

SWITCHOVER TO FILE-BASED PROGRAMME PRODUCTION AT NHK

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ABSTRACT

The switchover from VCR tapes to files for the production, transmission, and archiving of telecasts at NHK headquarters (the NHK Broadcasting Centre in Tokyo) was completed in April 2015. Approximately 2,400 programmes are transmitted each week from files. The switchover commenced with the production of programmes in the High-definition format. A project involving the relevant departments at NHK was inaugurated in 2004 to consider the necessary workflows and facilities. Trials commenced with small-scale file-based systems, given the considerable amount of facilities and programmes involved. Facilities were established to achieve the switchover in stages, on a programme-by-programme basis, rather than all at once. The task ultimately took eleven years. This paper will report on the switchover to file-based programme production at the NHK Broadcasting Centre and describe the systems that have been put in place.

INTRODUCTION

The 1998 Winter Olympics in Nagano prompted the NHK Broadcasting Centre to adapt its VCRs for the High-definition television format. Work on designing file-based systems not relying on VCRs commenced in 2004, in view of the need to update facilities and to have them accommodate the latest developments in information technologies.

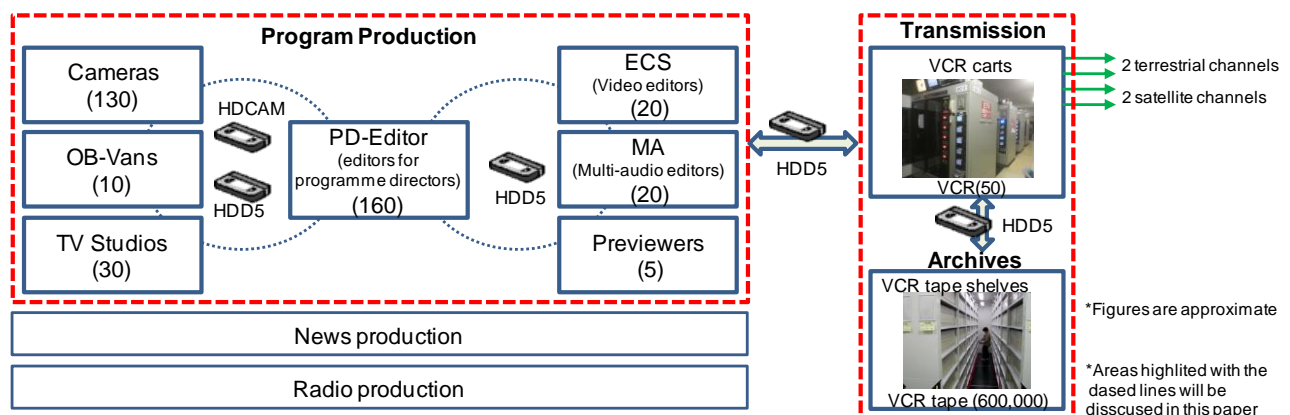


Figure 1 – Facilities at the NHK Broadcasting Centre prior to 2012

Figure 1 shows the principal facilities at the NHK Broadcasting Centre prior to 2012. NHK provides domestic telecasts 24 hours a day, every day of the year, on two terrestrial

channels and two satellite channels. Approximately 2,400 programmes are transmitted each week, excluding live telecasts. Both production and transmission were VCR-based, the latter relying on carts composed of 50 VCRs to send out programmes automatically. The Archives also relied on tapes, holding more than 600,000 of them. There were numerous other VCRs elsewhere at the Broadcasting Centre, which were also targeted for conversion to file-based systems. This paper will discuss the switchover to file-based systems for programme production.

GUIDELINES FOR NEW SYSTEMS

Files not reliant on a recording medium allow for a more efficient workflow. Server networks can be easily established for sharing and quickly forwarding material. A system based around a central server was adopted and put into operation for news production in 2011 in order to harness such benefits (see Figure 2). This type of system, however, was not absolutely necessary when it came to the production of other television programmes, given the limited sharing of material among them. A system based around distributed servers was therefore designed, taking into consideration a range of factors, such as system loads, workflows, and cost (see Figure 3). A network of servers or 'cells' was created according to programme genre. The network was made into a hybrid by connecting it to bridge media (BM) handling material on hard disks. Central Server was established for drama and sports programmes to allow for the sharing of material.

