Eng Inf

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The London Marathon

by Alan Woolford, OB Technical Co-ordinator.

It has always been considered that the most demanding programme from a Communications point of view is the Universities Boat Race from Putney to Mortlake. In recent years, however, coverage of the London Marathon has provided an even greater test of Radio Links resources. This year it came only two weeks after the Boat Race! The live Marathon programme covered the 26 miles 385 yards from Blackheath, past the Cutty Sark, Jamaica Road, Tower Bridge, The Isle of Dogs, The Tower of London, up The Mall and the finish at Westminster Bridge with continuous uninterrupted coverage.

From a television point of view the event is divided into two distinct parts. There is the race at the front, which has to be shown in the same professional way as any other athletics event. Then there is the spectacle of the thousands of fun runners and celebrities as they pass the well known landmarks, egged on by the crowds; the street parties; and the festivities along the route. The first requires continuous coverage of the leaders, using mobile cameras, and the second, a large number of static cameras distributed at places of interest.

Heletele in action, with remote camera in ball – Photo Helicopter Hire

This year, there were twenty-three cameras in twenty-eight positions along the route with OB units located at Blackheath (four cameras), Charlton Park Road (one), Woolwich Barracks (one), Cutty Sark (three), The Jamaica Road Street Party (one), The Tower (three), The Mall (five) and finally Westminster Bridge (four). There were also two portable single camera units (psc's) dropping

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Radio 1 Moves to Egton

Two new Radio 1 continuity suites, K and L, came into service in April. They have been included in a new complex that has been built from a suite of offices in Egton House near BH. Each suite consists of a control cubicle with its associated studio in which a disc-jockey can take over the running of the network.

A special feature is a fibre-optic link via the Egton House apparatus room to the main switching frame in BH. By means of a solid-state logic system a large number of outside sources can be switched through the fibre-optic link into programmes. Each suite has also access to fifteen cartridge machines, three EMT 950 gram decks and two compact disc players. It is the first time compact disc players have been included as an integral part of the desk itself.

Radio 1 Continuity

The cubicle desk is a BBC-

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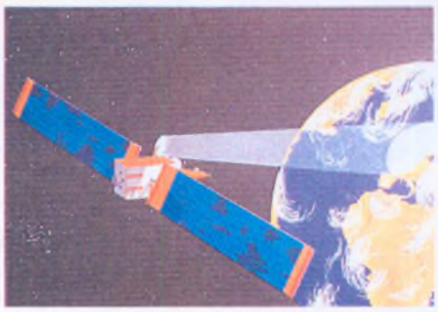
DBS Project Abandoned

The recent collapse of the DBS consortium must be disappointing news to many engineers. Despite the technical attractions of satellite broadcasting, the UK DBS project has been abandoned in its present form because of doubts about its financial viability.

During the first few years of a subscription-based DBS service, the operating costs, such as the costs of programming, satellites, billing and administration, will exceed the revenue from subscriptions. Assuming reasonable growth in the number of DBS subscribers, the income from subscriptions might cover the costs during the fourth year of the service, and lead to profits in subsequent years. With luck, these profits should be ample compensation for the losses incurred at the beginning of the service.



If the growth in the DBS audience did not meet expectations, the service might not break even until, say, the sixth year. As the guaranteed life of the satellite might be only 10 years, profits in years 7 – 10 would be unlikely to offset the accumulated deficits in previous years.

Even worse, it may become obvious after a few years that the DBS project is doomed to failure and hence the project would need to be aborted having incurred massive losses.

In summary, DBS is an expensive, high risk project which is unlikely to yield a high rate of return on investment. One intriguing thought is that it might be possible to squeeze a high definition television signal into a DBS channel. Hence it might be sensible to delay the DBS project until the early 1990's when suitable large screen displays will probably become available for domestic use.

Radio 1 at Egton
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designed and built Maxicon DK2/25. It contains control panels for the microphone, the studio repro, the cubicle repro and outside source channels. There are six microphones; five for guest speakers coming up on a single sub-mixer and a separate microphone for the presenter, who can control all the microphones from the studio desk. The studio repro panel gives control of six zero-level sources located in the studio. They can be in any combination of gram decks, cartridge players, tape decks or compact disc players. The cubicle repro panel duplicates the controls, which it can either override or delegate to the studio. The outside source panel provides access to ten stereo outside sources.

Four telephone balance units, UN 19/47, have inputs from two direct-exchange lines and two EBX lines. These are fed into the continuity.

The selection of outside sources is made by a Qwerty keyboard. A visual display shows whether the correct source is to line. Errors made when entering the source or destination information is corrected by logic in the system itself.

The apparatus room is unique in the large number of facilities it handles. It provides power supplies and technical services to both the Egton House and Langham Street premises. These include the programme presentation suite in which 'jingles' and trailers are produced, the gram library suite, the quality monitoring area, the rf broadband equipment and the continuity reception desk, with its video security cameras and monitors.

Radio 1 Cubicle

The project took two and a half years to complete. The continuities were built into an area which had previously been a suite of offices. Geoff Bottom of SCPD the project leader for the London Control Room and Continuities, had the overall responsibility for the area. Although John Clarke of SCPD as project leader for the continuities K and L had day-to-day responsibility for them; he retired at Easter with their completion. He was assisted by SCPD engineers John Tidy and Kevin Wise. Tony Robinson of ACED was the architect principally concerned in designing and supervising the building work.

* * *

Transmitters Opened

The following uhf transmitters have opened since April:

Felixstowe	Suffolk
Horn Street	Kent
Gravesend	Kent
Pwll-glas	Clwyd
Woodcombe	Somerset
Boddam	Grampian
Glespin	Strathclyde
Lamberhurst	Kent
Mickleham	Surrey
Glenelly Valley	Co. Tyrone
Wattsville	Gwent
Eardiston	Worcester
Sedlescombe	East Sussex
Skirmett	Oxon
Mochdre	Clwyd

The following vhf transmitters have opened or changed:

Llanrhaedr-ym-Mochnant	Clwyd
Llanfyllin	Powys
Ballycastle	Co. Antrium
Llanddona	Gwynedd

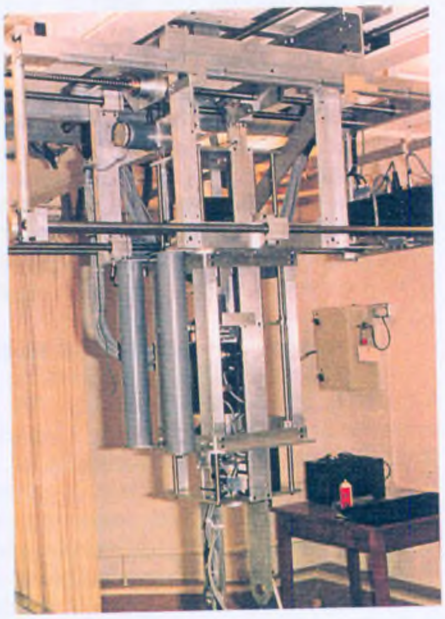
The following local radio transmitters have opened or changed:

The Wrekin	R. Shropshire
Shrewsbury	
Ludlow	
Woofferton	
Sandy Heath	R. Bedfordshire
Luton	
Bedford	
High Hunsley	R. Humberside

"Copies of the 1985 Transmitter Pocket Booklet are now available by ringing LBH 5040."

