

# POINT Jukebox Manager

## Dynamic Image Recording

White Paper

### 1 Optical Disc Characteristics

The different types of existing optical discs (CD/DVD, MO, PDD, ...) can generally be differentiated according to their physical characteristics. Regarding re-writable and write-once capability PoINT Jukebox Manger distinguishes between the following two groups:

- Non-sequentially written discs, (allow re-writing):  
DVD-RAM, MO, UDO/RW, PDD/RW
- Sequentially written discs, (cannot be re-written):  
CD-R, DVD-R, DVD+R, MO/WORM, UDO/WORM, PDD/WORM

If reliability regarding the write process (performed by the drive) is considered for all non-sequential disc types write errors can be detected by the verification process of the drive and can be corrected by the integrated media/drive defect management mechanism.

Also for the non-sequentially written disc types MO/WORM, UDO/WORM und PDD/WORM these drive capabilities (verification and defect management) are implemented.

For the disc types CD-R, DVD-R and DVD+R neither drive supported verification nor a hardware based defect management exists. Therefore these disc type provide a lower write and media reliability compared to the above mentioned disc types, from hardware point of view.

### 2 Jukebox Environment

Using optical discs in a jukebox system imply higher requirements to discs and drives compared to single drive usage. E.g. depending on the structure of data accesses the jukebox robotic will move discs between slots and drives multiple times. This means in case of incremental recording discs and drives must reliably support disc changes between write processes. Whereas discs types with integrated defect management (usually caddy based) generally support this application without problems, CD-R, DVD-R and DVD+R discs and drives do not provide the same reliability, especially in combination with high recording speeds (e.g. 8x/16x for DVD-R) and bad or scratched discs.

### 3 Software Approach

The physical drawbacks of the discs types CD-R, DVD-R and DVD+R as describes under sections 1 and 2 are compensated by a software mechanism called "Dynamic Image Recording" which is implemented by PoINT Jukebox Manager. The target of this approach is to fulfill the following requirements:

- improved write process reliability,
- automatic recovery in case or write errors,
- improved operable file system in case or jukebox failures,
- usage of maximum recording speed.

Dynamic Image Recording is the recommended method for CD-R, DVD-R and DVD+R discs and is the default setting in PoINT Jukebox Manager for these disc types.

### **3.1 Implementation**

In contrast to incremental recording, recording through Dynamic Images to optical discs means that first all data is written to an image file residing on hard disk.

Actual migration of a Dynamic Image to the corresponding optical disc will be performed automatically if the finalize command for the corresponding disc is executed. Using Volume Sets finalization can be performed automatically. As final step recorded data on the optical disc will be compared with data in the Dynamic Image and (if the complete process was successful) the Dynamic Image will be deleted from hard disk.

Read requests will be performed through the Dynamic Image before and during the migration process.

Every Dynamic Image file is directly assigned to a corresponding optical disc. This means that in normal operation the number of Dynamic Image files is equal to the number of optical discs in use.

Using Dynamic Image Recording is completely transparent to the user and the application. The mechanism works invisible in the background and provides transparent access through the jukebox file system.

### **3.2 Migration Status**

In the same way as for caching on hard disk PoINT Jukebox Manager indicates Dynamic Image Recording by the file attribute `FILE_ATTRIBUTE_OFFLINE` that the corresponding file has been stored on optical disc. By this capability an application can check the presence of the attribute and decide whether the corresponding file is on optical disc or not.

If the mentioned attribute has been set Windows Explorer shows a small clock in the icon of a file.

### **3.3 Error Recovery**

PoINT Jukebox Manager automatically selects a new empty disc and retries migration of the Dynamic Image in case of recording errors during the migration process of a Dynamic Image. The administrator can specify the maximum number of retries.

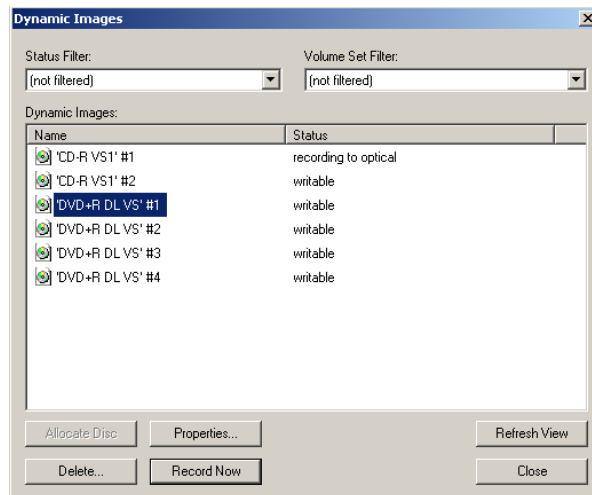
The error recovery process operates without administrator intervention. In the slot list discs with recording errors are marked as defect and can be exported and exchanged by new discs. In addition PoINT Jukebox Manager generates corresponding log file entries.