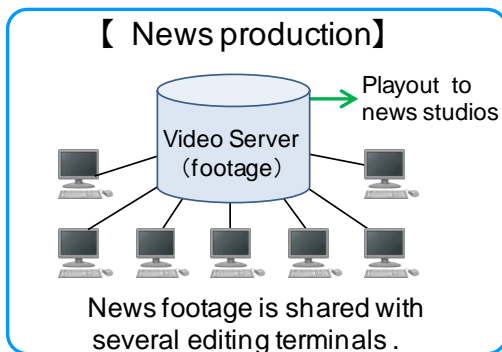


Figure 2 – Type of central server

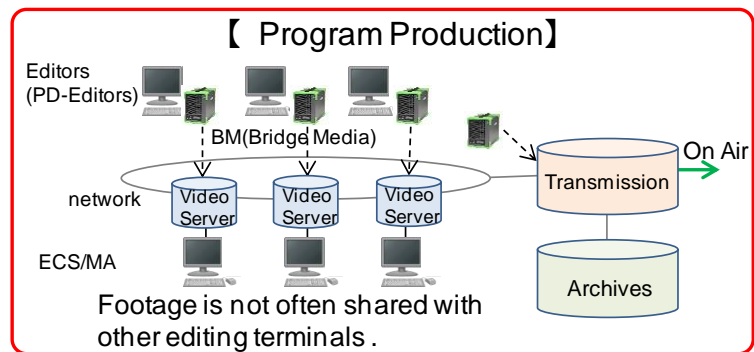


Figure 3 – Type of distributed servers

Server-based systems were also established for transmission and archiving. The archiving system was designed to reduce costs and power consumption in a number of ways, such as relying on data tapes for all files and on a cache for frequently accessed files.

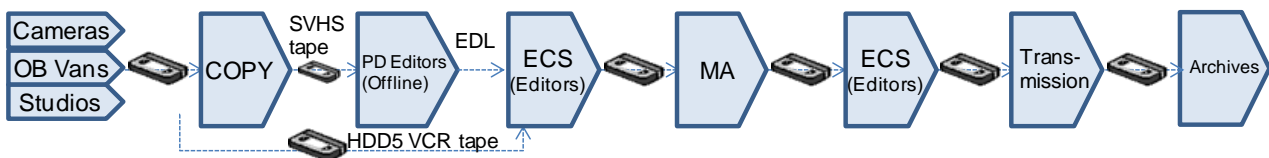


Figure 4 – Programme production relying on VCR tapes

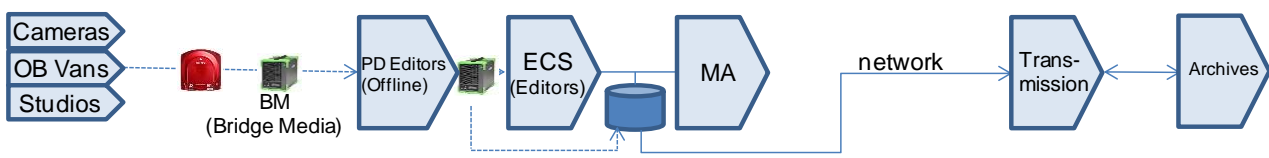


Figure 5 – Programme production relying on files

Files were adopted with a view to making programme production more efficient, editing in particular. Nonlinear video editors (ECS) and multi-audio editors (MA) were introduced and linked to servers, enabling editing work to be carried out simultaneously, and for the files containing the edited programmes to be forwarded to the transmission system (see Figure 4 and Figure 5).

OUTLINE OF THE FILE-BASED SYSTEMS

Figure 6 provides an overall view of the file-based systems for programme production. Servers have been established for the production of sports and drama programmes, transmission, and archiving. A hybrid arrangement has been established with bridge media.

Up to about two weeks of completed programme files can be temporarily stored in the transmission system. Files are forwarded to the transmission servers three days prior to the broadcast so that they can be sent out as programmes.

When it comes to archiving, files of frequently accessed programmes are kept in a cache, while all files are stored in the form of data tapes.

DVDs had been used for previews and for producing the likes of closed captions, sound effects, and bilingual productions. Improvements have been made here as well, with low-bit rate proxy files, capable of being forwarded on networks, being generated at the editing stage.

NHK developed a unique ID-secured Media Asset Management (MAM) system for keeping track of all aspects of programme production, from the proposal stage, management of resources, listing of programme files, transmission, and archiving.

