MMC-2   CHANGER MODEL

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Technical Editor:
Ron Roberts
Sierra-Pac Technology
PO Box 2389
Shingle Springs, CA 95682

E-mail: rkroberts@aol.com

6.0 Changer Model

A changer Logical Unit will perform exactly like a single ATAPI Logical Unit. However it shall support commands, MECHANISM STATUS (BDh) and LOAD/UNLOAD C/DVD (A6h).

A changer Logical Unit provides a storage area for more than one C/DVD Disc. This storage area contains multiple areas called slots. Each slot can contain just one Disc. Once a Disc has been placed in to a given slot, it becomes locked in that position. This specification provides no capability to move a Disc from one slot to another. Thus when a Disc has been moved from a given slot into the playing position, it can only be moved back into the slot that it came from. This shall be followed even if power is lost while a Disc is in the playing position or while it was being moved.

There are two basic types of changer mechanisms, one that has individually addressable eject and load capability and an-other that uses a cartridge to hold the discs. In the former, individual disc can be changed, while in the later all the stored discs must be changed at one time.

Any time a Disc/Cartridge is installed from the changer, the Logical Unit shall generate an Unit Attention Condition. After the host detects the unit attention on a known changer Logical Unit, the host may issue a MECHANISM STATUS Command. This will provide the host with information on what disc is present or was changed.
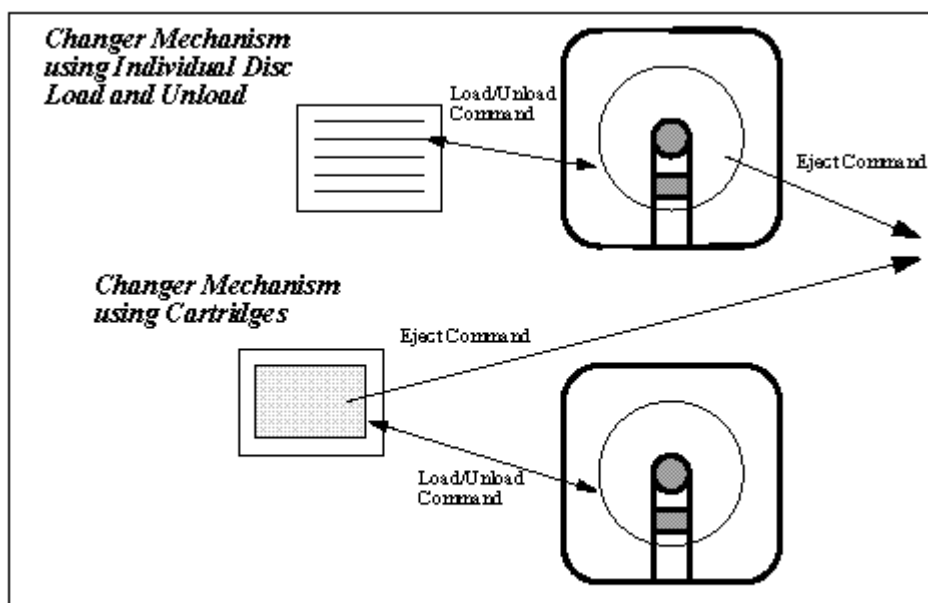
6.1 Side definition

As part of the DVD specifications, there is a type of media supported that includes data on more than one side of the Disc. This will allow devices that can automatically change sides to come into existence. Thus for C/DVD Devices, there is an optional capability to select each side of the Disc. Although this would not normally be thought of as a changer type of operation, the two sides to the Disc are independent and changer like functions are a good match for selecting sides. When the Logical Unit supports this functionality, each physical slot will have two logical slots. For example referencing slot 0 would be one side of the Disc, and slot 1 would then be the other side.

There are two fundamental techniques used to select each side of DVD media. The first is the most space efficient. It simply moved the Pick Up (laser unit used to read the disc) to the other side. This does add complexity to the laser mechanism to be able to position it on either the bottom or top of the media. The second approach is to actually flip the media over. This type does not exist today, although it is possible. This type of Logical Unit will pose some problems

making sure that the correct side is selected after a power on or hard reset condition. Some way to remember which side was selected when the power was removed would be needed.

For a Logical Unit that supports changing sides (see section 9.1.8.7, "C/DVD Capabilities and Mechanical Status Page", on page 126, "Side Change Capable"), the number of Slots reported shall be even, and every other slot shall be an alternating side.

6.1.1 Side Changing Only Logical Unit

There can exist a Logical Unit that is capable of changing the side of the Disc, but does not have separate Slots from the playing position. This type of Logical Unit reports that it has a Mechanism type that is not a changer, but also reports Side Change Capable. This style of Logical Unit will still make use of the LOAD/UNLOAD C/DVD command to change the currently selected side. This style Logical Unit shall report two slots available (see section Table 52 -, "Mechanism Status Header", on page 104).