As-large-as-life with Macro-Glide

Engineers and the Film Unit Manager in NPC Bristol were posed quite a problem when the Natural History Unit asked for a macro-television facility that could move in any direction. The success of the macro-bench, (see Eng Inf No 11) showed that it was possible to use a fixed camera and moving subject to produce exceptional television pictures. However, John Downer, a producer with the NHU, wanted the same sort of camera magnification, for the "Intergalactic Garden" programme but the camera needed to move to follow the subject around a miniature set, and still maintain the magnification.



The Macro-glide facility

Denis Valitis, Engineering Services Manager at Bristol said, 'We had to translate the production requirements into an engineering specification. Furthermore, the timescale was very short; we were only given the problem in January, and the facility had to be completed by the end of April".

A room in the basement of 19 Tyndalls Park Road was set aside for the project, which became known as the "Macro-Glide". A team was put together which combined the talents of builders, mechanical engineers and electronic engineers. Building Services Manager Gerald Porter was set the main tasks of converting two basements into the new studio and providing two RSJ support beams that would carry the weight of the Macro-Glide. Arthur Mockford (since retired), the Mechanical Maintenance Supervisor, had the difficult task of building a metal support cradle for the macro-camera that would allow it to move in any direction. Paul Townsend from Special Facilities had the problem of controlling the glide and putting the pictures onto the screen.

The specification called for the glide to move 2.5 metres along the length of the studio, 1 m across the studio and have a vertical movement of 0.5 m. The camera would be able to rotate through a full 360 degrees, limited only by the control cables. All this to happen at speeds of up to 0.25 metres per second.

The macro-glide would be suspended from the ceiling via the two parallel RSJ's. These needed to be erected to within a millimetre tolerance because the tracking rails had limited adjustments for alignment over the 2.5 metre movement called for in the specification. Underneath, an aluminium alloy support structure would carry the four main stepping motors, counter balance weights, and Ikegami HL79D or film camera.

The glide was designed and built section by section in the mechanical workshops. No drawings were available so each piece had to be machined to fit as the project progressed. The prefabricated parts were then dismantled and re-erected in the basement room when the builders had finished the support beams.

Meanwhile the control of the camera was causing a few problems. A simple joystick would provide comparitively coarse control in only two dimensions. Therefore a pressure sensitive joystick control was obtained from the American aerospace industry. This enabled the velocity of movement to be controlled by simple pressure; the harder the pressure the faster the movement. Up to six movements are possible from this joystick, though only four are actually used. The "thumb" button may eventually be used for future developments such as banking and tilting, thus achieving an "in flight" effect.

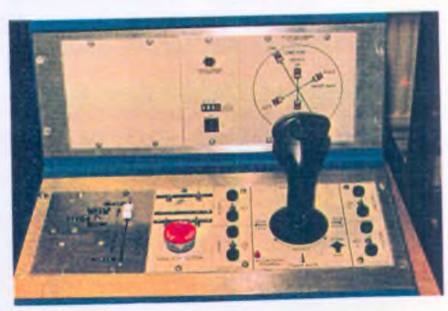
In the basement, the clearance between the floor and ceiling was insufficient for the elevation range. Some thought was given to reducing the size of the mounting frame, but various mechanical constraints prevented this. The only viable solution was, therefore, to lower the basement floor by 0.25 m, and then re-lay the concrete. Pressure on the time-scale meant that this had to be done over the Easter weekend, the additional work was completed in record time. Luckily there was only one "unknown hazard", a drainage pipe that had long since been dis-used.

A three-phase electricity supply was installed to reinforce the building's power supply so that the scenes could be lit to tv production levels. HMI discharge lamps were purchased because these provide a high intensity light source, while not being so hot that the specimens die.

The building work finished, the glide and associated electronics came together, and within forty-eight hours the system was working. The problems were not over however, the slight judder caused by the stepper motors was apparent under high magnifications and at slow speeds. The pendulum effect of the glide caused a small back-lash effect which was partially corrected by extra strengthening of the frame.

The glide met 90% of the producers requirements — a remarkable achievement in view of the different engineering disciplines involved and the short timescale of the project.

The NHU were delighted with the new unique facility and have already asked if the speed and elevation range can be increased. Having discovered the potential of the glide, they would like more and more facilities. Plans are being made to interface the individual movements onto a small personal



The aerospace type controller

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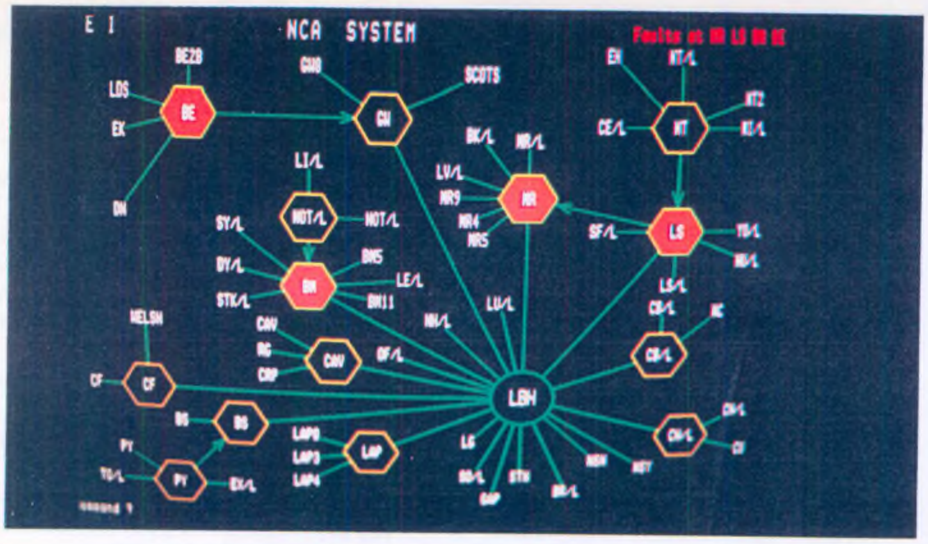


The NCA computer display showing simulated faults at Belfast, Birmingham, Manchester and London

News Routing by Computer

Providing circuits for contributors to Radio News and Current Affairs (NCA) Programmes will be made much easier when a new computerised routing system is introduced in London.

