M. Tanseer Ali
032 – 219 – 040#
CEG – 100 (sec – 2)
Assignment

Comparison Between

Compact Disc (CD) and Digital Versetile Disc (DVD)

Compact Disc (CD):

Optical disc technology

CD just happens to be one of the first in a long line of optical media which are read using a laser beam which is reflected in varying intensity from the surface of a rapidly rotating metallic disc embedded in a protective plastic substrate. Other optical disc formats include the Philips Video Laserdisc (LD) for recording of analogue video signals, and more recently the minaturized Sony MiniDisc (MD) for digital audio and the much denser Toshiba Digital Video Disc (DVD) which has myriad applications, including high-definition digital video.

CD is a very adaptable format which was initially only intended to store digital audio data. Today however, CDs are also used to store computer files, multimedia content and even digital video. Additionally, while CD was initially evisaged as a read only medium which was pressed in a die, cast forever with one digital imprint, it wasn't long before ways were found to exploit heat-sensitive dyes as well as the magneto-optical properties of some other compounds to allow CDs to be recorded and rerecorded by powerful lasers and magnetic heads.

The key technology needed to realise optical discs, apart from the laser, is error correction. **W**ithout it, optical discs would be far more sensitive and prone to errors than they are known to be today. Error correction, specifically the Cross-Interleaved Reed-Solomon Code (CIRC,) allows small errors in the read signal to be seemlessly corrected by applying mathematical transformations.

Prerecorded audio CDs

Audio CDs contain audio data which has been encoded into a fixed-rate digital bitstream. The audio is sampled at a rate of exactly 44.1 kHz to a resolution of 16 bits, and two channels of such data are stored to give stereo output. This yields a bit rate of approximately 1.4 Mb/s, and such measures are often invoked to compare sound quality of digital audio media and encoding schemes. Generally, a higher bitrate means a nicer sound, although there are schemes to achieve higher quality for a given bitrate (such as **Digital Theatre Systems Coherent Acoustics** (**DTS**) encoding, which delivers maximal sound quality over 6 channels at CD bitrate.)

The sampling rate of CDs is no accident. It is believed that the highest frequency a young human can detect is around 22kHz. By setting a sampling rate just above this, the standard supposedly allows perfect reproduction of all audible frequencies (which is not necessarily the same as "all audible waveforms.") The 16 bit linear **PCM** samples are signed numbers lying between -32767 and +32768, which represent the divergence of the audio waveform from the time axis on a linear (as opposed to logarithmic) scale. The magic number "16" comes from the power of two (and even better, multiple of 8) which allowed an hour of recording time at 44.1 kHz. It allows a theoretical dynamic range of greater than 100 dB. This scheme has become the benchmark for high quality audio in recent times, and all modern audio media and encoding schemes compare themselves to CD quality using phrases like "near CD quality" or "better than CD quality."

The most common type of audio CD is the prerecorded **Red Book** CD. Initially, the only way to produce optical disc media was through mastering and pressing. First comes the manufacture a glass master, which in turn gives rise to metal stampers which is then be used to press aluminium sheets with the required pits. These sheets are subequently embedded in a plastic substrate to keep them rigid and to afford protection to the aluminium surface. The result is a prerecorded CD.

The name "**Red Book**" refers to the original CD specification originated by Philips, which specified how audio data should be encoded on CD. The "Red Book" defines what is understood by discs bearing the words "**Compact Disc Digital Audio**" (often abbreviated to **CD-DA** in technical documents) and the corresponding logo. "Red Book" is the widely adopted name of the specification for the simple reason that the cover of this specification was red. Since then, in keeping with tradition, the various emerging CD standards have also been commonly referred to by the differing colours of the covers of the books in which their specifications are published.

Data and hybrid CDs

The "**Yellow Book**" specification document (in combination with an associated document known as te "**High Sierra Application Format**") discusses an extension of the CD format, initially only intended to carry digital

audio data, to accomodate more rigorously error-protected computer data in a hierarchical filing system. This is the format which forms the basis of all **CD-ROM** (**Compact Disc Read Only Memory**) discs in use today. It is more technically referred to as **Compact Disc Digital Data** (abbreviated to **CD-DD**.) The "Yellow Book" and associated "High Sierra" document will now simply be referred to collectively as "Yellow Book" in this document. (This is a common simplification.) Under this definition, Yellow Book comprises **ISO10149** (error protection layer) and **ISO9660** (hierarchical filing system format,) which are the ISO standards document describing it.

