Memory of the World Programme

International Advisory Committee

Report of First Meeting of the
Sub-Committee on Technology

Phonogrammarchiv of the Austrian Academy of Science,
Vienna
June 3rd and 4th, 1994

Various scientific prefixes denoting magnitude are used in this document. A short note on the hierarchy is given to help those not familiar with the terms. Each prefix is 1000 times the size of the term below. They are combined with Bit - a single binary digit - or a Byte - a group of eight binary digits.

Kilo	10^3	One Thousand
Mega	10^6	One Thousand Kilo or One Million
Giga	10^9	One Thousand Mega or One Billion
Tera	10^{12}	One Thousand Giga or One Trillion
Peta	10^{15}	One Thousand Tera
Exa	10^{18}	One Thousand Peta

Report of Meeting

Those Present:

Participants: Dietrich Schüller (Chairman), Abdelaziz Abid (UNESCO Programme Officer), Michael Alexander (IFLA), Julian Bescos (ICA), George Boston (FIAF, FIAT, IASA).

Observers: Harold Gardas (Secretary-General, Austrian Commission for UNESCO), Jacques Klossa and Franz Lechleitner.
(See Annex 1 for full details.)

The Chairman welcomed the Participants to Vienna and to the Phonogrammarchiv of the Austrian Academy of Science. George Boston was appointed as Rapporteur for the meeting.

1. Mandate of the Sub-Committee

Abdelaziz Abid tabled a report describing the Memory of the World Programme (Annex 2). He reviewed the history of the Programme and the reason for the creation of the Technical Sub-Committee. The Programme had two main aims: the preservation of information of all forms and the democratisation of access to the information. It had been felt that there was a need for a periodic review of the technologies available to ensure that the Programme was using the most appropriate systems to achieve these aims.

M. Abid also referred to a second Sub-Committee that was to deal with the marketing and commercial exploitation of the Programme.

There were a small number of projects already in progress under the Memory of the World Programme. These were seen as pilot projects to help assess the usefulness of current digital storage technologies and the possibilities of marketing the products.

The initial task of the Technical Sub-Committee was to set general guide-lines and standards for projects to follow. It was also envisaged that, because of the wide variations in the materials to be preserved, the Sub-Committee would also be available to assist by assessing individual projects and making specific recommendations for the technical methods and standards to be followed by that project.

2. Digital Preservation

The Chairman explained that this item was on the Agenda to ensure that the reasons for and against the use of digital techniques were clear and that the basic decision was correct.

He pointed out that some types of documents were not appropriate for copying to a digital storage system at present. The reasons vary. Some documents - for example motion picture films - require more digital storage space than present technology can provide at an economic cost. Other documents - for example large maps and plans - will not fit into existing scanners. Other documents give rise to other problems. This situation will change in the future and the Sub-Committee on Technology will keep the situation under review.

The meeting agreed that the main potential advantages of a digital storage system were:

a. Copying - the ability to make copies of digitised information to the same storage format without loss of quality except in cases of extreme decay.

b. Automation - not only of the play-back of items requested by the use of robotic storage systems but of the process of copying. As the signal is a string of binary numbers, it is possible to automate the process of copying and even to remove the need for human checking of the fidelity of the copy.

c. Searching - the ability to search both local and remote catalogues and to create a web of links or pointers from the document accessed by the user to associated documents.

d. Access - the ability to send a digital signal over standard communications networks without loss of quality except in the most extreme adverse conditions. The use of large scale robotic stores will enable the store to be accessible for 24 hours a day with the minimum of staffing.

e. Speed of Copying - within the digital domain, it is possible to accurately copy or transfer data at a very high speed. The provision of a copy to a researcher can be done swiftly. The future migration c collections to new carriers in the future will be much faster than the initial movement to the digital domain.

f. Quality - the ability to digitise an information carrier at a very high resolution if required.

g. Space Requirements - the density of storage of digitised information on the carrier resulted in a major reduction in the shelf space required. This in turn reduced the space that required archival climatic control with a consequent reduction in running costs.

The main disadvantage perceived by many people was the cost. This came in four parts:

a. Capital Costs - the equipment required to carry out the digitisation process was expensive to buy and often required skilled operators if the best results were to be achieved.

b. Running Costs - it was often supposed that the carriers used to hold digitised information required a very clean and climatically stable environment that would require an increase in the energy used and that there would also be a capital cost in the creation of the storage area. These were not correct suppositions. The climatic conditions required by modern carriers were those required by magnetic tape.

c. Preparation Costs - before capturing the document, it was necessary to prepare the material. The preparation includes the ordering and indexing of the original material and the entry of the textual references into the data base by specialist staff, as well as any physical preparations that may be required. Much of this work would have to done before copying the material using non-digital methods such as micro-filming.

d. Copying or Transfer Costs - the manpower requirement to copy the existing carriers to a new carrier was seen by many as being very high. The cost of the restoration and preservation programmes that are needed to keep the existing carriers in a usable condition are, however, even greater in the long-term. The costs of the mechanical process of making a digital copy are basically the same as making an analogue copy on, say, microfilm. The difference is in the capital equipment required.

The Sub-Committee felt that these economic points were outweighed by the advantages. A number of other points had also to be considered when examining the costs.

i. The equipment could be shared by a group of archives and libraries. The process of digitisation would, after the initial major capture process in each institution, be an intermittent operation.

ii. The material to be digitised often did not require physical restoration before digitisation. In many cases the "restoration" could be performed in the electronic domain when using the information. This also permitted the use of future improvements in the forensic type techniques of examining documents which may not be possible with a restored document.

iii. If an area constructed to high standards of cleanliness and climatic control was required, it would be very small in comparison to the traditional area of shelving that the digital store would replace.

iv. The capital cost of a robotic store had to be set against the savings in manpower costs.

The Chairman said that the question of a new storage system was very urgent in the sound and moving image fields. Each day more carriers had decayed beyond the point of restoration. This was a slow "Fire of Alexandria" in progress. The manuscripts and prints were also decaying. The question was no longer about if the information carriers would be lost but a question of when. Some carriers would survive for tens of thousands of years. Many are lasting for only tens of thousands of days. Some for just days. To preserve information it had to be copied.

To copy from a traditional analogue carrier to a new carrier - either analogue or digital - was expensive as trained staff with the ability to monitor and adjust the process were required to ensure that the best transfer quality was achieved. The technical quality of a copy made from an analogue original was not as good as the original.

To copy from a digital carrier to another digital carrier offered the possibility of automation for both the mechanical parts of the process and the monitoring. The technical quality of a digital copy made from a digital original could be identical to the quality of the original.

Overall, the Sub-Committee agreed that the use of digital storage was the way forward for many types of document. The advantages greatly outweighed the disadvantages.

3. Preservation Standards

3.1 Methods of Selecting the Appropriate Digitisation Standard

The Chairman said that different standards of digital preservation were possible. An examination of various ways of determining the application of these levels of standards would be helpful when the storage requirements for a project were assessed. After some debate it was agreed that grading should be by the type of document and the information that it contained

For documents that could be stored as a still image, it was agreed that three basic levels could be identified by examining the information to be digitised. Much textual information only required a basic bi-tonal storage standard. This would include many books and typed documents. The second group of documents would require a grey-scale storage standard to accommodate the texts. This would include mono-chrome images and photographic stills. The third group of carriers would require colour. These carriers include illuminated manuscripts, maps and items that may require forensic type examination.

Sounds and moving images, by their nature, require different standards definitions but in many cases these are already defined.

3.2 Digitisation Standards and Methods

Various suggestions and comments were made including:

i. All pages of books etc be captured in mono-chrome with a supplementary colour photograph taken when appropriate.

ii. Additional images should be captured using illumination other than visible light ie. infra-red and ultra-violet light, when the need for future forensic style examination is seen.

iii. Digitisation should be from the original whenever possible.

iv. Photographic processes such as the CIBA-Chrome offer very high resolution but at the expense of colour fidelity. A decision has to be made about the priority factor to be considered when making a copy.

v. A digitised image permits the creation of forensic style images by means of electronic image processing techniques.

vi. A taxonomy of carriers should be created to help form a list of the standards and methods appropriate to each. This will assist with the choice of the best methods and standards to be employed by new projects within the Memory of the World Programme.

vii. The capture should always be at a high standard. The human brain is capable of being taught to recognise, accept and demand improvements in technical quality. The public has accepted every increase in quality offered and at each stage has seen the previously accepted standard as no longer adequate.

viii. The technical quality of a digitised document is locked at the time of capture. The only way of improving the quality is to repeat the capture process if the original still exists. The costs of repeating the capture process on a large scale means that, in practice, it will be a one chance operation.

ix. If it is agreed that digitisation is desirable and if it is agreed that carriers decay, then we must consider the future process of migration to new carriers now.

x. The migration may create problems with catalogues and cross-links. Advice from documentalists is required.

xi. Images should be stored as bit-mapped files to avoid distortions being created during transfer between systems using different coding methods.

xii. The use of data-reduction techniques - non-reversible methods of reducing the amount of digital data to be stored - are to be avoided. The use of data-compression - the reversible reduction of digital date - is permitted if necessary. For preservation copies, full bit-rate storage is the ideal.

It was agreed that the further detailed consideration of standards should be done by two work-groups based on the carriers - Group A carriers that can be represented by a still image (texts, maps, photographs etc.) and Group B, sounds and moving images.

Each Work Group would draw up a table showing the types of carrier and, for Group A, the digitisation standards and storage requirements for making colour, grey scale and bi-tonal copies of each type of carrier.

Group B would consider the digitisation standards and storage requirements for sounds and moving images digitised to full preservation standard, to an intermediate standard for access and diffusion and to a lower standard for browsing or catalogue use.