At the moment, for domestic contributions, studios are routed to the News Traffic Area via an open-mix system. This is comprised of simple resistive mixers located mainly at BBC Regional centres. The mixers may have up to seven different sources directly connected. The NCA operator in London allocates a route which may pass through one or more centres in, say Leeds or Manchester. This system has worked well over the last ten years or more, but the increasing number of studios around the country, (currently around fifty), means that there is often a conflict of priorities when two studios need to pass through the same open-mix unit.

It was therefore decided, that the open-mix units should be replaced by remotely controllable audio routers so that exclusive routes could be established between the contributing studio and London. This would also allow the provision of cross country lines which would enable some studios to reach London by an alternative route should their normal route be in use. The problems were:- How to communicate with the remote audio routers, and how to control and display the state of the network in a way that could be simply understood.

The NCA computer keyboards

A computerised system seemed to be the answer, so SCPD and Radio Networks produced an outline operational specification which was put out to competitive tender. The contract was won by Micro Consultants Computers who assisted in developing the detailed operational and technical parameters. Micro Consultants Computers not only wrote the software but also wrote the final specification. The whole package was delivered on time, without bugs, and on price; a major achievement in view of the outline nature of the specification for which they had tendered.

The system hardware in London consists of a DEC Micro PDP11/23+ computer with a high resolution graphics board. This is coupled locally to twin floppy disk drives, a colour monitor, a vdu and two keyboards. At the regional centres the open-mix units have been replaced by audio routers manufactured by Glensound Electronics with a control protocol based on the LBH NTP routing system.

The data for controlling the routers is fed from the computer in the News Traffic Area to the Audio Test Area in LBH via a fibre-optic link, here it enters the Communications Department statistical data network for transmission to the regional centres.

The NCA operator can select a studio by entering a shortform code for the studio required. The computer will offer a route if available and provide details of any alternative routes, the information being displayed graphically on the colour monitor. The display in fact resembles familiar network routing drawings. Different colours are used to show the current state of the network i.e. the studios and lines in use or faults encountered. The vdu is used to provide information on the studio from a database file e.g. contact phone numbers, type of desk, tape machine etc and any peculiarities such as limited access hours or keyholders. Thus having selected a source and checked the details the operator can confirm the route and make the connection.

A printer is connected to the computer and this provides a useful hard copy of events. It records every operation and can thus be used for traffic analysis. It also records any faults in a coded message format that engineers can interpret and then organise repairs.

To check the serviceability of the routers, each router contains a built-in-timer which is scanned and re-set by the computer every five minutes. This is designed to ensure that the router does not become locked-up due to data link failure.

If a fault is encountered, it will be logged on the printer and a warning displayed on the colour monitor. If, after 15 minutes, the fault is not corrected then the timer will switch the router concerned, to a pre-set state, similar to the old 'open-wire' condition.

In the event of computer failure, all of the routers will switch automatically to the pre-set state.

The SCPD project leader was Joe Willis with Radio Networks represented by Graham Clifford, and Radio Projects by Bev Marks. Peter Holman was the Comms Department contact.

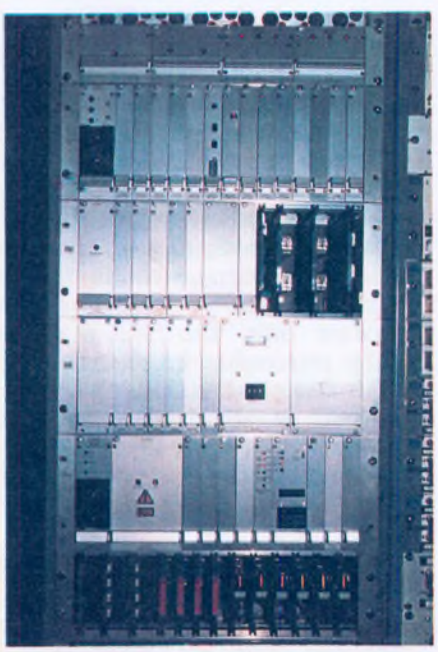
Remote OB System

It has been apparent for some while that it is not always necessary to have staff at an OB fixed site to set-up and check the correct operation of the masthead equipment. The necessary adjustments and monitoring could be carried out remotely from the associated regional communication centre. Designs Department have produced a remote control system that provides this facility.

Following on from the re-engineering of the Outside Broadcast masthead systems by TCPD, reported in the Autumn 1984 edition of Eng Inf, remote control facilities are now available at some regional sites, i.e. Manchester Plaza, Holme Moss and Kirk o' Shotts. Control equipment is installed in Manchester CTA for Plaza and Holme Moss and at Glasgow for Kirk o' Shotts.

Equipment is currently being prepared for installation at Sutton Coldfield and Wenvoe.

A similar system has been installed between the Swains Lane and the Crystal Palace OB site, so that the masthead equipment at Crystal Palace can be controlled by an operator at Swains Lane. The SHF installation at Crystal Palace being larger than in the regions (6 rotating aerials instead of 4), the remote control features have had to be enlarged to suit the extra control requirements.



Remote Control Equipment at CP

The switching arrangements in the wave-guide system connecting SHF aerials to receivers and transmitters at Crystal Palace are quite complex and a microprocessor-based routing selector has previously been provided to simplify the setting-up operation and reduce the likelihood of operator error. This equipment now forms an integral part of the remote control system.

All systems contain the following control features. On/off control of powered equipment, vision matrix selection, panning control for the aerials, and selection of aerials to receivers/transmitters via the waveguide system.