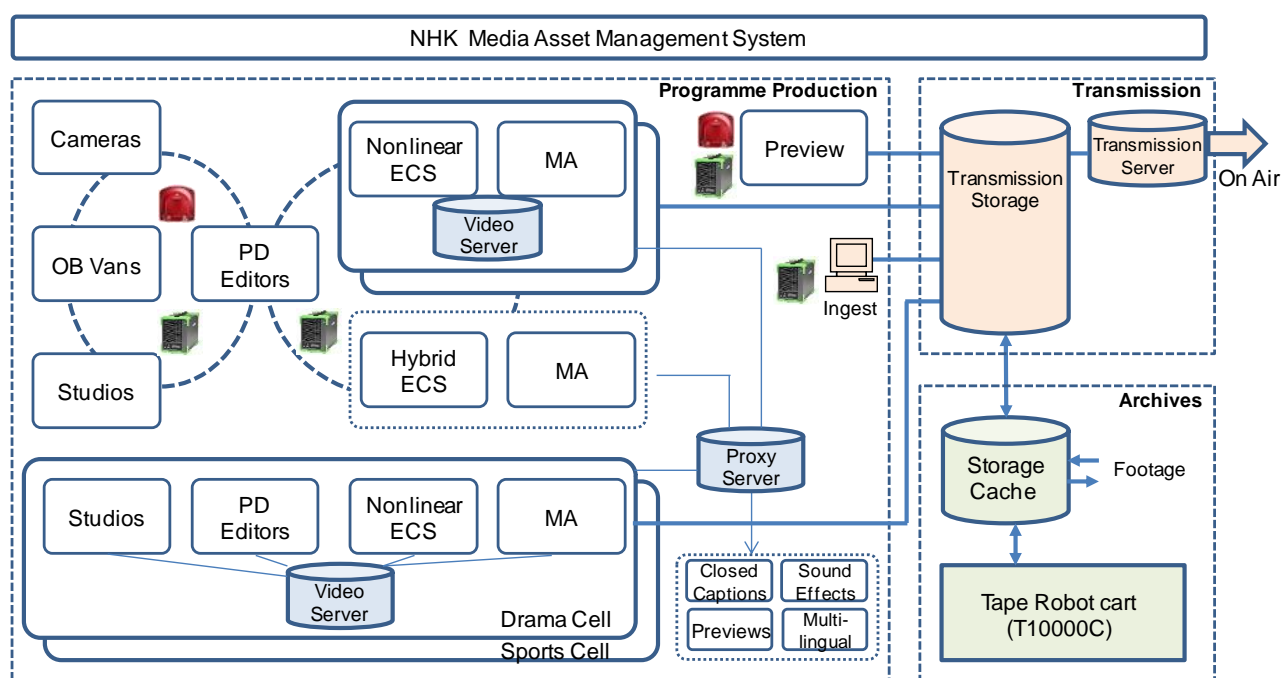


Figure 6 – Overall view of programme production with files from 2015

FORMATTING OF FILES

Consideration was made of the file formats, a key element in the designing of the systems. The Material Exchange Format (MXF) was chosen for wrapping, while H.264/AVC 1-Only 100 Mbps was selected for video compression for the following reasons:

1. The future potential of H.264/AVC.
2. 100 Mbps is compatible with full-specification High-definition signals.
3. I-Frame Only is a more responsive means of editing, allowing for partial substitutions.

The basic file format is principally suited for transmission and archiving. A range of different formats can be handled at the footage stage, and converted into the basic format during the editing.

THE SWITCHOVER AND HOW IT WAS ACHIEVED

The project that commenced in 2004 considered facilities for achieving more efficient workflows. While server networks were initially envisaged for transmission and archiving, trials with small-scale Bridge Media (BM) and network-based facilities were tried out for production.