Much of this work would have to be done outside the meeting. A timetable was discussed and agreed. The two work groups would prepare draft tables, consult with colleagues, revise the tables in the light of comments received and submit them to the full Sub-Committee by the end of September 1994. If any testing and evaluation of the draft standards was required, this would be done in parallel with the consultations. The aim was to present a table of standards to the next meeting of the International Advisory Committee to be held in early 1995.

3.3 Other Factors

a. Optical Character Recognition

The use of Optical Character Recognition (OCR) systems was discussed. These have a number of advantages over pure images. The storage space required is much less than the space required for even a bi-tonal image. It is possible to search the text directly without the need for the creation of a key-word catalogue.

At present, the reliability and usefulness of OCR software is limited. Work is still proceeding and commercial developments such as the systems that can recognise a small range of handwriting and convert it to type are signs of the increasing commercial interest in this area. If the systems become sufficiently reliable, the use of OCRs would create a fourth standard for the capture of textual documents.

b. Material to be Included in the Programme

It was agreed that the Programme should consider collections of significance as a whole and not "cherry-pick" spectacular items. The value of a collection is frequently much greater than the sum of its parts. For example, many of the documents in the Archivo de Indias are individually of little value; the collection, however, is priceless.

4. Mass Storage Systems

4.1 Review of Current Systems and Future Trends

Copies of information from two manufacturers' were distributed to the meeting.

The first was about the Sony Mass Storage System (Annex 3) which uses magnetic tape cassettes in a robotic store. The system offers several options with a maximum capacity in the largest cabinet of 30 Terabytes. The largest cabinet occupies a space one metre deep by 3.4 metres wide and two metres high and includes the play-back machines. It uses 750 tapes. The system is being used by Twentieth-Century Fox to preserve their collection of over 10,000 hours of news film.

The second was from Studer-Revox (Annex 4), a major manufacturer of broadcast audio equipment. They offer a CD jukebox which holds up to 6000 discs. The cabinet is the same size as the largest Sony cabinet and also includes space to fit up to 18 players.

A discussion followed about the applicability and speed of operation of such equipment. Julian Bescos said that the Archivo de Indias has 10 million pages of documents on 5000 5.25" WORM Optical Discs each holding 940 MegaBytes of information. With one operator, any of these can be played to researchers in 30 seconds. The capital cost of a robotic system would only be justified if a much larger number of discs meant that the operation slowed considerably and/or 24 hour access was required.

No firm conclusion was reached, underlining that each project had to considered on its own merits. It was noted, however, that without automation remote access using communications circuits becomes much more difficult.

It was also reported that ICI and a Canadian associate are marketing an optically read tape that has a storage capacity of 1 TeraByte. Eastman-Kodak are also working on a similar system. These developments offer the possibility of a larger capacity storage system than the systems currently on offer.

4.2 Migration Strategies

As was noted earlier, the data transfer speed, data protocols and the carrier would be major factors in the viability of future migrations. Another major factor would be the indexing cross-reference system employed. The structure of the storage requires close consideration. The operating systems employed would themselves require archiving.

4.3 Quantitative Aspects

One basic question was "How much is to be stored?". Some members of the Sub-Committee felt that this question was irrelevant for the overall Programme as the Programme would be constructed from projects. The amount of storage required each year would vary depending upon factors such as the demand for access, the dangers threatening collections and the availability of the required staff.

The storage requirements for the Programme were, in total, very, very large. The Library of Congress had surveyed 500 sound and moving image collections and, for sound and video but not film, had estimated the storage needs as being 1 ExaByte. This would not, however, need to be purchased all at once. As with traditional storage, it can be bought as required. It would also be fragmented over a number of institutions. UNESCO have an estimate of the number of books requiring de-acidification treatment. This, together with the audio and moving image, would give a clearer idea of the overall storage needs.

The biggest mistake would be to become overwhelmed by the size of the task. If the British Library or the Bibliothèque Nationale de France were to be created today and be required to achieve their present size in one bound, it would be seen as impossible. The critics of digitisation are looking at the finished programme and not taking it step by step.

Abdelaziz Abid reported that IFLA and ICA had been asked to undertake three surveys to produce lists of collections that have been lost; of collections in danger; and of current applications for inclusion in the Programme and active Projects. Of the last list, it was intended that it would normally contain about 100 applications for consideration by the International Advisory Committee.

The question of duplication of effort was raised. If a book had been captured by one institution and was available by remote access, there was little point in repeating the capture process on another copy elsewhere unless there was some significant difference in the copies.

It was suggested that publishers be asked to provide copies of the computer files of books etc. This would obviate the need to make OCR copies. It was felt that the publishers worries about pirating of books would make their agreement unlikely.

4.4 Indexing and Mediographic Access

The question of how deeply the Technical Sub-Committee should examine cataloguing and associated areas was discussed. It was agreed that it was necessary to be aware of the probable requirement for space for catalogue information and for the need for linkages or pointers. The detail of these, however, was the province of the appropriate experts.

An important concern was that for the Memory of the World Programme to achieve the maximum access that technology can provide, the individual projects must have linkages from documents in one collection to relevant documents elsewhere. These linkages would not be built up in a formal manner but would grow during the use of the total Programme by researchers. To achieve this, each item requires a unique identifier which is linked to the address in the catalogue.

Such an identifier may be in several parts as with telephone numbers ie. a country code (country identifier), an area code (city or region identifier), an exchange code (the institution identifier) and the telephone number (document identifier). Within the institution only the document identifier would need to be used. For a document in another institution in the city, the institution and document identifiers would be needed. For a document in another country, all the identifiers would be necessary.

A European Union project titled "Paragon" is already addressing this problem.

5. Data Retrieval and Distribution

5.1 Access/Distribution Resolution Versus Preservation Resolution

It was agreed that the resolution standards applied to preservation or master copies should be commensurate with the quality of the original material. Copies of the master made for access and distribution need not be to the same high standard. It was noted that the use of a high quality standard for the preservation master did not necessarily increase the costs of the capture programme. The use of lower standards frequently meant the continuous adjustment of the equipment, with the consequent increase in the time spent capturing each item, in order to make the best of the lower standard.

The amount of preparation necessary for documents to be digitised would vary depending upon the material and its physical condition. Subject to the physical condition of the document being at an optimum for the digitisation process, eg. in the case of pages from a book, able to lie flat, or for a tape, able to be played, it was better to perform the minimum of restoration work on the document.

Any work to improve the readability of the document or to enhance certain features was easier in the digital and electronic domains. Unlike restoration processes performed by chemicals on the physical document, the processes used in the electronic and digital domains were reversible and would not alter the state of the preservation master.

5.2 Access/Distribution

a. Networks

One of the major aims of the Memory of the World Programme was to democratise the access to information. This would be done in part by producing copies of documents on CD-ROMs, in books and other forms of mass-distribution. The documents on these copies would, however, be the selection made by curators marketing departments etc and would represent only a small fraction of the total. To truly democratise the access to information, the user had to be given the control of what was selected.

To some extent, the traditional library offers this democratic access but only to those able to visit the institution housing the document. The telecommunication networks and the spread of personal computers in the home and work place offer a method of bringing the collection to the user. Developments such as the experimental Video-on-Demand cable systems are an indication of the way that commercial entertainment providers are going.

The older telecomm circuits are relatively slow and some documents would require a data transfer rate much higher than the network can handle. Moving images and sounds, in particular, cannot be played at high quality at their correct speed. New data highways are being installed that will handle the stream of data required for access to these documents and, although they are currently limited in their geographic distribution, the number of these super-highways is steadily increasing.

Concern was expressed about the information gap between developed and developing countries widening as a result of these trends. The problem is economic for both the state and the individual. In some countries, the problem is partly political. The cost of the installation of modern communications networks falls mainly upon the state; the cost of the terminal falls upon the users.

A new search system is being run on the existing Bulletin Board networks by a number of academic institutions. This is the World-wide Web and it offers a seamless searching of texts and images all over the world. It is uneconomic at present but is providing a very useful testbed for ideas.

b. Distribution by Hard Copy

The access to and distribution of documents by means of copies on paper, CD-ROM, micro-film, tape or film will still be very practical ways of disseminating information. The demise of the book or the movie, for example, is not foreseen in the recommendation that a move towards digitisation should be considered. The book or film may, however, become more ephemeral. They may, for example, be printed on request from the digital master document held in an automated store.

5.3 Multilingual Access

The need to provide catalogue information in more than one language was desirable. The selection of the languages other than the original was a task for the International Advisory Committee but the Technical Sub-Committee considered that three would probably be the optimum number.

The linking between the original document and abstracts, commentaries and translations was also seen to a desirable aim for the Programme. For maximum effect, these linkages had to be a world-wide network providing linkages between collections as well as within collections. The establishment of protocols for the provision of unique identifiers for every document stored within the Programme was essential.

6. Copyright and Associated Concerns

6.1 Copyright and Ownership

Although the Technical Sub-Committee is not charged with the responsibility for copyright, it was concerned about the legitimate worries of owners of documents about pirating of the intellectual property. The Sub-Committee agreed that the protection of the rights of the owners of documents must be a major concern of the Memory of the World Programme.

Since in most cases the owners did not want to restrict access but did wish to charge for the service, methods of tracing users and billing them had to be built into the overall plans. The example of the premium charge telephone call was quoted as one way of generating the income necessary to sustain the service. The cost of calls to certain numbers was increased by the telephone company who passed the extra money generated to the service provider.

It was also accepted that it was likely that the owners of documents would not wish to provide access to the high quality preservation masters. The browse or access standard would be adequate for most purposes. This standard can either be generated directly from the preservation master or be available on a separate server. The access standard would require lower data transfer speeds and, therefore, be cheaper for the users. If access to the preservation standard form of the document was required, this should be available by application only.