Panning control consists of commands for clockwise or counterclockwise rotation and a 'stop rotation' command. Fine movement is achieved by a clockwise or counterclockwise 'inch' command, giving an angular displacement of about 0.2 degrees per command. For alignment on frequently used bearings thumbwheel switches allow a three-digit bearing (1 deg. accuracy) to be sent as a command, causing the aerial to rotate to this bearing in the direction requiring the smaller angular change. If an aerial is inadvertently left rotating then a 'stop rotation' command is generated automatically after about 1 minute.

Various arrangements exist on different sites for the handling of sound signals both as matrix selections and control of equipment associated with RF links. In some locations provision is made for the reversal of line circuits between the Communication Centre and the OB fixed site.

All equipment states are reported back to the operators's position and any detectable failures signal an alarm condition. Any spurious alarm from a known equipment mal-function can be inhibited. The bearing of an aerial being controlled can be continuously repeated together with the AGC reading from the receiver selected to that aerial, while adjustments are taking place. Any change in the state of the controlled equipment forces a 'change of state' message into the bearing/AGC readings to keep the operators display up-to-date.

Swains Lane, showing five rotating SHF aerials – 1 at the top and 4 half-way down

Communication is by BT circuits, signals in each direction being at 2400 bauds. Line failures are detected and a failure incoming to the masthead terminal produces an alarm signal back to the operator if the outgoing circuit is functioning correctly. Essential sections of the microprocessor unit at the masthead terminal are battery maintained so that the state of the equipment under control can be retained in memory during a failure of the mains supply. When the supply is restored, the previous state of all controlled devices is established without any action by the operator who is informed by the alarm system that there has been a mains supply interruption.

The main microprocessor in each terminal is composed of ZEUS units. Another processor is used in the conversion between parallel binary data to and from the main processor and the serial data transmitted and received by means of a modem connected to the BT circuits.

Crystal Palace has additional facilities to operate vision and sound monitoring matrices, which route signals to Swains Lane on monitoring circuits. There is also selection of vision and sound test signals available. Control can be assumed at either location allowing local operation at Crystal Palace when required.

Sutton Coldfield and Wenvoe

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SCV5 for Manchester

A new design of Stereo Control Vehicle (SCV) for Radio OBs has just been completed in the SCPD workshops at Woodlands. Designated SCV 5, the vehicle is destined for Manchester where it will be required to cover a variety of programme commitments from complex multi-track recordings to simple quiz shows. A similar vehicle SCV 6 is currently under construction for use in Birmingham.

Because of the limited space available at some venues, it was decided that SCV 5 and 6 should have a minimum height, and maximum manoeuvrability. The "vehicle" is therefore constructed on an articulated trailer chassis, which fulfils the design criteria, and also offers the bonus that the prime mover or tractor unit can be removed for mechanical maintenance.

The body work by CMA Coachbuilders Ltd. is built on to a Fromant trailer which has standard air-operated legs and an air suspension system which can be lowered, for stability on location.

The trailer has three main areas: a forward stowage area which encloses a dual air-conditioned system; a central operational area; and a rear termination and rigging area.

The forward area allows microphone stands and ladders to be stored across the width of the trailer (2.5 metres - the maximum permitted by the Road Traffic Act). It also serves as a rear service area for the computer associated with the control desk. The operational and rigging areas are cooled from an air-conditioner in the forward area. This is a low-velocity, high-volume, system designed in conjunction with Research Department so that the ambient noise level is low. A second system cools the control desk power supplies and computer in a sealed compartment. Both

Rear cable storage

systems can provide limited ventilation in the event of low-current mains power supplies being available.

The rear area houses the mains and programme cables as well as all of the termination panels. The heavy-duty mains cables are fed from power-assisted drum winders, to make the job easier. The programme cables are mounted in sliding racks that make rigging and recovery simple. To prevent road dirt creeping into the cable terminations, the panels are located on-board, with cables being fed through hatch-panels in the rear of the trailer. To cover every contingency an extra panel (known as the Gregory hatch) has been incorporated into the design

LSI chip for NICAM 3

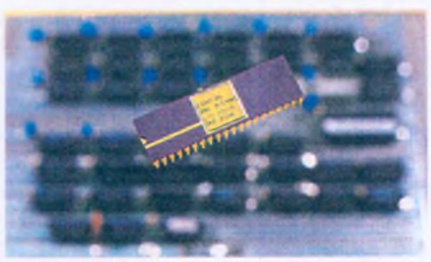
by John Robinson, Designs Department.

Many readers will be aware that digital sound distribution for the radio network is undergoing major changes. NICAM 3 equipment, which uses a format compatible with British Telecom's digital network, is coming into service, and will eventually replace the 13-channel linear pcm system that has been used since the early 1970s. NICAM 3 has a theoretical 6dB more dynamic range than the linear pcm, but uses only 0.7 times the bit-rate per channel. The penalty for these improvements is increased complexity of the coder and decoder: the equipment which is being installed at present uses about four hundred digital i.c.s to process each stereo channel.

Designs Department has recently incorporated the NICAM 3 technique in the design of a new sound-in-syncs coder and decoder for stereo tv sound. The new s-i-s equipment must fit into the same bay space as the old, so we needed a significant size reduction for the NICAM 3 coder and decoder modules.

Gate Array

Because a large number of s-i-s units will be required, we were able to consider designing a large-scale integrated circuit specifically for the job. The development of a fully custom-designed device, comparable to a calculator or digital clock chip for example, would be too expensive (at least £150,000), but many semiconductor houses now offer gate arrays, sometimes known as



Prototype chip and conventional circuit

uncommitted logic arrays (u.l.a.). These are partially made chips, in which a regular pattern of logic cells or gates has been created on a silicon wafer, but the final processing stages which interconnect the cells to form a logic circuit have not been applied. A customer such as the BBC can use computer-aided design techniques to translate a logic design into a set of one or more etching masks, which the supplier will then use to complete the processing of a batch of wafers.

For production quantities up to a few thousand, gate arrays are much less expensive than fully custom chips. The savings arise because only the final stages of wafer processing are specific to the logic design; the "blank" wafers with their standard patterns of uncommitted gates are manufactured and stockpiled with all the benefits of large volume production.

The largest available gate array would still not accommodate an entire NICAM 3 coder or decoder, but we were able to partition the design so that much from the trailer exterior to the operational area. Provision in the rear area has also been made for the riggers. A simple wash basin and water heater together with wet-clothing hooks and heating should make their life a little more comfortable.