A side effect of a Logical Unit that only has the capability to change sides is that when unloading a Disc does not actually perform any action. This will appear to the host as a Logical Unit with Delayed Load type of operation (See section 6.5, "Delayed Disc load operation", on page 70).

> Note that a DVD Logical Unit that supports changing sides will not be able to report if there is actually data on both sides until each side has been read.

6.1.2 Attention Conditions for Sided Discs

Devices that support changing sides shall only report Unit Attention Conditions for changes that involve movement of a Disc in/out of the Logical Unit. Changes of side shall not generate Unit Attention Conditions.

6.1.3 Error Conditions for Sided Discs

Devices that support changing sides of a Disc shall use the NO REFERENCE POSITION FOUND, Sense Key 02h NOT READY, ASC/ASCQ 06/00 to report when the currently selected side does not contain valid data.

6.2 Initialization

The Changer shall perform it's initialization routine at power on or receipt of a hard reset from the host.

"Initializing Changer" is a process that refers to gathering the information that is necessary to respond to the MECHANISM STATUS Command. If a changer is in the process of Initializing when it receives a MECHANISM STATUS Command, it will respond immediately and provide no slot table information (Only the Header).

Figure 6 - Changer State Diagram
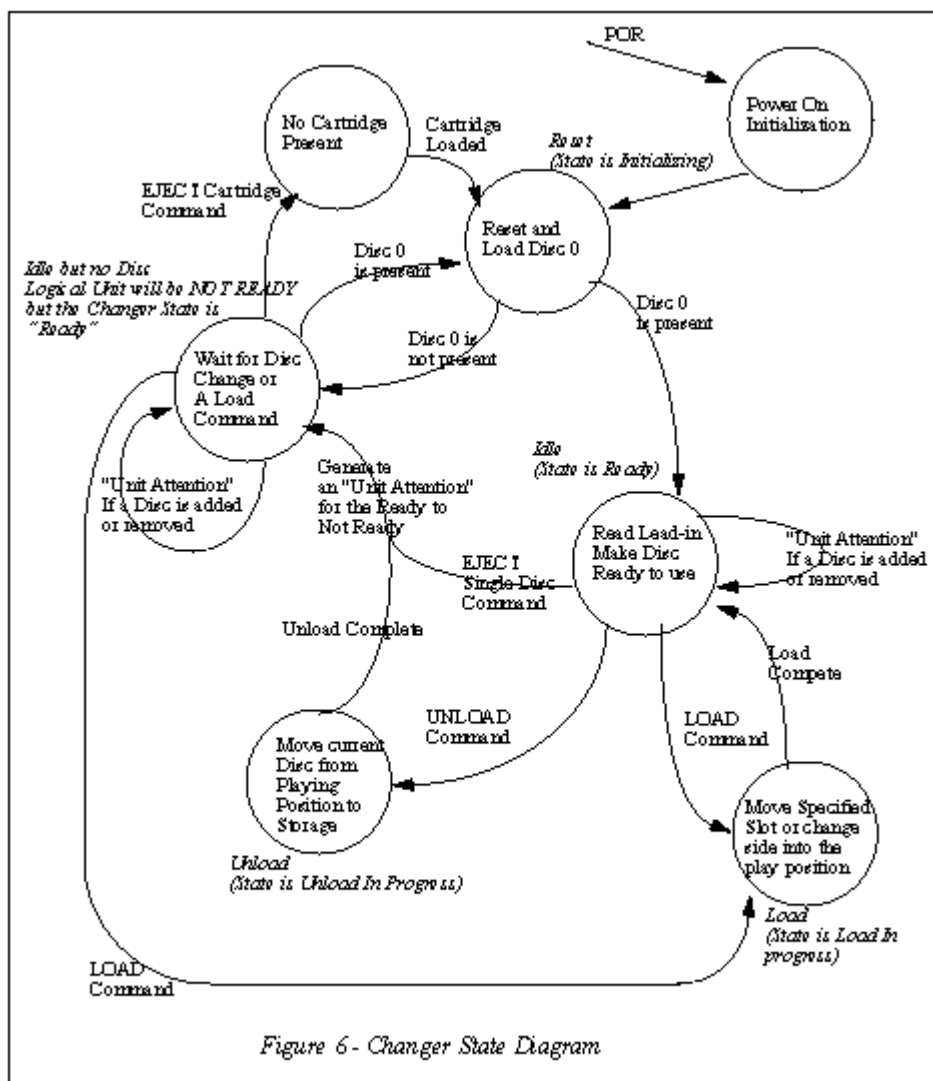
6.3 Changer Addressing

Several Changer specific commands use addresses called "Slots".