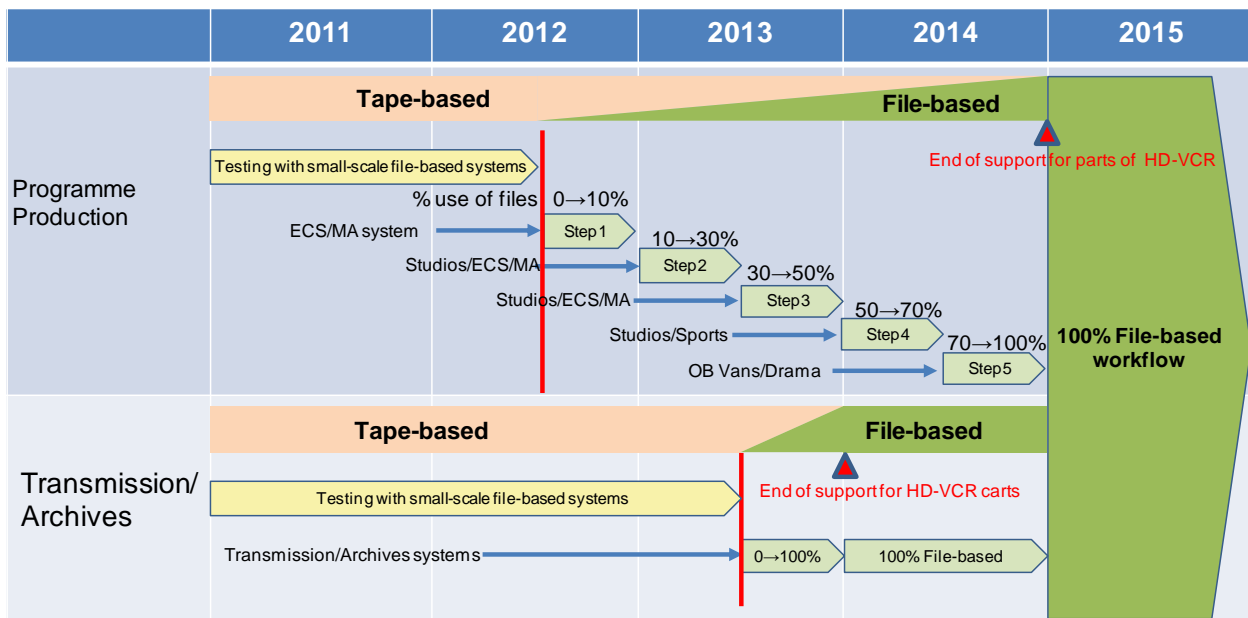


Figure 7 – Switchover schedule

2004 – 2007 Testing of networks

2008 – 2011 Testing of bridge media

2011 – 2012 Testing of small-scale bridge media-network hybrid

Tests were carried out according to the above time frames, taking into consideration technical trends and costs. A hybrid combining bridge media and networks became the actual goal. The necessary facilities began to be established in 2011. The switchover was



to be completed at the end of the 2014 financial year (March 2015) when support would end for VCRs and the VCR carts. A schedule for a phased switchover was drawn up working back from that date (see Figure 7).

The switchover for programme production was to be achieved in five phases or steps, with facilities planned and a certain percentage of programmes to be file-based at each step. There were proposals to make the switchover in production only after all of the transmission facilities had been provided, but this was not done, given the sheer amount of time involved in providing and testing such facilities, and the difficulties in making such a sudden shift in production.

Transmission was switched over to file-based systems over a period of about six months, during which time both files and VCR tapes were used, while archiving was switched over at once.

COMPLETION OF SWITCHOVER

All of the programmes produced at the NHK Broadcasting Centre were targeted for file-based production. Production staff were briefed as a whole, and then individually, about how their workflow would change. Switchover stages were determined for each programme. The production flow for each programme was investigated and there was careful consideration as to whether efficiency could be maintained once the change to a file-based production was made. Facilities were organised to handle both files and VCRs, allowing both to be used during the transition.

The final phase involved the commencement of a 'Drama Cell' for drama productions. All drama production was file-based by April 2015.

The changeover to new transmission facilities commenced in 2013, and the amount of file-based transmissions was gradually expanded. Back-up copies were made with VCRs in the first month in case of any problems. Newly produced programmes were mostly handled during the transition, but files were subsequently produced from tapes of programmes earmarked for repeat broadcasts. Transmission was entirely file-based by the end of the 2013 financial year (March 2014). The files of approximately 2,400 programmes are now transmitted each week. Files can be generated and transmitted of programmes provided in tape format from NHK local stations and outside production companies. The tapes are converted into files while being previewed in the preview rooms. Each stage of a programme, its production, transmission, and archiving, was made file-based, with the switchover being completed on schedule.

MAJOR FACILITIES FOR PROGRAMME PRODUCTION

Studio Recordings

A studio recording system was introduced to replace the existing High-definition VCRs (see Figure 8). It was designed to record and play on bridge media given the cost of a server-based system. Editing of studio footage recorded on bridge media can commence quickly, without ingesting it on an editor for the programme director (PD editor), thereby making the workflow more efficient.