The centre of the trailer houses the operational area. The heart of the trailer is an SSL 4000 E computer assignable forty-channel mixing desk, similar to those installed on SCV 3 and 4. This is mounted across the trailer to the rear, the weight falling on the rear axle. Above this are a pair of high-quality LS5/8 monitor speakers in cabinets designed for vehicle use, and Auratone check receivers. A colour monitor can display either the computer status, the output of a rigging/production camera, a tv receiver or a local scanner if television are covering the OB as well. A colour vdu is dedicated to display the computer output.

To the front of the trailer, hidden behind the extensive acoustic treatment designed by Research Department, is the on-board computer. Below this are three Studer A80 tape-recorders, with facilities for two Otari MTR 90 multi-track machines alongside. Additionally there is a minature audio-jackfield, Dolby noise reducers, EMX, audio distribution amps and a small printer for hard-copy of the computer output.

SSL control desk

Tape decks and computer

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of the processing could be done by standard microprocessor and memory chips, leaving a few high-speed tasks for the array.

Suppliers

Following the preferred and fashionable "top down" design method, we drew a circuit diagram for the NICAM 3 coder and decoder, including the gate arrays, before considering the detailed internal design of the chip. Identical gate arrays are used in the coder and decoder, working in each case with two Z80 microprocessors to process each audio channel.

Armed with a set of timing and pinout requirements for a 40-pin d.i.l. package, we were ready to explore possible gate array suppliers. Our first experience was not a good one; following internal advice we approached a British research establishment, who allowed us to carry out a complete design (including layout of the cells and interconnect on the chip) before announcing that they were unable to make our, or anyone else's, chips. This wasted a year and forced us to construct a t.t.l. simulator in order to prove the rest of the design. We also devoted some time to the design and construction of a processor-based test rig, since, had any devices been forthcoming from the appointed source, the onus would have been on us to test them.

We then made a rapid survey of commercial suppliers, and chose LSI Logic as a company likely to provide the goods.

Logic Design And Testability

The first stage was to sketch out a logic diagram for the array, using familiar building blocks such as gates, flip-flops, shift registers and counters. This followed conventional practice, within the constraint that every part of the circuit must be testable from the "outside world" interface - unlike a pcb, the internal nodes of a packaged ic cannot be reached with a test probe! We reserved nine pins for test purposes. Eight of these are outputs, switchable under the control of the ninth to monitor sixteen internal circuit nodes.

The chip is enabled by a single clock pulse, the trailing edge of which updates all the latches and counters in the circuit. This synchronous approach is essential to avoid the hazards which plague bad conventional logic designs, since the cost of a "re-work" in this case would be several thousand pounds.

Network Description

The logic circuit was next translated into a text file suitable for the CAD system at LSI Logic. Every block was given a name and a list of connections, followed by a list of its internal blocks (counters, registers etc) and their connections. The file has a strictly hierarchical structure, in which blocks are made from smaller blocks, which are made from smaller blocks, until the smallest blocks are defined in terms of simple gates. Thus once the designer has defined, say, a flip-flop in terms of gates, he can then use flip-flops as building blocks and let the computer break these down into gates. In fact, most standard MSI functions have already been defined, characterised, and put in

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TC3 Refurbished

Studio 3 at Television Centre re-entered service in May after a major re-furbishment of the control rooms, technical areas, studio floor and lighting grid. Many innovative technical features have been incorporated into the studio, some requiring in-house design and construction since no outside manufacturer could supply to the BBC's specification.

In the production control room a new Grass Valley 1600 vision mixer sits alongside a Probel six-channel pre-mixer. The monitor stack, capable of containing twenty monochrome and three colour monitors, has been totally wired so that monitors can be moved to any position, including the top! Under each monitor is an alpha-numeric display showing source information; although these are common in other studios, the keyboard that inputs the information has been cleverly hidden as a pull-out tray in the Technical Co-ordinators position.

The studio has a 2-channel Digital Video Effects unit which is fully integrated into the vision system. Its controls are adjacent to the video effects mixer which uses similar software and hardware to that used in the Video Effects Workshop. In place of the eight video mix-effects amplifiers used in the workshop, Studio 3 has only four; however, the control panels and interfaces are unchanged, which will assist operators who work in both studio and workshop. A mimic panel allows the operator to see the route of the sources and destinations of the effects mixer.

The five vision-mixing equipments are connected in a complex configuration which gives great flexibility for the programme staff. Because many devices can be connected in cascade and outputs re-entered, a comprehensive cue direction system has been installed. This guarantees that any source will receive a "red cue light" if it contributes to the studio output no matter how devious the route taken.

A new Engineering Manual Exchange (EMX) has been designed, developed and installed by David Ward of Television Studios Section, SCPD. He explained "The starting point for the project was comments from both SCPD and Tel O&M that the existing equipment was bulky, difficult to install and a nightmare to maintain. It was basically a glorified key and lamp system with audio, ring indication and line status information all being hardwired through expensive, unreliable multilevel switches. Furthermore, as all the electronics were in the control panel, maintenance of the equipment meant disrupting productions."

David agreed a new specifi-

TC3 Vision and lighting control, note the new YRGB waveform monitor

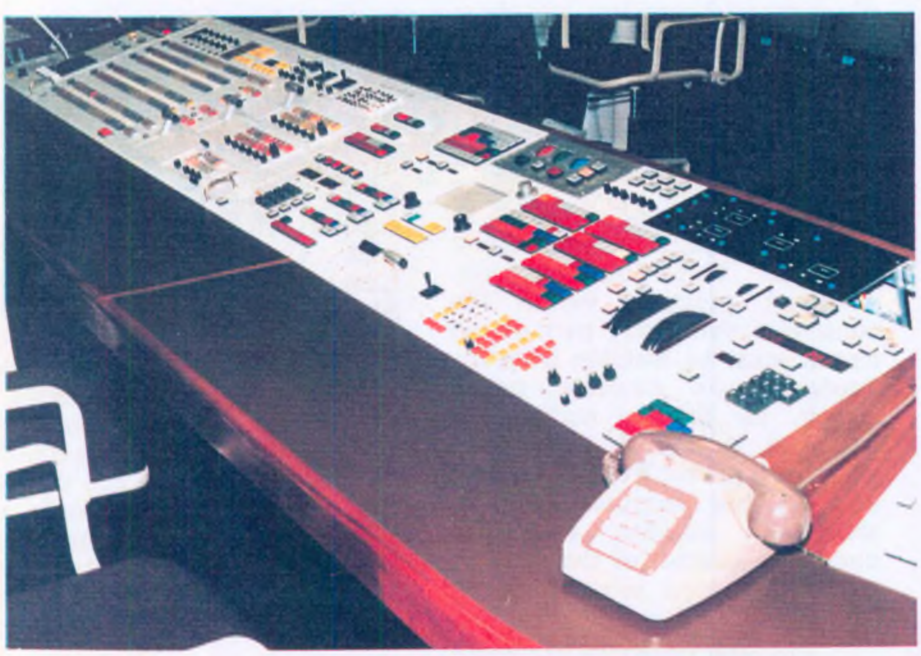
cation with the Technical Co-ordinators, who are the ultimate end-users, and set out to see what commercial equipment was available. He visited several companies who market custom telephone equipment for foreign exchange dealers, brokerages and banks. Sadly none were prepared to undertake the development work nor were they prepared to manufacture the small number of units required for the BBC's use. Thus the EMX has been designed, built, and installed in-house.