To keep control in the hands of the owners of documents, the consolidation of collections into one physical system is not desirable. It would also be unwieldy. The use of catalogue linkages would create a virtual unified collection but still permit owners to retain control.

6.2 Ethics

It was agreed that it was necessary to outlaw methods of enhancing documents when creating master preservation copies. These methods demand that the person applying the enhancements make judgements as t how the document should look or sound. If enhancements are required, they can be made to access copies or by the user.

The original should be transferred at high quality into the digital domain with all its defects. These are much easier to correct when access is required. The preservation master is a facsimile of the original document in its untreated state. The defects are themselves part of the history of the document.

7. Future Composition of the Sub-Committee

It may be necessary to invite additional experts to fill gaps in the breadth of knowledge available within the existing Sub-Committee. This was not urgent at present.

8. Future Organisation of the Sub-Committee's Work

It was foreseen that guidance would be required from the International Advisory Committee on a number of points.

A timescale for the Work-Groups was discussed and agreed. The Task-Groups will report back to the next meeting of the full Sub-Committee. This was provisionally agreed as being in London at the end of September or the beginning of October.

Testing by the Work-Groups of some of the draft standards may be required. This would be done in parallel with the consultations and, if necessary, continue beyond the next meeting of the Sub-Committee. This stage of the work would be completed before the next meeting of the International Advisory Committee in early 1995.

ANNEX 2

MEMORY OF THE WORLD

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Division of the

General Information Programme

UNESCO

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Abstract

The "Memory of the World" Programme is a new UNESCO initiative to safeguard endangered documentary heritage, democratize access to it and distribute, on a large scale, products derived from it.

There follows an outline of the main features of the Programme. It is important to stress that this is a new approach which is not intended to replace UNESCO's traditional activities in the field of preservation and conservation of archive and library holdings, but to complement them with vigorous action to raise awareness, stimulate initiatives and develop partnerships to carry out projects under the emblem "Memory of the World". The criteria used to select projects are set out, together with a brief account of the Programme's technical, legal and financial framework.

Lastly, five pilot projects at various stages of completion are briefly described. They are a CD-ROM featuring a selection of manuscripts from the National Library in Prague, another CD-ROM concerning the symbolic figure Saint Sophia, patron saint of the capital of Bulgaria, an inventory of nineteenth century Latin American newspapers and their state of preservation, a disc on the Radziwill Chronicle in Saint Petersburg and another disc on Yemenite manuscripts including the Koranic fragments at Sana'a.

The written heritage reflects the diversity of languages, peoples and cultures. It is the mirror of the world and its memory. But that memory is fragile. Every day, fragments, if not whole chunks of the world's documentary heritage disappear for ever. Precious documents, unique records of the history of arts, sciences and civilizations, sometimes even entire library collections or complete archives are lost forever through natural or human-induced disasters. Many others, subject to wear, neglect and natural ageing are in such bad condition that, at any moment, they may disintegrate. A considerable proportion of the world documentary heritage disappears through "natural" causes: acidified paper that crumbles to dust, leather, parchment, film and magnetic tape attacked by light, temperature, humidity or dust. The cinema, for instance, is in danger of losing most of the works that have made it the art of the century, just when it is celebrating its centenary. Thousands of kilometres of film could just fade away unless they are restored and preserved as soon as possible.

As well as natural causes, accidents regularly afflict libraries and archives. Floods, fires, hurricanes, storms, earthquakes... the list goes on of disasters which are difficult to guard against except by taking preventive measures. Every year, treasures are destroyed by fire, cyclones, monsoons and other extreme weather conditions.

Libraries and archives are as vulnerable as human lives to war and natural disaster. It would take a very long time to compile a list of all the libraries and archives destroyed or seriously damaged by acts of war, bombardment and fire, whether deliberate or accidental. No list has yet been drawn up of the holdings or collections already lost or endangered. The Library of Alexandria is probably the most famous historical example, but how many other known and unknown treasures have vanished in Constantinople, Warsaw, Florence, or more recently in Bucharest, Saint Petersburg and Sarajevo? There are so many more, and sadly the list cannot be closed - not to mention holdings dispersed following the accidental or deliberate displacement of archives and libraries.

The sheer scale of the effort needed to preserve what is part of this irreplaceable "Memory of the World" requires the implementation of a consistent protection programme which will pool endeavours and make use of state-of-the-art technology.

Objectives of the "Memory of the World" Programme

According to its Constitution, UNESCO has a duty to help maintain, increase and diffuse knowledge by assuring the protection of the world's documentary heritage and making it accessible to as many people as possible. Impelled by its responsibility to develop culture and protect the world cultural heritage, UNESCO launched a new programme in 1992 to protect and promote the world documentary heritage. The Programme, entitled "Memory of the World" and implemented by the Division of the General Information Programme, is designed to embody a new approach to protecting endangered documentary heritage, democratizing access to it and ensuring its wider dissemination. The Programme's objectives are complementary and of equal importance.

They concern safeguarding the most endangered handwritten, printed and audiovisual holdings and facilitating access to them by as many people as possible using the most appropriate technology, while ensuring that the originals are maintained in the best possible conditions of conservation and security. It should be possible to protect this heritage and, at the same time, make it accessible to the public by compiling high-quality image banks which could then be used to make reproductions in all sorts of forms, such as videodiscs, albums, books, postcards, microfilms, etc. Any proceeds from the sale of related products will then be ploughed back into the Programme.

Scale and structure of the Programme

The International Advisory Committee of the "Memory of the World" Programme, whose members are appointed by the Director-General of UNESCO, recommended, at its first meeting held in Pultusk, Poland, September 1993, that the concept of documentary heritage be extended to include, besides manuscripts and other rare and valuable documents in libraries and archives, documents in any medium: in particular, audiovisual documents, computerized recordings and oral traditions, the importance of which varies from region to region. In all these fields there is a need for protection, sometimes as a matter of urgency if we are to prevent collective amnesia and set up world cultural exchange.

The Programme should make governments aware that they must protect their documentary heritage, release potential for action, support the activities of professional, national, regional and international organizations and stimulate initiatives. A three-level set-up is envisaged:

An International Advisory Committee for the "Memory of the World" Programme to guide the planning and implementation of the Programme as a whole and make recommendations concerning fund-raising, the allocation of funds and the granting of the "Memory of the World" label to the projects selected, including those not receiving financial support from the Programme.

At the national level, it is planned that a committee will be appointed, firstly to selec projects according to the criteria agreed upon and submit them to the International Advisory Committee and, thereafter, to follow them up. The committee will be composed of experts able to make an active contribution to the projects and of representatives of the users. Persons submitting projects must ensure that the rights of the owners of the holdings or collections are protected. In addition, each project will set up its own scientific committee of specialists to determine the general thrust of the project and to supervise its organization.

Lastly, whenever the need arises, a regional committee will be required to select projects of a regional nature, taking local characteristics into consideration, with a view to submitting them to the International Committee. Finally, the partners of the Programme will be the experts, users, professional bodies, public and private organizations and institutions that agree to collaborate on the conceptual preparation of projects and also companies and firms which will provide technical and financial assistance.

Selection criteria

The Pultusk meeting recommended that the selection of holdings and collections for the "Memory of the World" Programme should be based on the following criteria: content (cultural, literary or scientific, artistic value), national, regional or international interest, physical condition, context, degree of risk, project feasibility (whether achievable within a reasonable time). The irreplaceable nature of the documents, holdings or collections concerned will be established by the combination of these criteria.

Furthermore, it was recommended that the organizers give some degree of priority to operations affecting several countries, national projects with a regional or international dimension and projects carried out in co-operation or in partnership, while not overlooking minorities and their cultures. Particular attention will be paid to reconstructing the memory of peoples in the case of collections or holdings that have been displaced or scattered.

Some current projects

1) **Prague**

The demonstration CD-ROM prepared by the National Library in Prague, in collaboration with UNESCO and Albertina Ltd., presents some of the most valuable manuscripts and other documents in its historic collections.

The disc contains samples of these works with notes in Czech, English and French and the Library intends to record some of its most valuable items on a set of discs.

Putting its most beautiful manuscripts and early printed books into digital form will make these treasures more accessible and prevent excessive handling of the originals, thereby helping to preserve them. In addition, while colours and ink react on contact with paper, parchment, silk and other traditional media, digital information does not fade with the passing of time. Even if some estimates put the life of a CD-ROM at no more than 20 or 30 years, it should be straightforward to transfer digital information on to the more lasting media which are expected to be developed in the future.

2) **Saint Sophia**

Devised by a group of Bulgarian and French writers, the "Saint Sophia" project is an attempt at a multimedia edition of Bulgarian manuscripts on an interactive compact disc. It is intended to evoke the symbolic figure of Saint Sophia, patron saint of Sofia, capital city of Bulgaria, in Bulgarian history, literature and civilization from the eleventh to the seventeenth centuries.

The documents selected include primarily the facsimile reproduction, in the form of digital images, of Bulgarian manuscripts, including the oldest one

known: the eleventh-century *Book of Apostolic Epistles of Enina*. They are supplemented by reproductions of illuminations, frontispieces and decorative motifs, and by photographs of various historic and archaeological sites. There are also printed transcriptions in Old Bulgarian of the manuscripts and their translations into modern Bulgarian, English where such translations exist, and French.

There is a choice of computer processes available for exploration of these documents. An initial solution, and the most elementary one, would be merely to use the resources of the thematic menus on the "Photo CD Portfolio" disc. Another method would be to use the software CDS/ISIS, which is produced and distributed by UNESCO. A final option is the SPIRIT system of multimedia database management, produced by the French company "Technologies GID", which allows queries to be made in natural language. A prototype, using the manuscripts from the Saint Sophia project, should be produced during the first half of 1994.