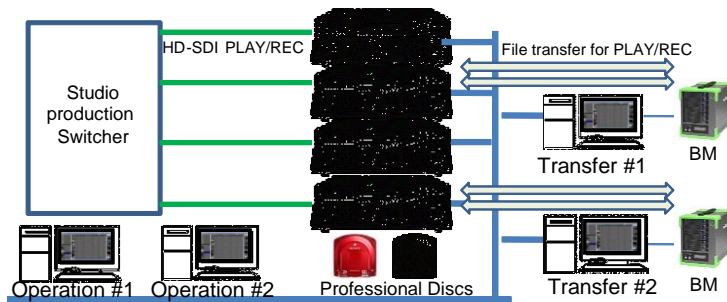


Figure 8 – System for studio recordings



Photograph 1 – Editor for programme director

Editors for Programme Directors (PD Editors)

Photograph 1 shows a nonlinear editor used by programme directors. These devices are much more efficient compared to offline editing with S-VHS tapes. Editing can be done directly on the bridge media without having to copy material on to a hard disk of PC. Resources can be used more efficiently, reducing the amount of time for ingesting material and allowing for easy transfers.

Video Editors (ECS)

There are two types of video editors (ECS): hybrid and nonlinear (see Figure 9, Figure 10 and Photograph 2).

The hybrid type, which adds nonlinear to conventional linear, was developed to offer flexibility during the period when both tapes and files were in use.

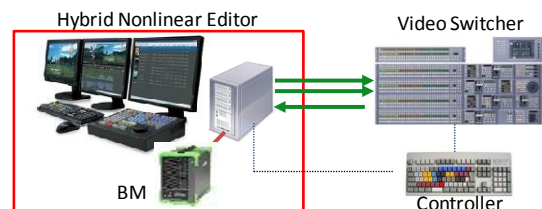


Figure 9 – Hybrid editing

Nonlinear editors allow for the incorporation of special effects and telop during video editing. A file can be generated of the edited images and allow for subsequent insert editing. The network will register the edited programme file on the transmission system.

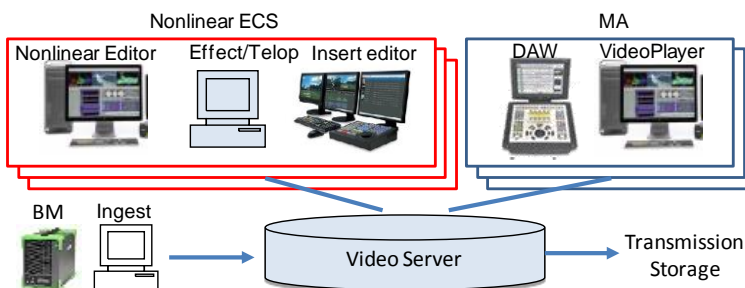


Figure 10 – Nonlinear video and multi-audio editing



Photograph 2 – Nonlinear video editor

Drama Cell

Three studios, seven PD editing rooms, four video editing rooms, and four multi-audio editing rooms have been set aside for drama productions. Everything has been networked for greater efficiency and for the sharing of material, which is frequently the case with drama programmes. There are special specifications for the nonlinear editors and video

formats, given the more frequent use of synthesized images in drama productions compared to most other programmes.

TRANSMISSION FACILITIES

Figure 11 and Photograph 3 show the transmission facilities to register and send out the programme files produced with video and multi-audio editing, etc. The completed files are stored two weeks prior to broadcast (1,900 hours of programmes for four television channels). Three days prior to the broadcast, the completed files are transferred to the transmission servers (holding 277 hours of programming). Programmes that will not be broadcast anytime soon are sent to Archives. They can be sent back to the transmission facilities when the broadcast date approaches. Registered programme files can be provided via networks or bridge media for alterations.

Proxies for reference purposes are low-bit rate files created from pre-broadcast material and can be viewed on the intranet. The proxies can be harnessed for producing the likes of closed captions.

