range of reception sites. Subscribers may be connected to a service without delay, optimising income to the service provider and making broadcast data services extremely attractive and cost effective.

DCC from page 1

particular design of impedance-modulated 50 kW transmitter. This unit provides audio compression varying from zero at low modulation levels to 3 dB (or some other preset value) at 100% modulation, together with an accurately tracking dc voltage to control the transmitter carrier level. Additionally, the unit ensures freedom from overshoot by delaying the audio signal ahead of the variable gain element, so that by the time the signal reaches it the gain reduction effected by the control circuits is complete.

Field trials have confirmed that use of this compressor with a maximum compression of 3 dB (ie at full modulation) is unlikely to result in a perceptible degradation of service quality when using normal domestic receivers, even at the edge of the transmitter coverage area. To obtain the full power saving benefit it is necessary also to modify the transmitter output impedance, but this can be done within the normal range of the control adjustment of existing components. The power saving achievable is dependent upon the mean modulation level of the programme and, with the mix of programmes such as provided by Radio 2, this is expected to be of the order of 20%. Thus DCC can provide a most worthwhile saving in the operating costs of the BBC's MF radio networks.

Television Sub-titling

The late Bill Northwood initiated sub-titling of news programmes for deaf viewers when BBC2 started in the early 1960s. BBC2 also sub-titled regular transmissions of foreign feature films.

In 1976 a new sub-titling system was brought into use for foreign films. It consisted of a mini computer (LSI2/20) with floppy disc readers, and a character generator made by Sween Electronics. These sub-titles were composed onto the floppy discs and replayed on cue from the telecine machine. The system was also capable of being cued by time code from a vt machine. The installation which included a complete spare set of equipment was carried out by SCPD, with programming by Recording Section of Designs Dept. This system gave both improved quality sub-titles and was much cheaper than the optical printing method.

These titles were, of course, inserted into the video and therefore readable by all viewers. This is now know as open sub-titling.

It was felt that in addition to this there was a need for sub-titles for deaf viewers which they could select if they wished to. Viewers with normal hearing would not need to see these. The medium for these sub-titles was to be the CEEFAX system.

Some experiments had taken place in the mid 1970's using palantype via CEEFAX. Palantype is a system of machine printed "shorthand". It works by printing phonetic symbols, and the experiments had used a minicomputer to translate these into text. However while the Palantype experiments continued for sub-titling live transmissions, it was felt their pre-prepared sub-titles would offer worthwhile improvements for pre-recorded programmes.

A special sub-title preparation terminal was made by Designs Dept. This enabled the operator to prepare the titles while viewing a Umatic VCR recording of the programme. The floppy discs prepared on this terminal were replayed on the same mini computers which were used for open sub-titles. These mini computers instead of feeding a character generator, were connected to the CEEFAX origination system. Thus a deaf viewer could select on his CEEFAX receiver the designated sub-title page and see the titles.

Experimental transmissions using this system started in 1980, the redoubtable Bill Northwood preparing the sub-titles initially. However his daughter Sue Northwood assisted him and took over when he died. Sub-titling operations were consolidated by the addition of another replay mini computer and the provision of a second Designs Dept preparation terminal.

In 1981 the Television Service decided to expand the sub-titling operations. Finance for additional terminals was approved in 1982 and further terminals were approved in 1983 and 1984. Currently there are eleven Sub-Titling for the Deaf terminals in Glasgow and four in London. These terminals were developed by Logica to a BBC specification and are marketed by them as Supertext I terminals. Each uses a DEC PDP 11/23 minicomputer, a keyboard/display unit, Umatic VCR, and timecode reader.

For live sub-titling, experiments with the Palantype method mentioned earlier had continued. However in late 1982 further work on this method came to a halt. Difficulties had been experienced as the system could not easily distinguish between words (or parts of words) with similar phonetic sounds but different spellings. Additionally, special training was required to operate the Palantype keyboard.