3) The Radziwill Chronicle

This is a monumental work of enormous significance, in that it retraces the origin of the peoples of Europe and describes the salient events of their history. It is a rare example of an illustrated Russian medieval chronicle. Drawings and almost 600 miniatures reproduce some of the most important European buildings of the thirteenth century and thus constitute a valuable record of a vanished world.

The Chronicle has been known since the seventeenth century and has been studied by a great many scholars and bibliophiles, including Peter the Great. There have been several rather unsuccessful attempts to publish a facsimile of it. A prototype CD-ROM is being produced by close co-operation between UNESCO, the Library of Congress and the Library of the Russian Academy of Sciences in Saint Petersburg, where the Radziwill Chronicle is held.

The project will make this outstanding work accessible to the public and to researchers in Russia, Central and Eastern Europe and, indeed, throughout the world.

4) The Sana'a manuscripts

In 1972, after heavy rain, a section of the wall of the Great Mosque of Sana'a collapsed. Work on the roof brought to light manuscripts which had been concealed in the ceiling in ancient times. They are parchment and paper fragments representing approximately one thousand different volumes, the oldest of which date back to the first century of the Hegira. Most are extracts from the Koran and are of considerable interest for the linguistic, religious and paleographic study of the literature of the early centuries of the Hegira and of the Arabic language.

The fortuitous and extraordinary discovery of these documents and their unique character make this find a remarkable event which will mobilize efforts and expertise on an international scale. Thanks to the active participation of the Federal Republic of Germany, a plan of work on the fragments was begun, which led to the construction of a House of Manuscripts, the restoration of some 12,000 fragments of parchment (out of 15,000), their storage, identification and classification and the training of Yemeni restorers and photographers.

Research work on illuminated fragments and on bindings was carried out with a grant from the Getty Institute. This work, together with papers read at congresses and articles in academic journals, shows just how remarkable the collection is. The Yemeni authorities concur in the view that the collection is the equivalent of a historic building of exceptional heritage quality. A UNESCO mission visited Sana'a at their request to consider including a pilot project on the Yemeni collections in the "Memory of the World" Programme.

The collections of manuscripts that it has been possible to examine have been outstandingly rich, justifying their status as a "Memory of the World" project. Their historical, archaeological, scientific and documentary quality is such that they have all the features of collections worthy of heritage status.

A lack of working instruments means that an on-site study is imperative in order to decide which documents meet the project's criteria, and then to describe and analyze them. This can only be done properly by specialists, whose opinions must be compared. Otherwise, only those documents traditionally assumed to be important would be chosen, with the obvious risk of errors and oversights, leading to controversy or even dispute.

A national committee has been set up to identify the most suitable documents. A demonstration disc based on a selection of manuscripts including some of the Koranic fragments is planned and should be ready within a few months.

5) Memoria de Iberoamerica

In November 1992, the "Asociacion de Bibliotecas Nacionales de Iberoamerica" (ABINIA) submitted a project called "Memoria de Iberoamerica" to UNESCO for the "Memory of the World" Programme.

A pilot stage of the project is concerned with protecting the nineteenth-century press published in Latin America and improving access to it for historians and interested members of the public.

ABINIA had previously organized a series of activities on the occasion of the Five Hundredth Anniversary of the Encounter between Two Worlds, in response to the desire to encourage appreciation of the documentary heritage of the Iberian world.

Among these activities was the compilation of a database indexing 90,000 books from the sixteenth to the eighteenth centuries, a travelling exhibition and the reissue of the most important historical works in the context of the Five Hundredth Anniversary.

The national libraries of seven countries (Brazil, Colombia, Costa Rica, Cuba, Nicaragua, Puerto Rico and Venezuela) are taking part in the project on the nineteenth-century press. It has led to the drawing up of a computerized inventory of some 2,000 newspaper titles and other press organs.

The second phase of the project will be to arrange for the conservation of the listed collections and their transfer to microfilm with a view to exchanges between national libraries, the organization of exhibitions and special publications. Several other projects are under consideration.

Technical context

From the examples mentioned above, it emerges clearly that the two basic principles which guide the "Memory of the World" Programme are the preservation of documents, holdings and collections and the democratization of access to them. The two principles are intrinsically linked, since access is conducive to protection and preservation ensures access.

The essential steps for carrying out any project in the "Memory of the World" programme are: selecting and preparing the documents, ensuring that they are placed in a suitable physical environment, photographing them where necessary, digitizing them, describing and annotating them, providing the staff to perform these tasks with appropriate ad hoc training where necessary, translating bibliographical descriptions where necessary, or even the texts themselves, and ensuring that the resultant product is distributed as widely as possible.

Provision has been made for the speedy establishment of two subcommittees, the first to make regular assessments of the technology that might be used by the Programme and the second to study methods for marketing and selling the Programme's products throughout the world.

Lastly, so that UNESCO can play its role to the full as co-ordinator and catalyst, three inventories in the form of regularly updated databases will be created in co-operation with IFLA, ICA and other competent professional bodies such as FID, FIAF, FIAT and IASA. They will be as follows:

1) an inventory of library collections and archive holdings which have suffered irreparable destruction;

2) an inventory of ongoing operations to protect documentary heritage; and

3) a world list of endangered library collections and archive holdings.

These three lists will take the form of databases periodically updated and will constitute the indispensable basis for the "Memory of the World" Programme.

Furthermore, UNESCO will shortly publish guidelines on the Programme's technical, legal and financial framework and its working structures.

Legal and financial framework

Working in partnership in an international context means that a legal framework is an absolute necessity if "Memory of the World" is to be managed in a properly accountable manner. The framework must nevertheless remain sufficiently flexible to guarantee the originality of each project and take account of the diversity of national legislation.

It is essential that the rights of the owners of the collections and holdings in a project are respected and that the relationship between the owners and the technical and commercial users is clearly defined, particularly with regard to the division of rights among the various parties, the allocation of rights of ownership to the images produced and the sharing of the profits from the sales of products made from images. It also seems clear, however, that excessive protection which might limit access to the documents would run counter to one of the Programme's fundamental principles.

Finally, with regard to financial support, an international fund will be set up within UNESCO to finance some of the Programme's projects. These will include, as a priority, projects with a regional or international dimension. Other projects which meet the agreed criteria could use the "Memory of the World" label without necessarily receiving aid from UNESCO or the fund.

Each "Memory of the World" project will be an entity in itself, especially as far as finance is concerned: each project must strike a financial balance between, on the one hand, the investment needed for digitizing, reproducing, and distributing products and for preparing the reproduced collections and holdings for conservation and, on the other, initial contributions from local or outside funds and royalties from the sale of products.

This balance will not be achieved without the participation of sponsors and technical and financial partners. The search for partners is an important, not to say decisive, phase of all "Memory of the World" projects. Profit can never be a prerequisite for carrying out a project.

Conclusion

As soon as it was launched, the "Memory of the World" Programme began to arouse great interest. Requests for assistance, sometimes even appeals for help, regularly reach UNESCO. It is a daunting task and only the mobilization of all the parties concerned can translate declarations of intent into a vast world workshop to rescue, reproduce and disseminate endangered documentary treasures.

From that point of view, the economics of the operation and the considerable investment it will require cannot be stressed enough. The twofold aim - securing the survival of the heritage and facilitating access to this collective memory so that it is within the grasp of as many people as possible - necessitates new approaches to funding, particularly through co-operation with the private sector. As Mr. Mayor said at the beginning of the Pultusk meeting, "Realism will be needed, but also daring and imagination".

Source: *"Memory of the World" Programme - First Meeting of the International Advisory Committee, Pultusk, Poland, 12-14 September 1993. Final Report. Paris, UNESCO, 1993 (PGI-93/WS/17)*

SONY

Sony Broadcast International
Jays Close, Viables, Basingstoke, Hampshire RG22 4SB, United Kingdom
Telephone (0256) 55 5 11 Fax (0256) 47 45 85 Telex 85 84 21

ANNEX 3

Re: Sony Mass Storage Systems.

Dear Sir/Madam

Thank you very much indeed for your enquiry regarding our new range of Digital Data Recorders.

We currently offer two distinctly different categories of mass storage products, those employing DAT technology for lower frequency, multi-channel, instrumentation applications, and the DIR-1000 Series of high capacity recorders which conform to the ANSI X3.175-1990 ID-1 standard.

Our ID-1 recorder is capable of storage of up to 100 Giga bytes on a single D-1 cassette tape, at speeds as high as 256 Megabits/sec. There are three models to choose from:

DIR-1000	10.7 - 256 Mb/sec	DM 470,245
DIR-1000M	16 - 128 Mb/sec	DM 243,200
DIR-1000L	8 - 64 Mb/sec	DM 158,400

Whilst the product itself is relatively recent, the technology involved has been available on a commercial basis since 1987 in the television broadcast industry. The DIR-1000 Series have already proven to be successful in a wide variety of fields including Remote Sensing, Radio Astronomy, RADAR, SONAR, Jet engine testing, and Government Security.

In addition to the recorders themselves, we are also able to offer a range of multi-cassette systems which provide capacity from 1.5 to 30 Terabytes, for mass storage applications.

DMS-16	Mass Storage System (1.5 Terabyte)	DM 115,500
DMS-24	Mass Storage System (2.3 Terabyte)	DM 115,500
DMS-300M	Mass Storage System (13 Terabyte)	DM 598,950
DMS-700M	Mass Storage System (30 Terabyte)	DM 874,775

Note: All prices quoted are for budgetary purposes only.

We are able to provide several System Solutions including VME, and SCSI-2 controllers and a UNIX based File System to complement our mass storage product line.

Further details of the ID-1 Format and the products and services that we are able to offer is outlined in more detail in the attached document which I sincerely hope that you find to be both informative, as well as interesting.

