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INTEGRATING OPTICAL STORAGE:

VIDEODISC, CD, AND CD-ROM

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Seminar Notes

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Eric Brown
LaserData, Inc.

James DeVries
LaserVideo

Mark Heyer
Mark Heyer Associates

Integrating Optical Storage: Videodisc, CD, and CD-ROM

James DeVries - LaserVideo, Inc.

DeVries described his business as a type of 'optical printing'. They put people's information out through the optical media and are involved in the production of master and replicates of all forms of optical discs. Historically, text was distributed first through print and then by magnetic means. Now the optical medium is another method for text distribution. The optical medium right now is composed of VideoDiscs (VDs), Compact Discs (CDs), and Optical Memory Discs (OMDs).

DeVries stated that there are technologies for integrating analog/digital storage and for combining image, sound, text, and computer programming. All that is needed is a CD player, a VD player, a computer, a RBG monitor, a computer monitor, an amplifier, speakers, a frame grabber, and all the necessary interfaces. However, this system is not low cost nor is it convenient. Advancement in this direction of integration has been curtailed because of the diadvantages of high cost and inconvenience. One of the reasons for the difficulty in integrating is that the three areas of VDs, CDs, and OMDs have been developed somewhat independently. In addition, communication between people working in these three areas has also been minimal. People in one area don't care about the other and are not really interested. As an example, DeVries said that prior to the VDs, video people never paid any attention to audio because the broadcasting on audio and TV was of poor quality. Now all of a sudden, video people have to produce a video tape that is going to be used on a VD. As a result they produce video tapes with very poor audio quality.

VDs were originally introduced by Phillips around 1978. However, it was thougnt of as just another method to deliver movies to the home. As a result, the first VD machine did not even take advantage of the ability to search to a particular frame on the VD (it didn't have the controller to do that). Subsequently Sony introduced industrial models that had the ability to grab a 1000 or 5000 program off the VD to be used for interactive training and industrial training, commercial marketing, point of sale, and military uses.

DeVries then moved on to describe the CD which was invented in 1983 and introduced to the US by Sony. He said the CD was a perfect way to deliver radio programming, since a lot of radio stations are basically computer operated. They stack up their music on tapes and CDs. If the interspersing audio messages have been pre-recorded, only one person is required in the studio to keep the system operating. The beauty of the CD is the rapid accessability to any particular track, and very good fidelity. The selection and cueing up of the music is done by the computer. He said that the music market has really "taken off" with the introduction of CDs. Last year LaserVideo, Inc. (LVI) sold about 15 million CDs in the US. Projections for this year and next year are 40 million and 80 million respectively.

The OMD nas been somewhat slow in coming. He said that it has been "two years away atleast, for the last four years". The CD-ROM (Compact Disc Read Only Memory) is the same size as the music CD but instead of putting music, it has data stored on it. The CD-ROM is used for database, publishing, storage, and customised memory discs. Other types of optical discs are the write once discs and the erasable discs. He said that some companies are now marketing write once discs with 100-200 mega bytes.

DeVries then spent some time describing the method of manufacturing optical discs. The injection molding process, though very capital intensive, gives lowest unit cost for long runs. There is a process called 2P which is photo polymerization. This gives more consistant quality, and is better suited for medium sized runs. It is more expensive than injection molding and there is only one company doing this, namely 3M. LVI developed its own process which is good for short runs. It is a sort of photo lithographic process. They also have a method for making playable masters.

DeVries described in detail the unusual VD manufacturing process for producing master disc as well as replication. The 14" diameter glass is coated with photo resist. While spinning at a high speed (VD about 1800 RPM, CD about 600 RPM) the disc is subject to a laser beam that has been modulated by the signal. The photo resist that has been affected by the laser beam is subsequently developed. Then a thin film of aluminium or nickel is deposited to make the surface conductive. This is followed by an electroforming process to separate the stamper from the glass master. The stamper is used in the injection molding process to replicate the disc. The manufacturing process used by LVI involves a glass disc quoted with metal (chromium) followed by photo resist. The rest of the process is somewhat similar to the standard method. DeVries mentioned that LVI does custom mastering for optical disc developers at reasonable rates. He stated that there were lots of people developing all kinds of optical discs ranging 3 1/2", 5 1/4", 12", and 14" and they all need 'masters'. In addition LVI sells substrates, some pre-grooved and others pre-formatted.

DeVries with the aid of a slide described the nature of 'pits' in a VD. When using analog signals the width of a pit is 0.5 um and the disc is read at a speed of 9.3 million pits per second. He also showed a slide of the arrangement of pits in a VD having a digital signal.