The equipment, controlled by a Z80 micro-processor, uses only two buttons per subscriber, and thus the size of the panel is considerably reduced. The first button selects the source, and the second button selects the destination. Associated with each source button is a small l.e.d. alpha/numeric display that indicates which destination has been selected. Each source is selectable to only one of the eight destinations at the main panel, although some local subscribers have direct access to any or all of the first eight sources by a push button on their own instruments. Speak/Ringing is selected by the second push-button, ringing being effected by holding the button down. Thus one switch is carrying out the functions of two on the old system.

The new EMX, once proven operationally, will become the standard for new television studios.

A new type of acoustic treatment has been used throughout the control suite. The sound control room now has cavity walls with heavier treatment. The area is finished in an attractive hessian and wooden batten design.

The sound control room awaits an assignable desk, so provisionally the existing Neve 44-channel desk installed in the early 70 s has been re-furbished. KRONE non-solder tag blocks have been



Studio 3 Production control room, the mimic diagram is centre right

used on the wiring frame for the first time in Television Centre. Over six thousand connections have been made, without a drop of solder being used, and with a considerable saving in time.

Sound monitoring is via LS5/8 loudspeakers, and visual continuity by two fourteen inch monochrome, and one twenty-six inch colour monitors. The monitors are selected from sources via the sound control desk, and a small SCAND readout shows this under each monitor.

The public address sytem uses eight 150 Watt power amplifiers for the audience, and four others for a variety of applications, each has its own jackfield and pin-patch so that it can be totally flexible. The sound control room has the usual complement of tapes and

Lighting control is via a Rank Strand Galaxy 2. This uses microprocessor control for three hundred and eighty-four channels. One hundred and eighty-eight Colortran dual-source luminaires are mounted on ninety-six mounting bars; each bar has four 5 kw dimmer circuits.

The vision and lighting control room has the conventional camera control suite for the six Link 125 cameras on the studio floor. The YRGB waveform monitor (MN6/513) shown at IBC 84 has been installed for the first time in TC3. A memory extension to the slide file stills store allows electronic stills to be colour and luminance corrected by TARIF before being re-recorded in the store.

The studio re-furbishment covered not only the control suite, but also the studio floor, scenery grid and the dimmer room. In the latter, five hundred and forty-one dimmers supplied by D.E.W. Electrical Engineering Ltd., have been installed, consuming a thousand amps from two phases of the supply.

The lighting and scenery grid has been refurbished to accommodate a higher safe working load. Above each lighting barrel is a section of square trunking that enables the luminaires, PA and other services to be easily connected. A new type of cable support system has been used in TC3. Gone are the folding trays and spiralled cable of earlier studios; in their place are convoluted Electroflex coiling cables that look rather like hosepipes. These are extended round elastic shockcords that reach from the barrel to the grid. The "hosepipes" coil neatly into open topped drum assemblies mounted on top of the barrel when it is raised and lowered.

Control of both lighting barrels and scenery hoists is affected from either side of the studio floor. The hoist tracking has been modified to enable the hoist to move right across the studio floor. A new type of grid alarm has been installed. This gives staff in the production control room an audible warning that someone is on the lighting grid. Similarly there is a yellow flashing beacon on the studio floor, that warns people that someone is working overhead. Other modifications above head height prevent the main studio scenery doors being opened when the cyclorama cloth is in front of them.

The concrete of the studio floor was found to be in good condition when the old lino was lifted, and a new 6 mm thick lino, complete with grid markings, has been laid. Epoxy resin, rather than steel, runners have been used to protect the floor below the audience seating.

Graham Cooke, one of the two project leaders, summarised by saying "We are packing more and more technology into the same amount of space, and are given less and less time to do it. Credit must go to the team from SCPD who were involved."

Nicam 3 Chip
Continued from page 7

a library by LSI Logic, so that very little gate-equivalent expansion needs to be done by the designer.

Initial Simulation

As part of our test rig design, we had devised a set of simulation procedures for the gate array, written in PASCAL. These were incorporated into a VAX program which generated a set of about 3000 test vectors. We transferred the files to LSI Logic's mainframe computer, where a logic simulator estimated the path delays through our design and created a file of outputs and times. This was transferred back to our VAX and checked against the expected results.

The initial results showed that the speed of the gate array which we were hoping to use was only marginally adequate. When informed of this, LSI Logic suggested we transfer the design to a faster array, using 2.5 micron CMOS and double layer metallisation. The transfer was made automatically, without any need for our involvement, and further simulation uncovered only a couple of misunderstandings between members of the design team, which were corrected by editing the network description.

Layout, Routing And Final Simulation

The layout of the circuit on the array, and the routing of the interconnects, were done entirely by computer. Once the track lengths were known, a much more accurate simulation run was performed and the results confirmed that we would meet the timing constraints by a good margin. Thus the design was fully tested before committing any silicon (assuming that our test vectors gave adequate coverage - LSI Logic's computer confirmed that every circuit node was toggled by the test sequence).

Prototype Samples

Ten prototype arrays were shipped to us within about 12 weeks of starting the design. These were tested by the manufacturer using the same test vectors as were applied to the software simulation, so there was no real need for us to carry out further tests. Nevertheless, we plugged one into the test rig, which promptly beeped and reported a companding matrix fault - but this was expected, since a minor design change had been made and was not incorporated into the test rig program. So we installed four chips in the prototype NICAM 3 link and listened to the output. At least it bore a likeness to the input, except when the audio exceeded a certain level, at which the decoder emitted a raspberry rather than music. There followed much anguish and activity with logic analysers, before we established that a set of EPROMs contained out-of-date data and should have been replaced. The result, finally, was that the system worked perfectly and we are now in a position to sign off the gate array design and order our first batch of 1000 devices.