We at Sony are very keen to learn more about your potential application, and would therefore welcome any further questions that may arise.

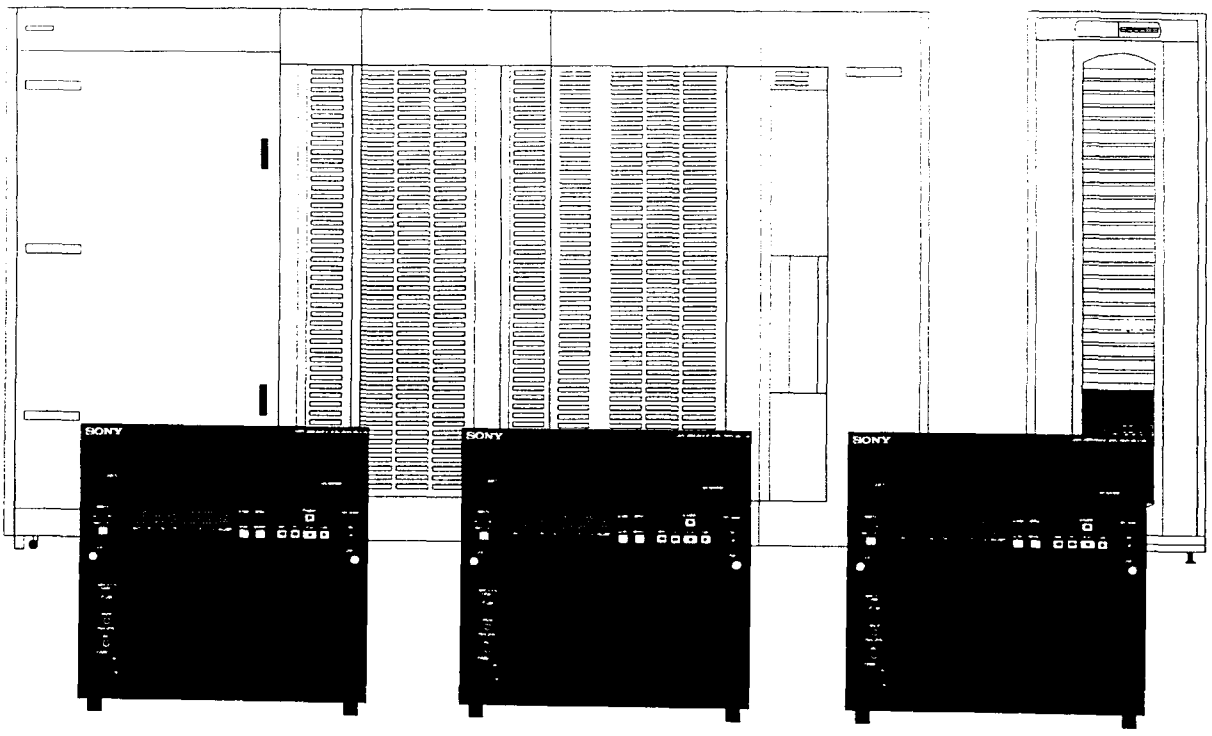
I can assure you of my best personal efforts on your behalf.

Yours sincerely

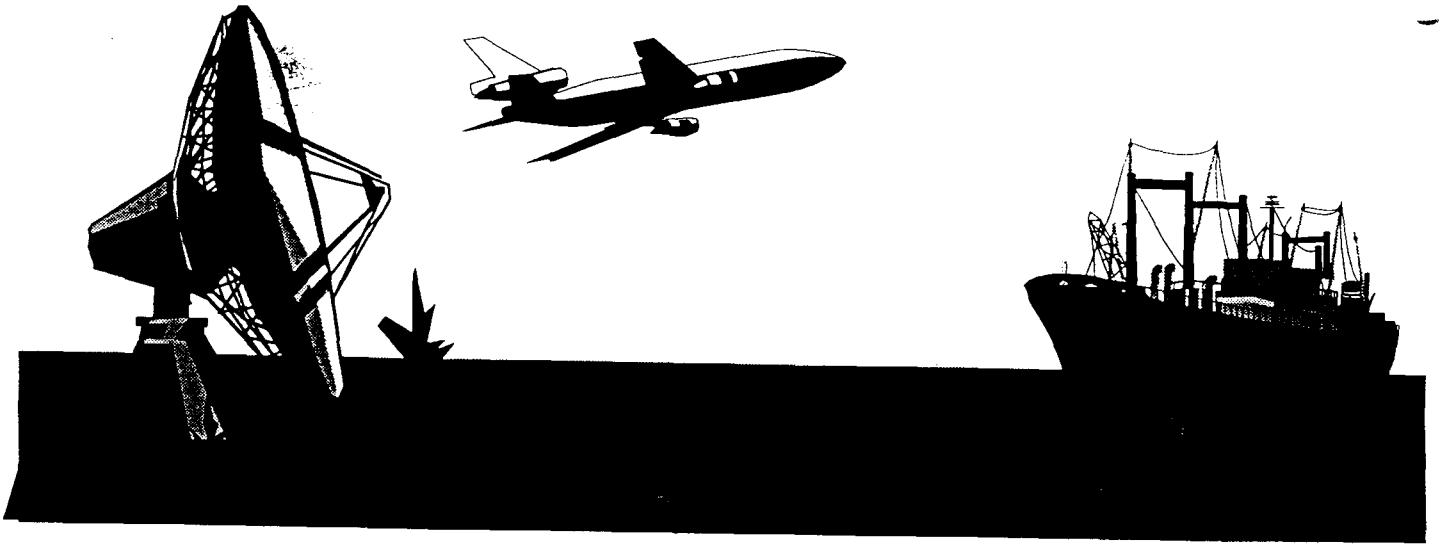
Allan Arthurs
Senior Product Manager

SONY

DATA RECORDER



MASS STORAGE SYSTEMS



Sony Broadcast
International

Sony: High Performance Mass Data Storage

Background

Having come to rely almost entirely on video recording technology for a wide range of applications, it was in the early eighties that the broadcast television industry took the first steps towards the development of the world's first digital video recording format. In 1986, the joint efforts of the SMPTE and EBU groups, together with several manufacturers, resulted in the formalization of a CCIR standard which has since become widely known as D-1, or the 4:2:2 standard.

The first production model was introduced in 1987. Since then the format has become widely used within the broadcast industry, with products available from multiple sources and the development of second generation models.

D-2 followed in 1988 and today both formats are in everyday use in broadcast and video production facilities around the world. Both are 19mm cassette based helical scan recorders, but differ in respect of the coding scheme used in the video domain.

D-1 is a component video recorder and tends to be used for the more complex program production applications while D-2, a composite video recorder, is better suited to today's terrestrial broadcast systems. D-1 is based on a high coercivity oxide tape formulation while D-2 utilizes a metal particle tape.

These developments did not go unnoticed amongst users of instrumentation recording equipment, and in 1985 the American National Standards Institute (ANSI) started working towards the standardization of a digital instrumentation recorder based on D-1.

The format was finally agreed and the standard published in 1990. Although it is true that the origins of ID-1 are firmly rooted in the D-1 video format, there are indeed several significant differences and it would be a mistake to link the destiny of the two formats in any way.

In recognition of the fact that there has been something of a proliferation of similar, but nonetheless incompatible, data recorder formats over a period of many years, it would seem that there are several advantages to be gained through standardization.

Advantages of Standardization

By keeping the number of formats to a minimum:

- Reduction in the number of different models, and hence a increase in the production quantity per model, resulting in uniformity in terms of quality, lower cost and higher reliability.
- Greater opportunity for multiple manufacture.
- Interchange between users.

The Format

The on-tape footprint described by the ID-1 format is shown in FIG 1. The geometry of the various tracks is the same as for the D-1 video format. However, unlike D-1, the ID-1 format utilizes azimuth recording techniques whereby adjacent helical tracks are recorded at different azimuth angles to minimize the effects of miss-tracking for greater reliability on interchange.

The control track is primarily used as an off-tape reference for the servo system during replay, but in the case of the ID-1 format it also contains a 23-bit binary address for each set of four helical tracks which to identify individual track sets on the tape.

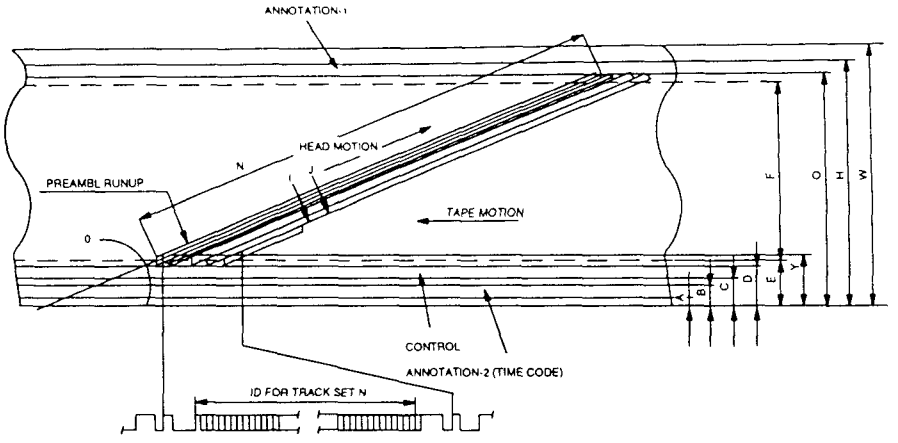
As shown in FIG 2, each sector recorded on the helical tracks consists of a preamble, 256 sync blocks and a postamble.

The preamble starts with a run-up sequence, followed by the sync pattern for synchronization, the track set ID and an auxiliary data area.

Each sync block starts with a sync pattern for synchronization, followed by an ID, an 153 x 9-bit source information and a 72-bit inner error code.