After hardware failure of the jukebox in most cases it is still possible to read and write to discs that have been formatted with Dynamic Images Recording and the corresponding Images still exist on hard disk. When using Volume Sets with automatic media allocation enabled PoINT Jukebox Manager will also continue adding media to the Volume Set until the maximum number of Dynamic Images (as specified by the administrator) has been reached.

## **4 Administration of Dynamic Images**

Dynamic Image Recording can either be enabled in the properties dialog of a Volume Set or can be selected when formatting the disc. Whenever a disc is formatted with Dynamic Image Recording enabled, an image file is created for each media side.

PoINT Jukebox Manager supports managing of existing Dynamic Images by a separate dialog which is available in the context menu of a Volume Set or a single disc.



The following operations are provided:

- Allocate Disc  
This command is available if the selected Dynamic Images either have no target disc associated or the slot that contained the target disc holds another disc.
- Record Now  
After executing this command, the selected Dynamic Images will be finalized and then recorded to optical disc. This command can only be executed if the selected Dynamic Image (i.e. the related slot) is currently active.
- Delete  
This command releases the hard disk space occupied by the selected Dynamic Images and marks the target discs as empty, unless they have not yet already been recorded.

## 5 Comparison to Incremental Recording

- Dynamic Image Recording eliminates disc changes during the recording process of an optical disc. This means drives and media are mechanically less burdened compared to incremental recording which normally involves multiple disc changes. This reduces the probability of mechanical failures.
- When using Dynamic Image Recording the recording and verification process can be performed with maximum drive speed, whereas incremental recording normally implies additional drive positioning operations limiting total recording speed.
- In case of a write error Dynamic Image Recording allows automatic recovery by re-doing the complete write process with a new disc. In case of a write error during incremental recording it may occur that automatic recovery of the complete disc (if corrupted) is not possible because previously written data is no longer available. In this case manual administrator action would be required.
- Enabled Dynamic Image Recording requires additional hard disk space compared to incremental recording.
- Data written through Dynamic Images is only stored on hard disk as long as a Dynamic Image file has not been migrated to the optical disc. Therefore it is highly recommend using a RAID system to store Dynamic Image files. With incremental recording data will be directly recorded to optical disc.
- In contrast to incremental recording the application has no possibility to enforce the data migration process from Dynamic Image to optical disc. This is automatically controlled by PoINT Jukebox Manager or can be started manually by the administrator.

## 6 System Requirements

Due to its design Dynamic Image Recording requires more hard disk space than direct incremental recording. Each formatted disc occupies hard disk space according to the size of the optical disc. The hard disk space will be released after successful recording of the Dynamic Image to the optical disc. In case of double-sided media data for both sides will be kept on hard disk until both sides have been recorded.

When using Volume Sets with Dynamic Image Recording hard disk space is required to store at least 3 media (single sided) or 4 media sides (double sided media).

Hard disk space is required for each writable disc not belonging to a Volume Set.

Data written through Dynamic Images is stored only on hard disk as long as a Dynamic Image file has not been migrated to the optical disc. Therefore it is highly recommend to use a fail save system (RAID) to store Dynamic Image files.

Dynamic Image Recording requires at least two recording drives per jukebox.

## 7 Relation to Hard Disk Write Caching

Write cache on hard disk can also be used in combination with Dynamic Image Recording. Since Dynamic Image Recording also copies data to hard disk first, it is only necessary to use both schemes if specific functionality is only provided by caching on hard disk. This functionality comprises e.g. the following functions:

- modifying files as long as they are in the write cache,
- migrating data if read-only file attribute has been set,
- keeping data in read cache after migration.

It is important to understand that in case of using write caching in combination with Dynamic Image Recording migrating data to optical discs is a two steps process. In the first step data will be migrated from write cache to Dynamic Images and then in the second step data will be migrated from Dynamic Images to optical discs.

When using Volume Sets with both Dynamic Image Recording and write cache on hard disk the size of the write cache should be set to a value which is smaller than the size required to store the maximum number of Dynamic Images as specified in the properties of the Volume Set. In other words, the maximum number of Dynamic Images must be large enough to store all data which can be in the write cache at a time.

To reach best results in performance Dynamic Image and Write Cache directories should be allocated on different hard disk drives.