

RADIOPHONIC WORKSHOP

Making CDs write

Ray White describes the CD system now used by the Radiophonic Workshop to store archive sound recordings.

There it is on the turntable - the only copy of his or her most important work. Invariably someone, whose talents might be better used elsewhere, scratches those delicate grooves. All is lost, you might think. Not so!

A quick transfer to digital audio tape and our precious recording is on its way to that warren of rooms hidden in the depths of Maida Vale studios. Here resides Mr Dick Mills, custodian of the Sonic Solutions *No Noise* system and, incidentally, author of a number of books on fish keeping.

For many years Dick created Radiophonic sounds more appropriate to the future: he now concentrates his efforts on rescuing those of the past. Firstly the ancient analogue material is hacked up into little digital pieces and stored as data on a hard disk; this process is known as *loading*. Then this digital version is processed, passing it back and forth between computer and hard disk.

Most of this processing happens in real time; de-crackling, de-noising and de-hissing. Finally out of the end comes a near-pristine copy of our ancient artists work: this is called *dumping*. But what do we do with it now?

Worm-CDs

Compact Disc is the answer: it is the ideal medium for radio, convenient to mix with other material and provides those essential track and indexing facilities. And so it is to the laser that we turn and the Write Once Read Many (Worm) CD.

The blank discs are gold plated and come coated with a rather sickly looking green vegetable dye. Curiously, Dick has to use these within one year otherwise they turn stale, thus converting themselves into very expensive, but decorative, beer mats. They come with a spiral groove already cut into the surface, which a laser can follow. As the CD spins, the intensity of the laser varies, warming the dye layer and so changing the reflectivity of the disc. By this simple process the recorded disc has all the properties of a normal 'pressed' disc; the 'spiral of pits' simulated by the changes in reflectivity.



General view of Studio X with the No Noise computer in the centre, and the Koch CD-tester and the CD-writer stack on the right-hand side.

BARRY BOXALL

Archive recordings

The BBC is required to create for itself a vast repository of recorded material; really our heritage in sound. To do this, Sound Archives regularly gathers in material which may be needed for future programmes; raw war reports from the Gulf, historic occasions in news and sport, speeches from apparently important people, etc.

Until recently, we would get someone down the road to cut an LP record especially for us - an expensive business whilst 'someone' was willing to do it. Now they are not, so Dick's in-house CD-making facility is put into action for this as well. The manufacturer says that the discs, once recorded, will last at least ten years. Only time will tell: even if they do not, at least the original recordings will not be exposed to the violent rigours of day-to-day broadcasting.

Equipment housing

So what was needed to provide Mr Mills with this wondrous facility? Well, obviously a lot of equipment and, perhaps most important of all, a housing to contain it all.

Jeremy Quinn, designer and cabinet maker extraordinaire, was our man. Based on the modular consoles used in previous studios, his men in Telford constructed an excellent oval-shaped desk, pleasingly finished in 'limed' ash. The free-form cabling is restrained and concealed by removable covers running around its periphery. It is also provided with numerous drawers to hold blank CDs, and equipment cupboards with doors back and front to give easy access to their contents.

The task of designing and installing this pioneering project was achieved by the author, ably assisted by Ray Riley. Audio cables were prepared off-site at Ray Cooper's excellent wiring shop at Broadcasting House.

System outline

And now to the Sonic Solutions system itself. This comprises an Apple Macintosh 11FX computer which is fitted out with three NuBus cards, connected to a total disk storage space of 2.8 GBytes. All three of these horribly complex cards perform digital signal processing of sound material. The cards also connect to an

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audio input-output box sporting both AES/EBU and SDIF2 digital interfaces.

The first two cards are concerned with the basic provisions of the Sonic system- an on-screen four-channel mixing desk with faders, pan pots and a huge range of equalisation which you can adjust to suit your taste. They also deal with the small computer system interface (SCSI) to the disk drives and the CD encoder. The final card does the really hard work of de-noising and then transfers the results of its labours to its fellows, and on to the disk drives.

So how is the system presented to our intrepid sound expert? Well, it actually works very much as you would expect a Macintosh to behave: Window, Icon, Mouse, Pointer (WIMP) and What You See Is What You Get (WYSIWYG) - well almost! The sounds themselves appear as sets of wavy lines across the screen: the system lets you zoom in or out to see detail or to gain a more general view.

You can do exactly what you like to the sounds: hack out sections of sound, replace the gap with 'black' silence or allow the remaining material to join up around the gap, repeat sections or swap and copy material between the stereo tracks. Having made the changes you can compile a new sound file onto the disk. Of course you need to take care with disk space: at a rate of 10MByte per stereo minute, it is quickly consumed.

System operation

No Noise processing is quite simple to operate. Firstly you set a number of parameters to suit the material to be treated: here the artistic judgement of our sound expert is vital. If the treatment is just that little bit too harsh, it might well knock the 'sparkle' off the original recording: the on-screen mixer comes in useful here since Dick can 'rehearse' the process before taking the final step.