The postamble contains the same sync pattern and ID information as the preamble.

Data recorded on each track on tape is processed by two Reed-Solomon product code arrays. The data is interleaved within the track to minimize the effects of larger dropouts. Each array is configured for 128 by 162 Bytes, of which 118 by 153 Bytes are allocated for recording of user data.



	Dimensions	Millimetres Nominal
A	Time-code track lower edge	0.2
B	Time-code track upper edge	0.7
C	Control track lower edge	1.0
D	Control track upper edge	1.5
E	Data-area lower edge	1.8
F	Data-area width	16
G	Annotation track lower edge	18.1
H	Annotation track upper edge	18.8
I	Helical track width	0.045
J	Track pitch: basic	0.045
N	Helical track total length: basic	170
O	Track angle: arc-sine (16/170) basic	5.4005°
W	Tape width	19.01
Y	Data-area reference line: basic	1.8075

The helical track azimuth is 15°

Figure 1. The ANSI ID-1 format. Tape footprint.

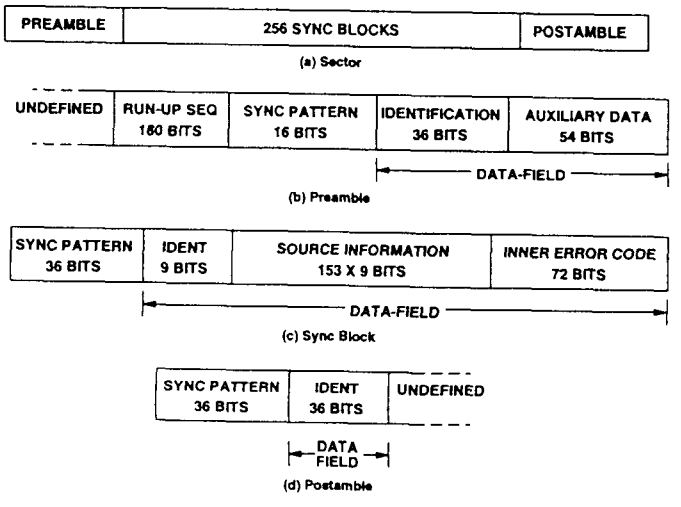


Fig 2. Helical data

Total user data is 2 x 118 by 153 or 36.108 kBytes per track, or 144.432 kBytes per track set.

Each track set occupies approximately 1.91mm in the longitudinal direction. The L-size cassette holds 1,300m of tape, the maximum data capacity is therefore just under 100 GBytes on a single cassette.

The error correction scheme has been designed to provide corrected bit error rate of 10E-10, assuming some margin for the earlier SMPTE D-1 tape error model.

Implementation of an ID-1 Recorder

The first Sony ID-1 recorder, the DIR-1000 ,was produced in 1990 and since then a further two models have been introduced. The key design performance specifications are summarized in FIG 3.

Parameter/Model:	DIR-1000	DIR-1000M	DIR-1000L
Recording Format	ANSI X3.175		
Cassette Tape	19 mm type D-1 standard cassette Large/Medium/Small		
Recording Capacity	Max 770 Gbits (L-Cassette) Max 330 Gbits (M-Cassette) Max 100 Gbits (S-Cassette)		
User Data Rate (Mb/sec)	256 128 64 32 16 10.7	128 64 32 16	64 32 16 10.7 8
Bit Error Rate (corrected)	1 x 10E-10 (std)	1 x 10E-13 (re-try)	
Data Assurance	Read-after-write (Data and CTL) (Data and Track Set ID)		
Tape Loading time	Less than 14 sec		
Servo Lock-up Time	Approx 2.5 sec from stand-by Approx 10 sec from stop		
Tape Shuttle Speed	L-Cassette: Less than 180 sec M-Cassette: Less than 90 sec S-Cassette: Less than 45 sec		

Recording Time/Tape Speed

Data rate (Mbps)	Recording time (hr: hours, min: minutes) L-size	M-size	S-size	Tape speed (mm/sec)
256	80min	20min	7min	423.8
128	1hr 40min	45min	15min	211.9
64	3hr 20min	1hr 30min	30min	105.9
32	6hr 40min	3hr 00min	1hr 00min	53.0
16	12hr 30min	6hr 00min	2hr 00min	26.5
10.7	20hr 20min	9hr 00min	3hr 00min	17.7
8	27hr 00min	12hr 00min	4hr 00min	13.25

Fig 3. DIR-1000 series key performance parameters

Despite the similarities to D-1, it was decided early on in the development to design a new, purpose built , tape transport. This clearly major decision was taken after considering three main factors: tape path, loading mechanism and ease of signal processing.

In the case of the D-1 product the tape wrap angle is 270 degrees. However unlike a VTR, the ID-i recorder is required to record (and playback) at various data rates while maintaining the same tape footprint and this means that the rotary speed of the scanner and the linear tape speed need to change proportionaly. The smaller the wrap angle, the easier this is to achieve. In addition it is highly desirable that the tape path be constructed on a single plane. For any helical recorder, the deviation in the height of the tape path above the entry and exit plane varies as a function of the helix angle. By inclining the entire scanner assembly (thereby minimizing the deviation in the height of the tape path around the scanner) and adopting a smaller wrap angle (larger diameter scanner) the deviation is small enough to allow the use of a simple two- dimensional loading mechanism on a single plane, as shown in FIG 4.

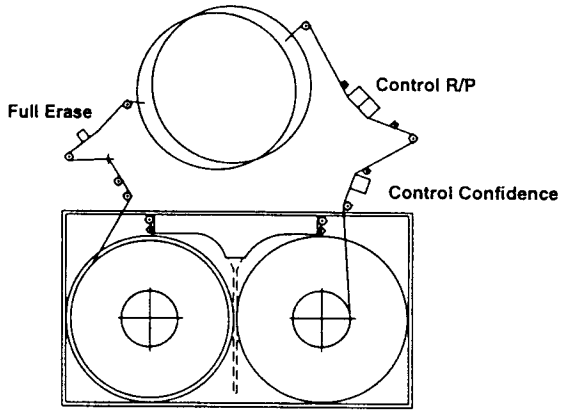


Fig 4. DIR-1000 tape transport

The loading mechanism is designed to handle all three sizes of the D-1 cassette shell. The reel tables move automatically along two guide rails to align with the spindle pitch in accordance with the type of cassette loaded, a technique quite common in the professional broadcast field.

The scanner itself is made up of three separate parts, only the inner drum (or wafer) on which the heads are mounted rotates in contact with the tape. This three-part construction offers the highest degree of tracking accuracy. The spinning wafer presents a very low mass for external forces to act upon, it is highly reliable and simple to replace. Higher manufacturing costs however need to be justified by volume production.

The heads are configured in pairs for recording and playback as shown in FIG 5. Up to sixteen heads are mounted on the inner drum.

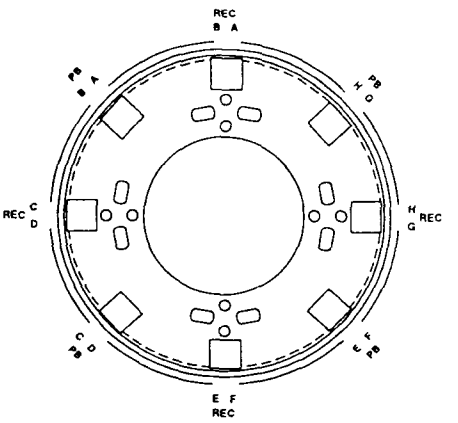


Fig 5. DIR-1000 head configuration

Separate record and playback head pairs allows for read-after-write and confidence playback while recording.

The use of a 180 degree wrap angl, enables the processor to be time shared between two heads, since only half are in contact with the tape at any one instant.

Data is processed at a maximum rate of 10 MBytes/sec per channel, and the maximum head-to-tape data rate is about 88 Mbits/sec per head, just under 360 Mbits/sec which corresponds to a maximum user data rate of 256 Mbits/sec allowing for the required overhead for error correction.

Several dedicated LSIs (Large Scale Integrated circuits) were specifically developed, for example the Reed-Solomon encoders and decoders which form the heart of the processor. These are CMOS devices, the larger of the two incorporating over 35,000 gates.

The three models in the series offer a range of user data rates from 8 Mbits/sec to 256 Mb/sec to realize a spread of potential user applications. The three models differ primarily in respect of the number of heads used and the amount of signal processing and equalization involved, resulting in considerable cost savings.

Logical File Format

Whilst the ANSI ID-1 Standard provides the fundamental Media Format on which the product is firmly based, several computer peripheral applications demanded the addition of an appropriate Logical File Format to ensure the highest level of data security and interchange.

Sony has recently introduced a Logical File Format to enable data interchange on the ANSI standard 19 mm ID-1 Media Format.

This File Format can be embedded into various interface solutions to enable the DIR-1000 series to operate effectively as a computer peripheral.

The File Format offers several key benefits:

Fast File Access

Volume and Directory Information Tables recorded on the leader of the tape for fast file search.

High Data Reliability

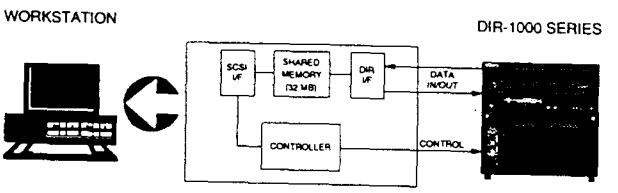
Improved bit error performance through Automatic Write Retry yielding an improved bit error rate performance of better than 1 in 10E-13

System Interfaces

The standard recorder provides an 8-bit parallel Data Input/Output port, with additional lines for clock, sync, parity and an error flag. Comprehensive remote control facilities are provided via a selection of interfaces including RS-422, RS-232C, and IEEE-488 (GPIB).