DeVries showed slides of LVI's manufacturing plant and described each production stage. He emphasized the importance of ultra fine clean rooms. This is necessary because any little particle can cause defects in the discs being produced. The whole process has 11 quality control points from the first stage of glass substrate upto the final packaging and wrapping stage.

He then discussed the need to integrate all these technologies namely the VD, CD, and CD-ROM. Currently it is technologically feasible though not economically so. He stated that integration research requires significant R&D investment, but at present there did not appear to be a sufficiently large market to support/justify this level of finance. He said that

LVI currently spends 90% of its time on the music market which is its immediate market. As a result, other development he predicted would take time. From the consumer's point of view, inorder to have an integrated system, you need the various disc players as well as the computers to go with it. He stated that there was no real standard to make it all work effectively, and no one system has enough software to make it attractive to buyers. He suggested that what we need now are combinations of technologies that meet the needs of users sufficiently to create a mass market.

Eric Brown - Laser Data Inc.

Brown began by referring to his work while at MIT where they looked at video discs as a means of publishing very large databases out to a number of sites. In this context he referred to the 'Aspen project' as an example. At the time he did his work at MIT, he said that the idea of taking a giga byte of information and making 50,000 copies of it available at local sites was a little absurd. However, now it is a little more reasonable to consider that kind of idea and CD-ROM is certainly underscoring that kind of potential.

Brown then described two types of discs. First the replicated discs which are very much akin to publishing. They are less expensive when you make many copies rather than just one. Second, the writable discs which are similar to using a typewriter, and are best for making single copies. This he called WORM (Write Once Read Memory) discs, which are also called DRAW (Direct Read After Write) discs. He restricted most of his comments to optical publishing using replicated discs.

In the world of optical replicated discs there are the analog and digital discs. While the material is similar, the method of encoding is different. That does not mean that an analog disc cannot contain digital information. Infact CD is a digital medium which is ultimately carrying an analog signal. The differentiation is somewhat blurred and what one should look at, he said, is the information that is being stored. He said that data could be manipulated and we could store whatever we want.

Brown discussed hybrid video signals that contain both video and digital information. He cited teletex and videotex as being good examples of early versions of that sort of mixture where a little bit of data is hidden at the top of every frame. The two signals don't have anything in common except that they share the same channel space. He stated that 'closed caption' is a better example of a hybrid video signal where unlike in teletex or videotex, here the data relates to the video. It is a computer controlled coordination of both video and data. More advanced machines combine the audio channel with the video disc delivering a simple interactive program.

He then considered what could be done in terms of technology. Swinging to the other extreme he looked at pure data publishing. While at MIT together with a colleague he had looked

at VD-ROM and not a hybrid video. At that end of the scale for data only publishing VD-ROM had a cousin in the industry namely CD-ROM. Both were entertainment and mass market medias in a consumer sense till economies of scale adapted them to be used for data publishing. The initial application for these types of databases are electronic publishing. They tape predominantly texts, numerics and data. As people have tried to push the technology further, they have taken digitized images converting it to data. However this cannot be called a hybrid disc. Brown claimed that these were just CD-ROM with digitized data which effectively are data only. He then mentioned their work where databases were augmented by video imagery working back as an optical video disc. This he called a hybrid video disc. Referring to CD-ROM he said that though you could store digitized images it was much less efficient. At the very extreme where it requires to have an application for full motion video, CDs are not appropriate. He projected that in the long run everyone would have adopted CD-ROM or some other small optical disc standard. CD-ROM though suitable for still images will not be appropriate for full motion video.

Brown referred to the Aspen project as an example of a visual database. He said that while at MIT they looked at 'Aspen' as a potential target for the hybrid disc. The disc although very compact required a 32 bit mini computer and a very large disc drive in order to maintain the database. What would have been ideal to have was a frame with a detail description of the picture. This would have required a uniform distribution of video and database with each frame as a hybrid piece of video. He then cited a notable example of demand or interest in hybrid video discs. This is the EIDS (Electronic Information Delivery System) project as described by the army. The Army's aim is to establish a standard by which they can distribute visual and digital information in training sites to operate equipment.

Finally, he described the work being done by Laser Data Inc. and demonstrated such a system comprising of a PC, video disc player and a Laser data box. In the CD is a single board for the IBM PC which they call the 'PC Trio'. It (1)controls the video disc player such that you get the standard video disc features such as play, fast forward, reverse, etc., (2)reads digital data off the disc that has been encoded, and (3)if the digital data represents digitized and compressed audio you can play it.

Mark Heyer - Mark Heyer Associates Inc.