Once he is happy with the results, the machine can be set up to treat an entire sound file (de-crackling, de-noising and de-hissing require separate 'passes' through the system). Finally, he can dump the entire contents of the ultimate sound file to tape or CD as desired.

Fortunately the system allows Dick to continue working on 'foreground' tasks, using the on-screen mixer, whilst those busy cards compute their way through

their material. Dumping to CD, however, stretches the system's computer power and therefore provides a handy prompt for Mr Mills to proceed to his lunch or tea break.

Compact Discs include an essential, and to many, a mysterious thing called a Table of Contents (TOC) which is recorded at the centre of the disc. Without this vital component, our expensive CD will simply refuse to play. Fortunately, creating a TOC is very easy with the Sonic Solutions system.

Our expert can use one of two methods; either manually, by simply marking start and end flags onto the graphical display or, with delightful laziness, he may set a 'silence' threshold and duration, after which the machine will create the table all by itself. The lazy option may require some gentle manual 'trimming' of the track ends: care also needs to be taken to avoid acquiring additional erroneous tracks, often of surprising shortness and containing perhaps just a solitary cough or click.

Peripheral equipment

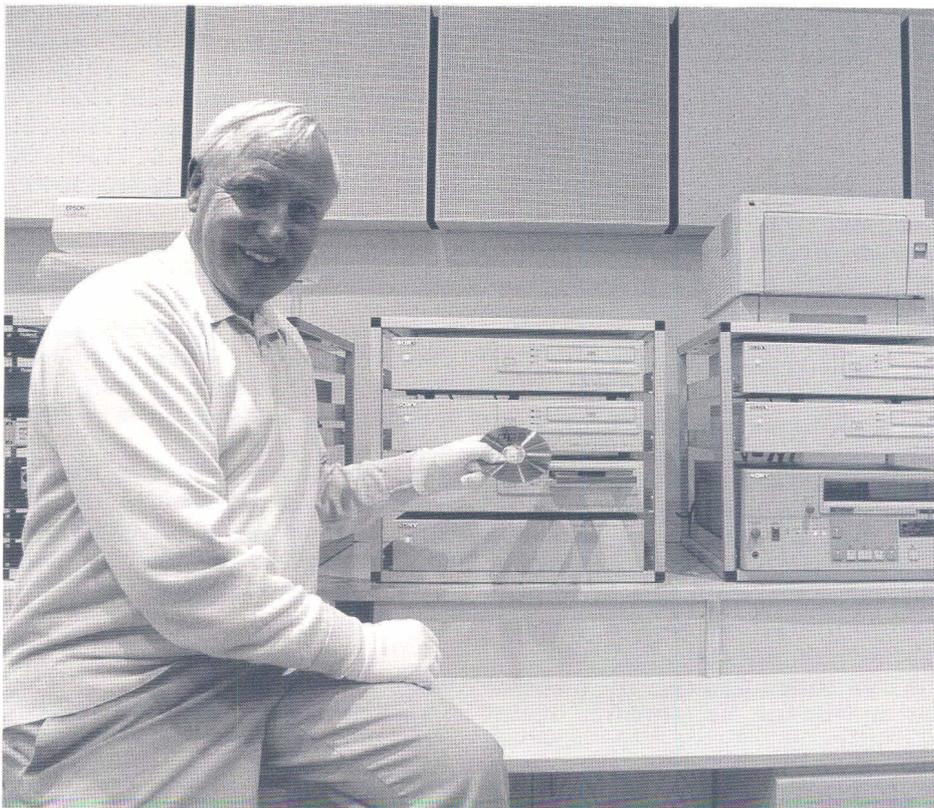
I shall now proceed to list in gruesome detail the peripheral equipment vital to make this studio complete. Audio signals are routed through a vast amount of Klotz

Monocore 16' cable by means of four Akai DP3200 routers, each sporting thirty-two inputs and outputs and controlled using software developed by Tony Morson. Mixing is accomplished by three 8-channel Yamaha DMP7Ds with associated AD8X 20-bit A-to-D converters and Yamaha SPX1000 digital effects devices.

Also included is a Roland SN-550 Digital Noise Eliminator, a Precision Power Phase Chaser and an Audioscope spectrum analyser. Digital audio tapes are accommodated by Sony PCM2500 and PCM7030 machines. The latter features excellent timecode facilities and can be controlled from the Sonic system, thus providing automated loading and dumping.

And so the vital work of our ancient artiste, or the sounds of more recent times, travel via SCSI to the Sony CD encoder and hence via fibre-optic cable to the bank of five CD writers. For a little while longer these sounds are safer than they were before: that is until someone devises something even better. When they do I am sure that the Radiophonic Workshop will still be the first to use it.

Ray White
Senior Engineer
Radiophonic Workshop



Dick Mills holds a CD-Worm in front of the CD-writer stack.

Mike Meyer