Because Yellow Book was written in the early days of microcomputers, it unfortuantely shares some of the limitations of the filing systems of those computers. The all uppercase, eight character filename with three letter extension was the most painful of these. Unfortunately, many extensions were developed to overcome this obvious of flaws in the original design, all mutually incompatible to a degree. The Microsoft **Joliet** extension was one attempt to overcome this limitation, and perhaps one of the more popular solutions today, though this wasn't always the case. Other solutions included Apple's **HFS** solution and **Compact Disc Extended Architecture** (**CD-XA**.)

Another limitation of Yellow Book was that it didn't allow for **hybrid discs**—that is, discs which contained both Red and Yellow Book sessions—or for discs with multiple Yellow Book sessions—an extension most useful in allowing CDs to be written in "stages." **Multisession extensions** given in the first part of the "**Orange Book**" specification overcame this limitation in a standardized way. Most computer drives and operating system device drivers now support hybrid or multisession discs, popularized under names such as "**CD Extra**" (formerly "**CD Plus**") and "**Enhanced CD**."

Recordable and Rewritable CDs

Orange Book defines two standards for recordable and rewritable CDs, one of which is really only used today as the basis of Sony's MiniDisc system. The first, still common format, **Compact Disc Recordable** (**CD-WO** or **CD-R**,) uses a heat-sensitive dye which can be "burned," but only once, with a powerful laser to form a pattern by a device known as a **CD writer** or **burner**. The second, Sony/Philips CD rewritable (**CD-MO**,) uses a material with magneto optical properties which can be rewritten many times by using a powerful laser in combination a magnetic field. This format should not be confused with what is currently commonly called **CD Rewritable** (**CD-RW**,) which is a purely optical media.

While CD-R is today used for audio, even in solid-state consumer recorders, **CD-Rewritable** (**CD-RW**) unfortunately it is incompatible with most audio players, being designed primarily as a medium for transporting computer data. This is expected to change as solid-state recorders become more popular, because CD-R is a difficult format to work with due to its more permanent nature.

Video and Interactive CDs

Building on the basic data formats (CD-DA, CD-DD and hybrid) and media modes (CD-R and CD-RW) are standards which further specify the usage of CDs in particular areas of application.

Format	Abbreviations	Description
Movie CD (Yellow Book)	MCD	A CD-DD based format storing digital video files to be played back on a personal computer.
Video CD, Compact Disc Digital Video (White Book)	VCD, CD-DV	A CD-DA analogous format storing an MPEG-1 video stream, either for PAL shape or NTSC shape, at a fixed 1.4 Mb/s.
Super Video CD (White Book)	SVCD, VCD3, CVD, HQVCD	A hybrid format storing MPEG-2 quality video streams and auxillary data at variable bitrate.
Digital Video CD (Rainbow Book)	DVCD, DVD-CD	A DVD Video based format on CD carrier media for use in DVD players.
CD Interactive (Green Book)	CD-i	Philips' platform independent multimedia format to be viewed on solid state electronics.
CD Extended Architecture	CD-XA	A CD-DD based format storing multimedia content

(Green Book)		for general use.
Video CD ROM (Blue Book)	VCD-ROM	A multisession format with White Book and Yellow Book sessions.
CD Extra, CD Plus (Blue Book)	CDX, CD+	Sony/Microsoft's multisession format with Red Book and Yellow Book sessions.
CD Enhanced, Enhanced CD (Blue Book)	CD-E, ECD	A multisession format with Red Book and Yellow Book sessions. Sometimes "Stamped Multisession."

Notes about Audiotek CDs and numbering schemes

At the present time, Audiotek does not have the capacity to produce CDs en masse. Almost all CDs in the Audiotek collection have been produced by external parties, and all but a mere few are prerecorded. The Audiotek CD catalogue is divided into five sections, based on the format of the various media and their applications. Recordable and Rewritable CD variants, CD-R (from Orange Book Part II) and CD-RW (from later standards) respectively, are not distinguished.

The **ATKR Red Book catalogue** consists of CD-DA compatible discs, including those with other sessions. This implies that all CDs with a red book session have an ATKR catalogue number, however the number in the ATKD multisession catalogue is to be used by preference. The exception is backup copies which only include the audio session—in these cases the ATKR code should be used. **Mix-mode discs**, where data masquerades as an audio track in a Red Book session, belong to the ATKR catalogue. **CD-Text** is an extension to Red Book which stores track titles in the unused subcode space, and is not distinguished. **Hidden Track**, **CD+G** or **CD+Graphics**, **CD-ROM Ready**, **Track Zero**, **i-Trax** and **Audio Vision** discs are also primarily enhanced music discs, so belong to ATKR as well.