Film Dirt Detection

Although a great deal of the material broadcast by both BBC TV networks originates from television camera and other electronic sources, a significant proportion is derived from film and is likely to continue to do so. Film used for television can have a number of imperfections such as grain, dirt and scratches, which can be a source of irritation to the viewer. Film grain has been substantially reduced in recent years by passing the telecine output signal through a video noise reducer prior to transmission. Dirt and scratches can be reduced to a certain extent by improvements in handling techniques, but engineers in Research Department at Kingswood Warren have also been investigating optical and electronic methods of detection and concealment.

Film dirt can arise in two ways: first, it can appear at the photographic stage when it becomes part of the film image and is known as printed dirt, and second, it arises due to dirt particles adhering to the film surface. In the latter case, the impairments tend to increase with film handling and so one logical place for applying detection and concealment techniques is at the point where the film is converted to television images, i.e. in the telecine machine. Engineers at Kingswood Warren have developed two different methods of film dirt detection, one of which is optical and the other purely electronic. Both of these methods have their own strengths and weaknesses, most of which are complementary; so the use of both in combination, gives a comprehensive dirt detection facility. Each method can however, be used in isolation to give a worthwhile improvement in picture quality.

Once the physical location of the dirt is known, it is a relatively simple matter to substitute some more appropriate picture information to effectively conceal its presence. The concealment system is electronic for both detection methods.

Optical Dirt Detection

The optical method relies on the ability of infra-red light to pass unhindered through the emulsion layers of colour film stock. It cannot therefore detect printed dirt which is part of the photographic image, but it can detect surface dirt and scratches. The method does not work however for black and white film stock because the silver-based emulsion is opaque to such light.

Modifications to include a light source rich in infra-red, together with a suitable sensor, would be difficult to implement on a standard telecine but much easier on the new generation of line-array telecines and this type of machine was chosen for the experimental work.

An optical dirt detection system based on this work was developed jointly with Rank Cintel and is incorporated in their ADS 1 solid state line-array telecine. In this machine, the visible light from the illuminating source passes through the film and optical system to provide the normal red, green and blue images. At the same time the infra-red light emitted by the lamp, after passing through the film, is deflected by the optical system onto a fourth line-array sensor. This infra-red beam detects the presence of blemishes on the surface of the film and the resultant electrical signal generated by the sensor is fed to the concealment circuitry.

The optical method tends to be better at detecting the larger dirt particles for two reasons: first, it is very difficult to design a lens system which can focus simultaneously at both infra-red and visible light wavelengths at reasonable cost, and second, there will in general be dirt particles on both faces of the film, but only one face can be in focus.

The system can, however, be used safely without the need to preview, since the infra-red image contains very little information about the actual scene content, and therefore no motion related impairments can occur.

Electronic Dirt Detection

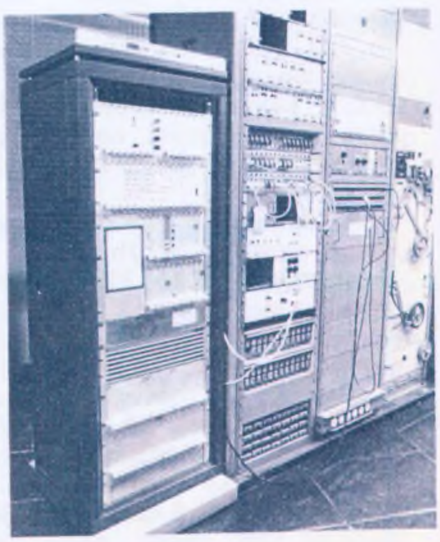
This method entails operation on the colour coded signal produced at the output of a telecine and not on an optical signal within it. It is, therefore, ideally suited for use with standard telecine machines because it avoids the need for modification. One or two electronic dirt detectors could, possibly, service a large number of telecines and thus provide an improvement in quality for a small capital outlay. Since a system based on this method operates on the telecine output signal, it detects equally both printed and surface dirt, on black and white as well as colour film stock.

The principle of the electronic method is that the contents of a particular film frame can, in the absence of scene motion, be predicted from the content of the frames on either side. If this predicted image is then compared with the actual image, any imperfections on the latter due to dirt can be detected. The images in this case exist as electronic signals in a set of frame stores.

Implementing such a system for use on real pictures is not quite so simple since scene motion cannot of course be ignored. The simple principle outlined above is used along with a battery of motion and unsteadiness protection schemes designed to maintain dirt detection in all picture areas where no misinterpretation is likely. What this means in practice, is that dirt will be detected in all areas which do not contain rapid motion.

No set of safeguards can be foolproof, however, and the protection schemes do occasionally fail. This failure manifests itself, depending upon which type of motion detection strategy is chosen, as a failure to detect the larger dirt or alternatively, as an inappropriate concealment in rapidly moving areas, i.e. a motion impairment.

The first strategy offers



Prototype electronic film dirt concealer (left) detection of small dirt with no motion impairment and therefore no need to preview before transmission. It can detect over 95! by number of the pieces of dirt on typically dirty film and offers a useful "clean up" facility for the majority of 16mm and 35mm film.

The remaining few percent, mainly large dirt particles, can be detected if required: to clean up a very dirty film for instance, by relaxing the motion protection safeguards. This adjustment effectively sets the compromise between the maximum size of dirt that can be detected and the likelihood of motion impairments and is made by means of a single five position control. The likelihood of motion impairment increases with the maximum detectable dirt size, and may occasionally become noticeable when the largest dirt settings are used. It is advisable therefore to preview very dirty film before transfer or transmission to identify any shots in which motion impairments occur and reduce the 'dirt size' control accordingly. The telecine operator must make a subjective decision as to whether any motion impairment at the larger dirt setting is more objectionable than the dirt particles that would be left unconcealed on a smaller dirt setting. Motion impairments are in any case infrequent and it is possible, with practice, to anticipate the types of motion that might cause problems.

The large dirt modes offer a comprehensive "clean up" facility for film which might be considered too dirty to transmit.