Heyer began by claiming that microcomputers and the associated technology are only a means to reaching an end which is the possibility of addressing the human brain and intellect directly. To underscore his statement he drew a parallel between the main frame computer and the steam engine. He said that one main frame could power an entire information factory, but again

like the steam engine, the power itself may be largely inaccessible to individuals. Further developing this theme, he compared microcomputers to the early cars both of which clearly showed the outline of something very useful, and yet we don't understand the complete nature of the 'beast'. The important thing is not the vehicle itself but the destination that it helps man reach.

He then referred to the great CD-ROM debate and all the enthusiasm generated. While the CD-ROM is capable of storing large volumes of data, it doesn't have bandwidth to hold motion video information. It is widely recognized that this technology has a significant future. However, it will take some time to be fully developed. In this context he referred to the 'Aspen Project' as a landmark in the history of information technology.

An area of information technology that is very necessary is its application to achieve a creative workplace. Until now this has been somewhat limited. Heyer claimed that the "conception, design and production of interactive programming is the newest challenge to face the creative producer". He further said that while interaction with tape is limited, with videodisc, when complex still frame sequences are integrated with motion, a whole new world of creative control opens up. All interactive programming involves the cooperation of three groups which have not traditionally worked together: Interactive designer, Video producer and the Computer programmer.

Heyer stated that, in addition to the reduction in creativity, the lack of appropriately developed video technology increases the production cost and production time. Every distribution medium has its work medium. The writing of books would still be in the distant past if every draft had to be typeset, printed and bound before revisions could be made. For editing purposes motion picture film has work print and video has off-line editing. Yet videodisc, the most complex visual communication medium ever, is the only one which till recently had no work medium! For the first time designers, producers and programmers are all working on disc creation as a group, and in real time. All aspect of the process, from initial designing and programming studies to final masters are produced in the same facility with each group making real time input to the activities of the others. Hundreds of changes can be made in a day and the results of each and every change are demonstrable immediately. As a result, design and development time are cut to a tiny fraction of what used to be required. Heyer then went on to describe in detail how this process of design and development is accomplished in an integrated fashion.

This development he said gives rise to a significant improvement in the bottom-line result of videodisc workprint processes. The reasons are as follows:

(a) The risk associated with making discs is greatly reduced since the process is open and understandable to all concerned and critical problems are discovered at the beginning rather than after the budget and time are spent.

(b) Experimentation and revision are encouraged.

(c) Each creative tallent involved can clearly understand and make input to the activities of the others.

In discussing the value and use of information, Heyer stated that three things could be done with information: Store, Transmit and/or Replicate. He suggested the term 'user bandwidth' to describe the impact of transmitted information on an individual. He defined this as 'technical bandwidth' multiplied by 'attention factor'. He then quoted two examples to explain his definitions. The computer has a low technical bandwidth and a high attention factor because it could be recalled at will by the user and is controllable, whereas in the case of TV, technical bandwidth is high and attention factor is low. Further, explaining the whole process of information gathering, Heyer divided it into three categories namely: grazing, browsing and hunting. Grazing is a situation where no decision is made about information that is coming in - an example is that of sitting in front of the TV almost in a trance taking in all that appears on the screen rather than going through the trouble of changing the channel. Browsing he said, refers to the process of scanning a large amount of information without an explicit target in mind - e.g. reading a newspaper (TV browsing began with the advent of cable). Hunting is a specific and well defined search for information as in the case of using a computer.

According to Heyer, the immediate problem we face is - how to improve the ability of people to manage and control vast information power. Obvious and imminent improvements in the human engineering of computers will lead us to accept advanced information machines as easily and as naturally as TV, automobiles, airplanes and electricity have already been. The real future he said, is using computer/video tools to maximise the efficiency of thinking, learning and doing. He stated that the first revolution was agricultural and the second was industrial. Heyer claimed that the third revolution is the information revolution and it is the first to address the capabilities of the human brain and intellect directly.

Speakers' Comments and Responses to Questions

A member of the audience requested a definition for compressed audio. Brown responded saying that it was audio with a low data rate, and Heyer added that it physically separates audio and video in programs.

To the question of the error rate on CDs DeVries stated that what you measure is called the 'block error' rate. If the 'block error' rate is below 220 'block errors'/second the CD is marketable.

Regarding the market potential for using these devises in computers, DeVries mentioned that CD-ROM allows you to do anything you want with mainframes, but unlike mainframes it allows you to work at your own time and leisure. To the question of databases being available in CD-ROM form, DeVries stated that the Grautier Encyclopedia is available at $199/- and also some other databases.

To the question of trade off between data and video text on CDs (digitized) Brown noted that a good NTSC picture requires about 100,000 bytes and also that more media space is required for digital than for the equivalent analog storage.

Finally, DeVries stated that everything that has been talked about so far basically is made, developed, and produced by the Germans and the Japanese. He mentioned that the Americans had let the whole optical industry get away from them.