The ATKR catalogue lists whole second timings for tracks and CDs, and for each track the title and primary artists are given. The title of each CD is derived by the primary artists and the longest form of the title printed on the CD, and the publisher is listed. For soundtrack CDs, the designation "Soundtrack" is included in the title. Special formats are denoted by an annotation in box brackets. Additionally, the copyright year for the CD is given. No data on the mastering of tracks is listed, as this is rarely given in any detail on prerecorded CDs anyway.

The **ATKY Yellow Book catalogue** consists of all CD-DD discs which have no Red Book sessions and do not fall into the **ATKJ** or **ATKG** catalogues (see below.) This includes all variations and extensions on CD-DD, such as **HFS**, **Joliet**, **El Torito/Bootable**, **Hybrid/Janus CDs** as well as those **CD-XAs** which are computer specific. Only Yellow Book CDs which contain primarily audio or video content (i.e. files containing audio/video data) appear in the ATKY catalogue. Movie CD, distinct from CD-DV and VCD (White Book) by being specifically designed for use in personal computers, belong in the ATKY catalogue.

The **ATKD Blue Book catalogue** consists of all multisession CDs which have at least one Red Book session. These include CDs bearing the marks "**CD-Plus**," "**CD+**," "**Enhanced CD**," "**ECD**," "**CD-Extra**," "**CDX**," "**CD-Enhanced**," "**CD-E**" and "**Stamped Multisession**."

The **ATKJ White Book catalogue** consists of all CD-DV or VCD compatible discs (including multisession and hybrid discs with a White Book session) which contain highly compressed MPEG 1 video. NTSC and PAL VCDs are not distinguished. The **ATKG Green Book catalogue** consists of all CD-i and CD-XA compatible discs which contain machine-independent interactive content. DVCD or DVD/CD hybrid media are typically distinguished by receiving a categorization in the **ATKX catalogue** for DVD Video media.

Digital Versatile Disc (DVD):

DVD Background and How the Technology Works

Since the Audio Compact Disc and CD-ROM were introduced in 1982 and 1985 respectively, compact discs (CDs) have become popular media formats, and are used to carry music, data, and multimedia entertainment (AME). When the CD-ROM was developed, it had the ability to store over 650 megabytes (MB) worth of data or music (Disc Manufacturing, Inc.). Today, however, the capacity of 650 MB of storage is too limited for computer applications. As a consequence, a second-generation disc technology is needed to provide video, multimedia, and databases more quickly and in greater volume. In 1995, the successor to CD, DVD, was announced.

DVD refers to a high density optical disc format. The specifications for the five variations of DVD are as follows:

- DVD-ROM is a high capacity data storage medium which is similar to CD-ROM;
- DVD-Video is a specific application of DVD designed to deliver linear motion picture content;
- DVD-Audio, which is similar to CD Audio, is designed for audio-only usage;
- DVD-R or DVD recordable permits one time recording of data, a write once, read many (WORM) implementation;
- DVD-RAM is erasable and rewritable (IMA DVD SIG).

Currently, however, only DVD-Video and DVD-ROM are available now.

Every DVD disc is made of two parts, each of which is 0.6 mm. Thick; thus, together, the two parts are 1.2 mm. thick, which is the thickness of a current CD (IMA DVD SIG). Compared to a CD, which has ability to store 650 MB, DVD holds seven times the data. The storage capacity of a Single Sided/ Single Layer DVD is 4.7 gigabytes (GB). "That's enough room to store 133 minutes of full-motion video per side" (Normile 56). Single-Sided/ Dual Layer, which is expected to be the most popular configuration, can hold a special edition DVD video movie or 8.5 GB of computer data (Disc Manufacturing Inc.). Another configuration is Double-Sided/ Single Layer, which can hold 9.4 GB of computer data or one movie plus 4.7 GB of data. (IMA DVD SIG). The last one is Double-Sided/ Dual Layer, which can store 17 GB. This disc could pack up to four movies (Normile 57).

Owing to the data capacity, DVD will be able to provide multiple language and subtitle tracks, which allow users to choose whether to listen to the original movie dialogue, with or without subtitles, or to a dubbed version (Normile 57-58). Moreover, in theory, the viewer would be able to control how a scene is viewed, choosing from as many as eight different camera angles (Vizard 71).