Concealment

The concealment operation is electronic for both the optical and the electronic dirt detection systems. The concealment scheme for the electronic detection system is however, a little simpler than for the optical method. This arises because the electronic dirt detector tends not to operate in rapidly moving areas of the scene, whereas the optical detector operates in all areas regardless of scene motion. It follows that more care will be needed to conceal the dirt detected by the optical system, since the scene content obscured by that dirt is more likely to change between adjacent film frames.

Dirt detected by the electronic system can be concealed effectively by a simple substitution of picture information from corresponding areas in the adjacent film frames. The signals corresponding to these adjacent frames are readily available in the set of picture stores used by the detector. As mentioned above, this simple strategy is sufficient because the detection tends not to operate in moving areas and so there is very little possibility of making an inappropriate substitution.

The optical system, however, detects dirt in all areas, moving and stationary, so a simple substitution is not sufficient. Several methods of concealment are being investigated for use with the optical detection system involving both inter-frame and intra-frame processing. A further area of future work is the consideration of the way in which both types of dirt detection methods might be used in conjunction with each other to further optimise the overall performance of the complete film transmission system.

Summary

Two film dirt detection and concealment systems have been developed as part of the drive towards improving film picture quality. One system uses infra-red light to detect dirt particles and scratches of any size on colour film only. It cannot detect printed dirt nor can it be used on monchrome film. This system is available with the Rank Cintel ADS 1 solid-state line array telecine.

The other system is entirely electronic and processes the coded PAL signal at the output of a standard telecine, so a single equipment can serve more than one telecine. It can detect both printed dirt and dirt particles on monochrome and colour film, concealing the majority of dirt on typical film without the need to preview; however, if the larger dirt modes are required to clean up very dirty film, previewing is advisable. A prototype equipment has been on field trials in the Television Centre for over a year with results that have been very favourably received by the television service.

Industry is currently being approached with a view to licensing commercial production.

* * * * *

Remote OB System
Continued from page 5

will be using a more recent type of matrix which receives instructions and provides indications of its switched state by means of serial message communication at 38.4 kbaud (in accordance with the EBU standard for communication between broadcast equipment). The masthead terminal has to provide additional input/output signals at this communication rate and translate these messages to and from the 2400 baud signalling circuits. Work on this development is now reaching completion.

* * * * *

Macro-Glide
Continued from page 3

computer so that they can be memorised and thus repeated to build up complex shots.

The glide has found another use:- When HNPC Bristol wanted to show the Bristol Planning Committee what the Phase II (a post production block) buildings would look like he used the macro-glide facility. The Architects' scale model was borrowed and a video tape was produced, using the macro-glide facility, which showed the planners what the development would look like at street level.

* * * * *

SCPD Engineers on the replacement of Studio A Glasgow project had a problem:
how to replace a floor, reposition equipment and keep it in service. The answer "Hang it all!"

London Marathon
Continued from page 1

off recorded contributions at the start and finish for instant replay into the programme.

At the Cutty Sark, after the runners had passed, two of the lightweight cameras were moved through the Foot Tunnel under the Thames to see the runners at the seventeen mile feeding station on the Isle of Dogs, and to see how the fun runners were coping with the psychological "wall".

The three cameras at the Tower also moved as the race progressed. Here, as in other years, weary back-markers, who had now completed twenty-two miles, met a very fresh Bob Wilson, fitted with radio microphone, ready to share a few experiences as he jogged alongside them.

All the OB units and mobiles were fed to either Crystal Palace, the British Telecom Tower or the Television Centre East Tower.

The major communications operation was at the front of the race, where there were three radio-linked mobile cameras. There was a single camera on an electric truck, which eliminated the possibility of exhaust intake by the runners. A hand-held camera was on a BMW motorcycle; the cameraman was facing backwards to enable better angled shots, this is the first time this has been attempted. Finally there was the Helitele helicopter camera.

The pictures from the two ground cameras were both relayed by separate double-hop 2.5 GHz radio links to a mid-point helicopter and then to a reception site on Guys Hospital tower roof. It was found in tests that, on an open road and with the mid-point helicopter at 2000 feet, acceptable

The motorcycle camera team – Photo Cine-Video

reception was still obtained with the motorbike almost ¾ mile away despite the compromise aerial system fitted. To maintain quality when they went under bridges, the first part of the sound effects circuits from the mobiles was by vhf link to the mid-point helicopter. Completing the trio of mobiles was Helitele, now well established in OB operations. This has amazing steadiness from the remotely controlled gyro-stabilised sphere fitted outside the helicopter cabin. The cameraman, sitting beside the pilot, is guided from a monitor situated between them. Helitele, using its own 2.5 GHz transmitter, was also received on top of Guys Hospital.

One of Executive Producer John Shrewsbury's problems was the refuelling of the helicopters so that front coverage was not in jeopardy. This was completed, in turn, while the front of the race was in the Surrey Docks.

There were also sixteen separate radio talkback systems provided for communications between the OB producers, the presenters, and mobile cameramen.

It is interesting to note a remote connection between the BBC today and the famous distance of 26 miles 385 yards. This was first set in the 1908 Olympics at the recently demolished White City Stadium, only a stones throw from Television Centre where the whole operation was co-ordinated. Here, David Coleman and Ron Pickering, sitting in front of a bank of monitors were able to guide viewers along the route with an instant supply of information about the runners at their finger-tips from the Digital Computer specially installed.

Finally, while the last stragglers were still coming in, and the live programme came off the air, there was frantic activity in the video-tape area to produce a package programme of highlights for transmission later that day.

Princess Anne visits Pebble Mill

On Thursday May 2nd, HRH The Princess Anne Mrs Mark Phillips, visited Pebble Mill to present the 1985 Dettol Youth Caring Award.

Prior to appearing on Pebble Mill at One, HRH toured areas of the building and saw the newly installed Quantel Paint Box. This is sited in the old Technical Apparatus Room, which is being developed as the Electronic Graphics Area for Pebble Mill.

In addition to the Paint Box, areas are being prepared for the Aston III Character Generators, viewing facilities and a small apparatus room with the hardware for all the electronic graphics equipment, including Rank Cintel Slide-Files, and Digital Video Effects equipment.

The photograph shows Paul Howell, Senior Graphic Designer, Pebble Mill explaining the Paint Box to HRH. Bob Cosford, Graphic Designer operates the device. Also present, were Peter Booth, HPSE Pebble Mill, Bill Seymour and Julian Stone, SCPD and Mike Tomlin, Engineer Services, Pebble Mill.

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