Whilst several highly specialised applications have called for the development of application specific interfaces, most commonly developed by third party System Integrators, Sony also offers a selection of standard system solutions which include SCSI-2 and VME bus controllers.

DFC-1500 (SCSI-2 Controller)

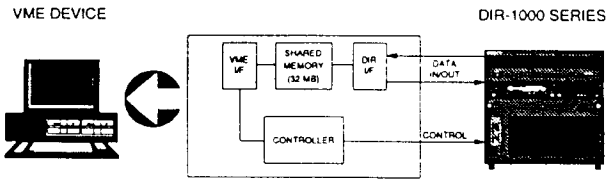


This small, stand alone external unit is equipped with a cache buffer memory of 32 MBytes, is capable of supporting recording data rates up to 64 Mbits/sec (8 MBytes/sec) and is ideally suited for use with the DIR-1000L model.

A built-in standard SCSI-2 interface is provided for simple connection to a wide range of workstations.

The unit incorporates, as an option, the Sony File Format for data interchange, high speed file search and the highest level of data reliability.

DFC-1400 (VME Controller)

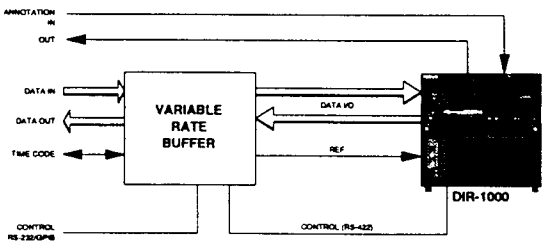


A VME Controller on a standard 6U board, incorporating a 32-MByte buffer memory which can be expanded using plug-in SIMS to 128 MBytes.

This VME controller is capable of supporting a sustained data rate of up to 128 Mbits/sec (16 MBytes/sec). It can operate either as a Master or Slave on the bus and supports both simple transport commands as well as a higher level macro command set.

In addition to the "Computer Peripheral" interfaces described above, Sony will shortly introduce a variable rate buffer more appropriate to several instrumentation applications.

DFC-1800 (Variable Rate Buffer)



A highly versatile Variable Rate Buffer suitable for a variety of instrumentation applications will soon be available. The DFC-1800 is an external unit (424 mm X 100 mm X 645 mm) capable of matching the user data rate with one of the fixed rates supported by the DIR-1000 Series.

It provides the standard 8-bit parallel data I/O interface as well as a serial data interface and an optional VME Bus interface.

An additional interface is provided for an IRIG Time Code Channel, the user's timecode data being recorded within the helical data tracks and updated incrementally in each track set.

The unit can be configured with 64 MByte, 128 MByte or 256 MByte buffer memory using industry standard SIMS to cover the entire range of data rates supported by the DIR-1000 Series.

The product also provides a unique "Reverse Replay" facility enabling up to 256 Mbits/sec (burst) or 120 Mbits/sec (sustained) to be replayed in reverse for some remote sensing applications.

Mass Storage Systems.

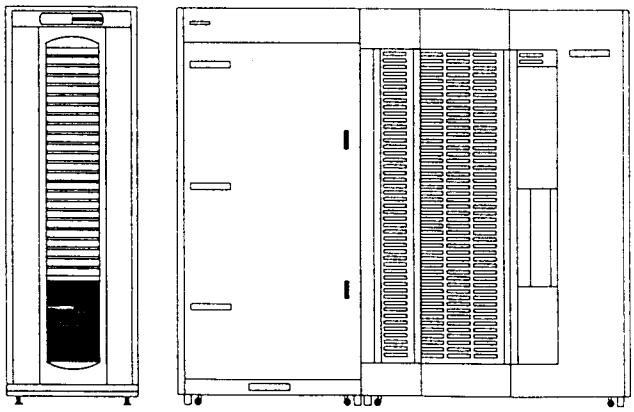
As a cassette based format, ID-1 is ideally suited to many styles of operation, from stand alone recording to fully automated, large capacity, mass storage systems.

By integrating the ID-1 recorder into a range of multicassette systems similar to those already widely used amongst broadcasters for automated library management and transmission, Sony is able to offer systems providing storage capacity from 1.5 to 30 Terra Bytes for mass storage applications.

These Digital Mass Storage Systems can be configured with several recorders and are capable of accessing any cassette in the system in a matter of seconds.

We currently offer three models:

- DMS-24 — 1.5 Terra Bytes - 2.3 Terra Bytes
  3.5 Terra Bytes/m^2
- DMS-300M — 13 Terra Bytes
  6.1 Terra Bytes/m^2
- DMS-700M — 30 Terra Bytes
  8.9 Terra Bytes/m^2



DMS-24 & DMS-300M

MDFS (Mass Data File System)

In addition to the hardware, Sony will shortly be introducing a comprehensive system for the storage and management of mass data based on the DIR-1000 Series recorders and the DMS range of multicassette systems.

The software to be introduced in the European market in August 1994 is to be based on an industry standard UNIX workstation, most probably the SUN SPARC 10 Series.

The system incorporates the Sony DFC-1500 Recorder Controller with SCSI-2 interface with the embedded Sony File Format as the primary interface to the recorders.

MDFS supports standard UNIX commands as well as some expanded commands for library management and recorder control. File access is via standard NFS (Network File System) using either Ethernet or FDDI network interfaces.

Facilities include Partial Staging, Database Search, File Delete/Restore and File Revision Control, as well as a comprehensive range of diagnostics including Data Error Rate Reporting and Database Reporting.

The concept is one of a Virtual Hard Disk, such that MDFS appears as a "very large capacity, sequential access disk" is shown below in FIG 6.

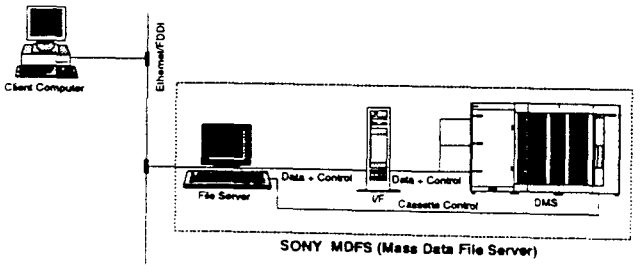


Fig 6

Recording Media

Sony offers the appropriate 19mm recording media for use with the DIR-1000 range. At present, the standard (D-1) broadcast quality, digital video tape is available in several models offering recording capacity from 12 GBytes to 96 GBytes per cassette.

Data Cartridge

While current professional broadcast video media is perfectly adequate for a number of instrumentation applications, Sony has recognised the need for a significantly higher performance "Data Cartridge" for the growing number of computer peripheral applications.

The new Data Cartridge boasts a new formulation for improved reliability, durability and error performance. The medium is packed in a new high-performance shell for improved resistance to both heat and impact.

Two models will be available initially:

SD1-600 M	Medium-size Cassette	40 GBytes
SD1-1300 L	Large-size Cassette	100 GBytes

Technical Support

Sony has developed the product and the appropriate infrastructure to provide the highest level of support for these specialist products.

User Replaceable Units

The DIR-1000 Series offers a comprehensive "Self Diagnostics Package" capable of detecting and reporting abnormal system utilization, and faults down to the level of "User Replaceable Units".

A selection of User Replacement Units are available to enable a high level of maintenance to be carried out by the user in the field:

- URU-D1000 — Inner Drum kit for DIR-1000
- URU-D1000M — Inner Drum kit for DIR-1000M
- URU-D1000L — Inner Drum kit for DIR-1000L

Sony guarantees the Inner Drum for 500 Hours, the expected head life is between 1000 and 2000 hours depending on the nature of usage and the local environment.

- URU-B1000E — Set of common replacement boards
- URU-B1000 — Set of replacement boards for DIR-1000
- URU-B1000M — Set of replacement boards for DIR-1000M
- URU-B1000L — Set of Replacement boards for DIR-1000L
- URU-T1000E — Set of common replacement mechanical parts

In addition, there are two "Calibration Tapes" available for use in the diagnostics mode:

- DKCT-2 Mechanical Alignment.
- DKCT-5 Electrical Alignment & System Diagnostics.

Field Replacement Block Scheme (FRB)

Sony Broadcast & Professional Europe offer a FRB scheme to all users of DIR-1000 Series recorders whereby faulty assembles can be replaced within a period of (typically) 48 hours.

Service Contracts

Sony Authorized Service Centres are able to offer comprehensive Service Contracts designed to specific customer requirements.

Technical Training

Sony Broadcast & Professional Europe offers comprehensive technical training courses. These can be provided at our facility in Basingstoke or on the customer's site as required. The maintenance training course for DIR-1000 Series is of approximately three days duration.

Conclusion

I trust that you will agree that our product line is designed to provide a high degree of customer satisfaction by maintaining the highest possible level of availability, reliability, and maintainability.

While the product itself is relatively recent, the technology involved has been available on a commercial basis since 1987 in the television broadcast industry.

The recorders have already proven to be successful in a wide variety of fields including Remote Sensing, Radio Astronomy, RADAR, Jet engine testing, Air Traffic Control, Sound & Image Archive, and Government Security. There are currently over 300 DIR-1000 Series recorders in active use worldwide. The product is mature and readily available.

For more information please contact your local Sony Broadcast & Professional Products representative, or you can contact me directly at Sony Broadcast & Professional Europe:

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SONY

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SONY

FOX SAVES IRREPLACEABLE HISTORIC NEWSREELS WITH SONY'S STATE-OF-THE-ART DIGITAL DATA RECORDING TECHNOLOGY

Sony's High Capacity, High Speed DIR-1000 Digital Data Recorders Used to Preserve 60 Million Feet of Historic Movietone News Footage

8 September 1993 - **Twentieth-Century Fox** and Sony are making history by using the newest digital data recording technology to preserve the world's oldest and most comprehensive collection of news films, the Fox Movietone Newsreel Library.