The Factors Speeding the Rate of Adoption

"Innovations that are perceived by individuals as possessing greater relative advantage, compatibility, and the like, have a more rapid rate of adoption" (Rogers 23).

As we know, DVD is a successor to CD, and it has been created to have more capability than CD. However, it is not only improved features of DVD that will accelerate the rate of adoption, but its backward compatibility-the ability to use CDs and CD-ROM in equipment designed for DVD disc-is another factor that will help to speed the rate of adoption.

DVD-Video is intended to replace the VHS tape and it will consist of linear movies encoded in MPEG 2 and Dolby Ac-3 audio (IMA). " DVD offers 500 lines while a VHS tape offers a mere 240 (laser disc has 420). Basically DVD offers twice the visual experience of videotape. The DVD-Video player, like a VCR, will be connected to the TV, and it will play these specially made movie discs; furthermore, it will also play CD audio discs (IMA). "Backward compatibility with CD formats is a feature of DVD, not a requirement" (IMA DVD SIG).

DVD-ROM is expected to deliver high volume, high bandwidth content. A DVD-ROM drive, like a CD-ROM drive, will be used to read data from the DVD-ROM disc; in addition, it is expected that movie titles will play on DVD-ROM equipped computers (IMA). Due to backward compatibility, current CD-ROMs will also play on DVD-ROM drives. On the other hand, current CD-ROM drives cannot play the denser DVD and DVD-ROM disc.

The relative advantages of this technological innovation will be the major key to speed the rate of adoption. It is likely that most individuals will perceive the advantages of this new technology. "The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be" (Rogers 15). Besides, the compatibility with the existing technologies is another factor to motivate people to adopt the innovation

The Factors Retarding the Rate of Adoption

In early 1995, two major groups were competing to develop the second generation of high density compact discs (Disc Manufacturing, Inc.). This competition led to incompatible DVD formats. The first group was the alliance between Philips and Sony, the creators of the compact disc. Another group was led by Toshiba and Time Warner (Normile 55). Due to the competition between the two standards established by the two groups, time has been wasted in the search for solutions. Fortunately, in September 1995, the two groups agreed to develop a single standard for a high-density compact disc (Disc Manufacturing, Inc.).

Even though a standard format for DVD has been decided upon, there will still remain some factors that must be resolved.

Firstly, because DVD is still in developmental stages, this technology is not available in all formats. Though compared with VHS tape, DVD has the advantage of superior video and sound, instant search and rewind and greater durability, the VCR owners still hesitate to adopt the new technology, DVD. The reason is that DVD players are not able to record. People do not want to give up their options even though surveys shows that the majority of VCR owners use their machines only for playback (Vizard 71).

Another factor retarding the rate of adoption is the price. A DVD player itself costs $500 or more, and each movie costs $20 (Vizard 70). Compared with the VCR, the price of DVD is higher. If the price of the innovation drops, the rate of adoption will take off. It is expected that the price of DVD will drop to VCR level within the next few years.

The last factor is the standard of DVD. Similar to the VCR format war, digital convergence seems to have been complicated in the process of negotiation and implementation. Recently, Matsushita, Zenith, and Thompson Multimedia announced plans to create a variant of DVD called *Divx*. Divx or Digital Video Express is being developed by a partnership between retailer Circuit City Stores and a powerful Hollywood law firm (Gross, Brull, and Grove 35). A Divx player will play Divx discs and normal DVDs; on the other hand, a regular DVD player which is available now cannot play Divx discs (Divx: the death of DVD?). Furthermore, each Divx disc will cost only $5 and will have 48 hours of viewing time (Divx: the death of DVD?). "The DVD drama is already looking like a replay of Betamax vs. VHS, the epic battle of rival VCR formats from Sony corp. and Matsushita Electric Industrial Co. in the late 1970s (Gross, Brull, and Grove 35). This competition causes uncertainty among the adopters and it will retard the rate of adoption.

In conclusion, the innovation of DVD is in the early stages and it is still in the process of being developed. All formats of DVD are not yet available, some formats are still in the works. Besides, the price of the innovation is too expensive for the majority of people to adopt. Accordingly, this technological innovation will require time before it is able to replace the similar technologies, which already exist. However, most likely, DVD-ROM will take off faster than DVD-Video because the computer companies are making DVD-ROM drive available in their new products.

References:

1. http://kasoft.freeyellow.com/Central/Audiotek/Press/CD.html
2. www.computerworld.com
3. www.hyperdictionary.com