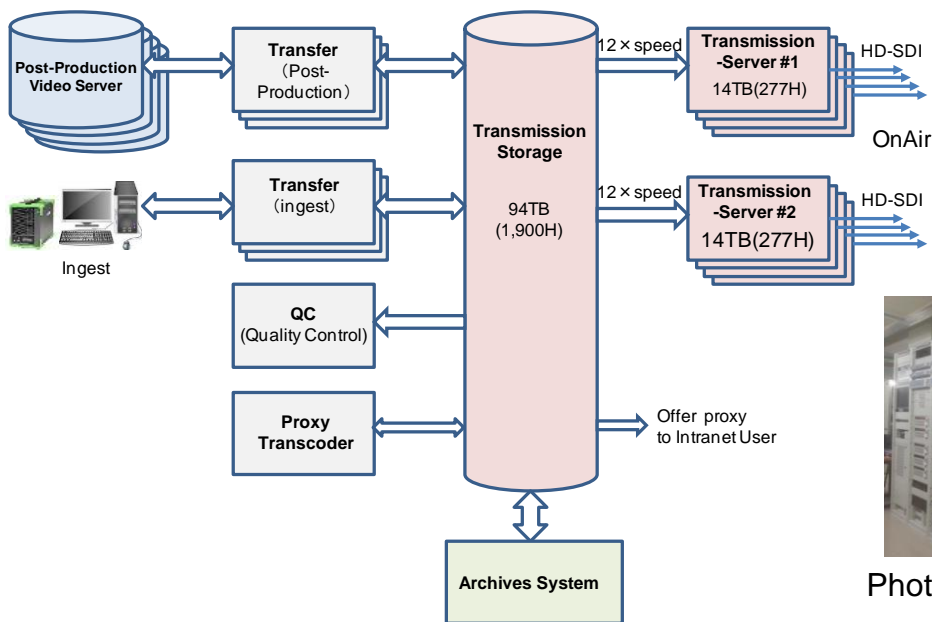


Figure 11 –Transmission



Photograph 3 – Part of the Transmission facilities

ARCHIVING FACILITIES

The Archives are the repository for storing and keeping track of a vast amount of video, audio, and other electronic files (see Figure 12 and Photograph 4). Data storage tapes take up much less space compared to the previous VCR tapes. Footage can be stored almost indefinitely and managed and maintained efficiently.

The hard disk cache can hold up to 850 hours of material, owing to the requirement for fast access to the system for transmission. Tape libraries are used for long-term storage. Files are recorded on numerous heavy-capacity magnetic tapes (T10000T2: 5TB/volume). There are four such libraries, occupying an area of 54 m², which is much less compared to the previous VCR tapes. They can hold up to 820,000 hours of files.

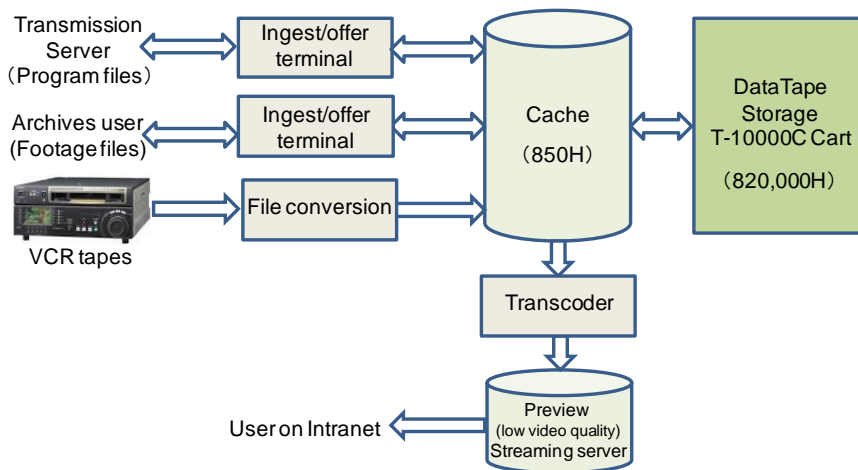


Figure 12 – Archiving



Photograph 4 – Part of the Archiving system

BENEFITS OF FILE-BASED PRODUCTION

Tests have revealed the following benefits from using files:

1. The convenient nature of files is such that staff feel they could never go back to relying on tapes.
2. Linear video editing, which enables simultaneous production of telop, modification of images, and so on, means the time required for editing is reduced by about 10 per cent.
3. A more diverse range of visual effects and visual depictions are possible with the editors for programme directors. Repeated editing is easy, helping improve programme quality.
4. The new file-based transmission and archiving facilities take up much less space. The Archives can provide files more quickly and conveniently.

CONCLUSION

The project at the NHK Broadcasting Centre to switchover from VCR tapes to files for production, transmission, and archiving took about eleven years. The success was due a cost-effective provision of facilities, a hybrid arrangement combining bridge media with server networks, rather than relying entirely on the latter, as well as a phased switchover on a programme-by-programme basis. Programme directors expressed support for the switchover to files, saying this made work more efficient, and improved the quality of programmes. They said they could never imagine going back to VCR tapes.

Following the switchover at the NHK Broadcasting Centre, NHK is now looking to do the same for the facilities and operations at its fifty-three local stations. Know-how on the facilities and operations with High-definition files could also be applied to 4K and 8K ultra High-definition in the future.