In the first application of its kind, Fox is using four Sony **DIR-1000** series digital data recorders with a unique digital progressive scanning system to digitally restore and archive more than 10,000 hours of deteriorating, irreplaceable black-and-white newsreel footage dating back to 1919. Fox is taking advantage of the Sony digital data recorder's extensive storage capacity and high transfer rate to store the massive film library as digital information.

According to Andrew Setos, senior vice president of Fox, Sony's digital data recording technology is essential to meet the challenge of preserving the 60 million feet of film. "Each frame of the 10,000 hours of newsreel footage is an individual 1.3 megabyte picture which must be scanned, digitised and recorded as data. With this much film to scan, we need to record the digital pictures at the same 24 frames-per-second speed that we play the film. Sony's DIR-1000 can record at this speed and handle such vast amounts of information."

- more -

"Without ID-1 digital data storage technology, the project would be economically unfeasible." Setos continued. "The traditional method of preserving fragile newsreel footage is to copy the original film on to special safety-base film, but printing 60 million feet of film to film would require over a decade and tens of millions of dollars." Setos estimates the conversion of the entire American library will take approximately one year.

The scanning system converts the films to digital images, which are recorded on to magnetic tape via the DIR-1000 recorders. The DIR-1000 can store up to 96 gigabytes of uncompressed data on a single 19mm cassette - equivalent to 170,000 novels of 350 pages each.

The DIR-1000 also has the flexibility to record and play back digital information at data rates up to 32 megabytes-per-second - equal to recording the entire text of *War and Peace* in less than half a second.

Thanks to Sony's ID-1 digital storage techniques, copies of the original newsreel footage will be of equal or greater quality to the deteriorating film images, and duplicate copies will experience no loss in resolution or image quality, an important point in the preservation of the Movietone collection.

Digital recording also provides the Movietone collection in a computer readable format. When converted from film to the digital form, the newsreels can be easily accessed by computer and integrated with other digital information, such as graphics, text, digital audio and video.

Applications in which the DIR-1000 is typically used include: test and measurement (jet engine testing, telemetry, geophysical studies), signal intelligence (sonar or satellite tracking, telecommunications monitoring), simulation (process simulation, crisis management), imaging (medical imaging, computer animation, planetary mapping), and data archiving (scientific research and large reference libraries).

ENDS

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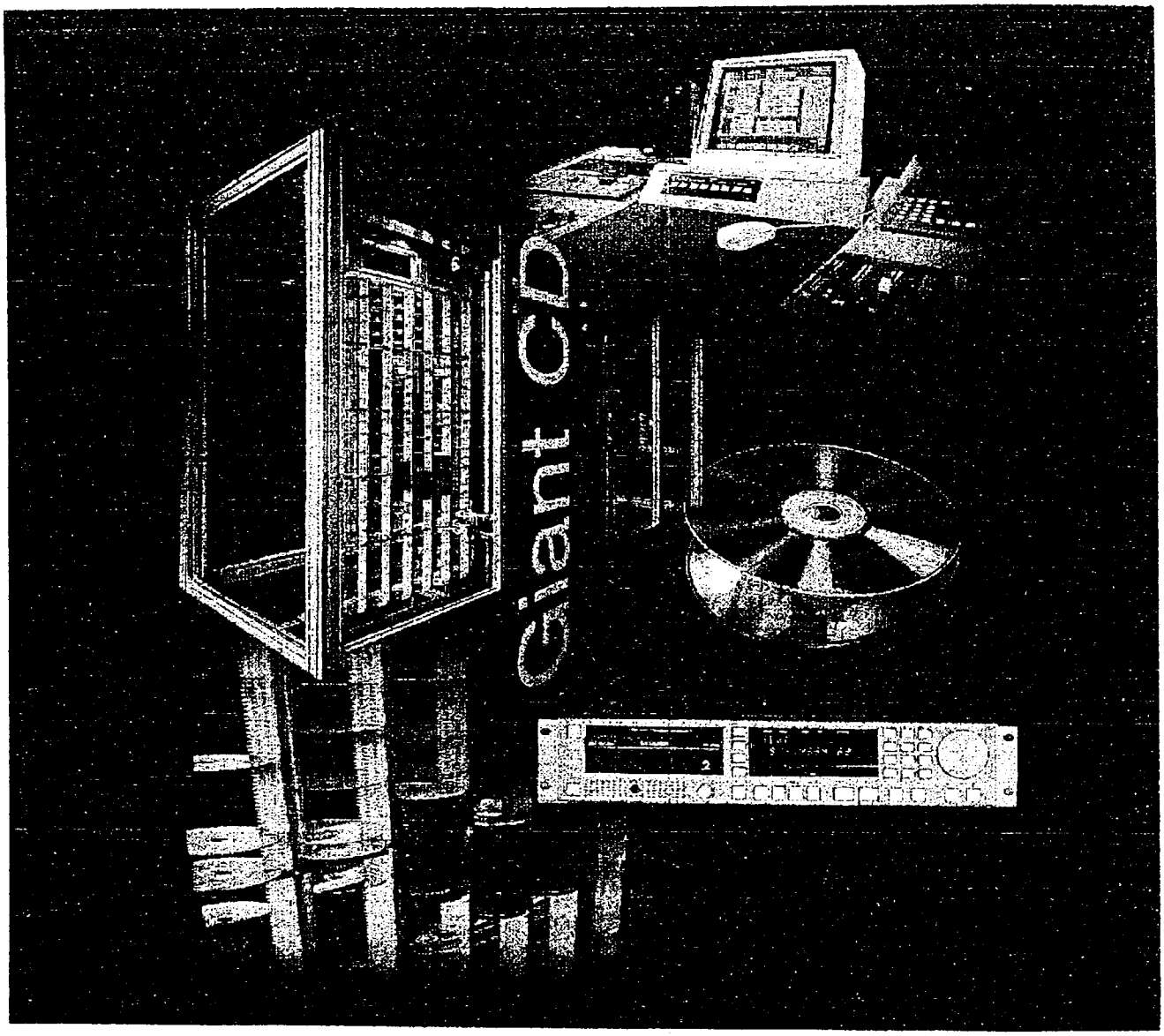
ANNEX 4

STUDER
PROFESSIONAL AUDIO EQUIPMENT



GIANT CD
Professional CD-Changer

STUDER GIANT CD - Professional CD-Changer

Which media for automation?
There are many reasons why automation is becoming more and more important for broadcasters. Automated broadcasting requires a mass storage medium - a digital medium which is cheap and yet of highest quality. The only medium which is able to fulfill this and other important requirements is the Compact Disc - furthermore the CD-R, which has potential and could become the cheapest recordable medium.

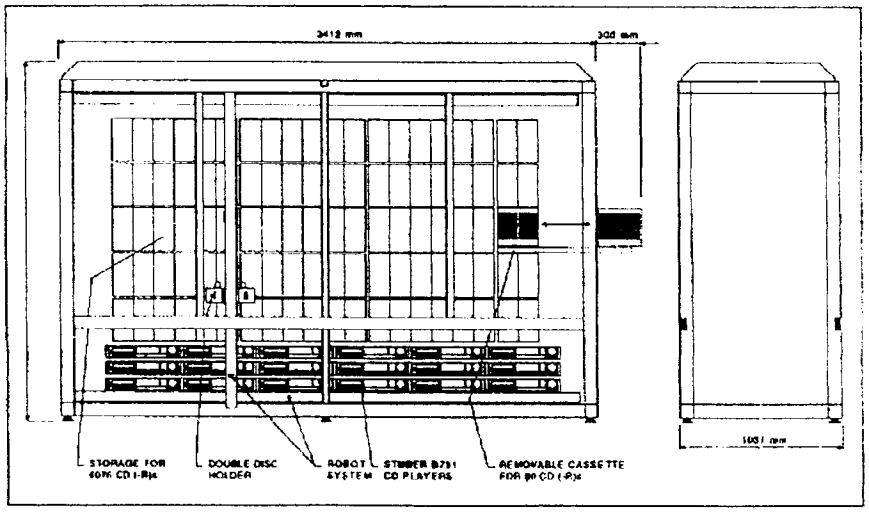
Which CD-Changer for professional applications?
Preferably a changer which is designed to match the expectations of the broadcasters:

- A capacity of more than 6'000 CDs and CD-Rs (or a total of about 100'000 titles) and an interchangeable cassette for 80 CDs and CD-Rs which can be loaded without interrupting the running programme.
- Up to 18 built-in CD-drives offering multi-user applications without limitations.
- Housed in a transparent illuminated box with a slightly higher air pressure inside to protect the system from dust and to make visible checks possible.
- A Swiss high precision robot system with two axis linear servos and brushless stepper motors.
- A double disc holder, which allows the exchange of a disc (loading / unloading) in one movement or the transport of two discs at the same time, and additionally assures redundancy for the system.

That's what the STUDER GIANT CD offers you, and even more, because the CD-drives are of the already well proven STUDER D731 CD-Player types:

- CD-Rs playable without TOC
- SKIP functions of CD-Rs are interpreted from TOC
- Excellent playability performance
- CD-quality warning
- START-/MID-/END-review functions
- Professional analog and digital outputs
- AES/EBU output with an optional sampling rate converter, which can be synchronised to an AES /EBU reference signal. This is very important for DAB, where 48kHz will be standard for the future.

STUDER GIANT CD - the professional answer to the question of mass storage in broadcast automation systems.



Ordering Information
GIANT CD: 60.052.32001
(CD-Players D731 are not included; electronics in separate rack on special request)

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STUDER
PROFESSIONAL AUDIO EQUIPMENT

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