A different approach was proposed whereby a special keyboard could be used to recall prepared words or phrases, or a standard QWERTY Keyboard, (operated by a second person), could be used to compose sub-titles. As the basis for this development, Designs Dept used a terminal, know as the NEWFORE, which was developed by Southampton University as part of a study sponsored by the IBA. The special DD Keyboard and new software enabled sixty words or phrases to be recalled, which can be changed as required by down loading from a floppy disc. Thus, for example, if covering Wimbledon, one group could be prepared for a particular match, another for the following one. This equipment came into operation experimentally for the finals at Wimbledon in 1984 and has been used regularly since then for this, and for Blue Peter and other programmes from time to time.

It became apparent in early 1983 that the expansion of sub-titles for the deaf programmes would be inhibited if the

Sub-titling
Continued from Page 11

replay facilities were not improved. Operationally, it was difficult to sub-title consecutive programmes, and impossible to simultaneously sub-title on BBC1 and BBC2.

Discussion of the best method of dealing with the problem indicated that a centrally located replay system would require an elaborate and expensive routeing system for time code, vision, etc. Instead, Television Recording proposed equipping most telecine or vt cubicles with their own floppy disc replay systems. The routeing problem would be overcome by coding the signals into teletext format and combining these with the output of the CEEFAX computer system. The equipment was made by Screen Electronics Ltd to BBC specifications and entered service in the first half of 1986. The original replay system continues in use (at the moment) for open sub-titles. However, further funds for the replacement of the equipment have been approved.

This equipment develops the principle used in the new replay equipment. Special character generators receive the teletext encoded output of a cubicle, decode it, and insert open sub-titles onto it. Thus the same replay equipment is used for both open and deaf sub-titling. It is expected that this will come into operation late in 1986.

The three National Regions will be equipped later with units which will enable them to record programmes which are distributed on the Network with sub-titles. These units will extract the sub-titles from the teletext stream, reinsert it on to the blanked frame blanking for recording on a local VTR. When the recording is reproduced, the processor in the VTR is adjusted to not blank the sub-titles and the signal is fed into the original unit. This then recombines the local sub-titles in place of any on the National distribusion. Thus if the region opts-out and records the National Network programme for later replay, the correct sub-titles will be distributed to the region's transmitters.

Late in 1985 approval for two more live sub-titling terminals was given which are developments of the first experimental unit mentioned earlier. The developments consist of a restyled keyboard, better software, and the ability for the terminal to pre-record BBC format floppy discs. One of these units, without the pre-recording ability, which was used in Edinburgh for the 1986 Commonwealth Games is currently in Designs Dept having work completed. This, and the second one, will be brought into service, and then the original unit will be brought up to the new standard early in 1987.

There have, over the year, been a large number of staff involved in these developments. The following are some of those, and the author begs the forgiveness of anyone he has forgotten.

Richard Browne, Tel Rec; David Crawford, Tel Rec; David Clarkson, Tel Rec; Richard Cloutman, late of SCPD; Peter Jones, Tel Rec; Roger Kelly, P&ID Tel; Bill Hawkins, late of Designs Dept; Ron Spencer, Designs Dept; Ray Taylor, late of Designs Dept; John Wynne PID Tel; The late Bill Northwood, Sub-Titling; Sue Northwood, Sub Titling; Ruth Griffiths, Sub-Titling; Gay Robertson Purchased Programmes; Geoff Pointer, Television Network.

Manufacturing Licence Agreements

A manufacturing licence agreement has recently been signed with BAL Components Ltd for the EBU Parallel Interface equipment developed by Design Group, D & ED. The Interface is in two parts; a transmitter which consists of a Triple ADC CO8/512, Clock Generator GE7/509 and Multiplexer COllS/503, and a receiver comprising a Demultiplexer UN16/548, Triple DAC CO9/510 and Analogue Sync Pulse Generator GE/517.

Vistek Electronics Limited now have a licence to manufacture the Network Clock Generator GE 1M/597.

The Licence for the ACE Standards Convertor has been transferred to Marconi Communications Systems Limited.

Brabury Limited now have a Licence to manufacture the 6 dB Video and Pulse DA, AM4/536 and associated equipment, EQ5/562A, C-H, MP1/3, MP2/20, MP2/23, PA20/521A, PA20/522A, PS3/64, PS3/67.

Surrey Electronics Limited, have a licence to manufacture the Stereo PPM Amplifier AM20/5.

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