If any commands related to Changer operations are implemented, then all the Changer commands shall be implemented. To determine if an ATAPI Logical Unit is a changer type Logical Unit, the Loading Mechanism Type field in the Capabilities page will contain one of the two changer type code (See "9.1.8.7 C/DVD Capabilities and Mechanical Status Page" on page 126) for individual disc or cartridge implementations. A Logical Unit that reports Side Change Capable shall implement all Changer commands.

6.4 Automatic Load and Unload Operations

After initialization is complete the changer shall have Slot 0 loaded into the play position. This enables drivers which are not changer aware to work with a changer Logical Unit as if it were a normal single Disc ATAPI Logical Unit. This also insures compatibility with Bootable C/DVD. In support of this goal the changer shall also load and unload (Eject) default Disc 0 if the changer supports loading and unloading (Ejecting) individual Discs unless otherwise commanded by the use of one of the changer specific Load/Unload commands.

When a LOAD Command is received and a Disc is present in the Playing position, it shall be unloaded automatically be-fore the specified Load operation is performed.

6.5 Delayed Disc load operation

C/DVD Changer Devices may either move a disc into the playing position immediately upon receipt of a LOAD command, or delay the loading of the disc until a media access command is received. It is recommended that the Logical Unit not load discs into the playing position until data from a disc that is not cached is requested from the host. Note that the delayed operation extends to the UNLOAD operation as well. Both the load and unload operations can be delayed.

Note that Host Drivers should expect to encounter load mechanism delays on media accesses in addition to the spin up and seek delays normally introduced with these commands.

If the Logical Unit supports delayed loading and the selected disc is not in the play position, then the following commands shall move the selected disc into the play position When data that has not been cached has been requested by the host:

Table 13 - Delayed Load Operation by command

Command	Allowed Action
BLANK	Delay in processing command is allowed
CHANGE DEFINITION	No extra delay for medium movement *shall* occur
CLOSE AREA/SESSION	Delay in processing command is allowed
COMPARE	Delay in processing command is allowed
COPY	Delay in processing command is allowed
COPY AND VERIFY	Delay in processing command is allowed
FLUSH CACHE	Delay in processing command is allowed
FORMAT UNIT	Delay in processing command is allowed
GET EVENT STATUS NOTIFICATION	No extra delay for medium movement *shall* occur
INQUIRY	No extra delay for medium movement *shall* occur
LOAD/UNLOAD C/DVD	Delay in processing command is allowed but is not recommended
LOCK/UNLOCK CACHE	Delay in processing command is allowed
LOG SELECT	No extra delay for medium movement *shall* occur
LOG SENSE	No extra delay for medium movement *shall* occur
MECHANISM STATUS	No extra delay for medium movement *shall* occur
MODE SELECT (10)	No extra delay for medium movement *shall* occur
MODE SENSE(10)	No extra delay for medium movement *shall* occur
PERSISTENT RESERVE IN/OUT	No extra delay for medium movement *shall* occur
PLAY AUDIO	The current slot selected *shall* be moved into the play position
PLAY AUDIO MSF	The current slot selected *shall* be moved into the play position
PLAY CD	The current slot selected *shall* be moved into the play position
PREFETCH	Delay in processing command is allowed
PREVENT/ALLOW MEDIUM REMOVAL	No extra delay for medium movement *shall* occur
READ(12)	Delay in processing command is allowed
READ BUFFER	No extra delay for medium movement *shall* occur
READ C/DVD CAPACITY	No extra delay for medium movement *shall* occur
READ DISC INFORMATION	Delay in processing command is allowed
READ HEADER	Delay in processing command is allowed
READ SUB-CHANNEL	Delay in processing command is allowed
READ FORMATTED CAPACITY	No extra delay for medium movement *shall* occur
READ CD	Delay in processing command is allowed
READ CD MSF	Delay in processing command is allowed
READ DVD STRUCTURE	Delay in processing command is allowed
READ LONG	Delay in processing command is allowed
READ TOC/PMA/ATIP	Delay in processing command is allowed
READ TRACK INFORMATION	Delay in processing command is allowed
RECEIVE DIAGNOSTIC RESULTS	No extra delay for medium movement *shall* occur
RELEASE	No extra delay for medium movement *shall* occur
REPORT KEY	No extra delay for medium movement *shall* occur
REPORT LUNS	No extra delay for medium movement *shall* occur
REQUEST SENSE	No extra delay for medium movement *shall* occur
RESERVE	No extra delay for medium movement *shall* occur
RESERVE TRACK	Delay in processing command is allowed
REZERO	Delay in processing command is allowed
SEEK	The current slot selected *shall* be moved into the play position
SEND DIAGNOSTIC	No extra delay for medium movement *shall* occur
SEND KEY	No extra delay for medium movement *shall* occur
SEND OPC INFORMATION	No extra delay for medium movement *shall* occur
SET C/DVD SPEED (Obsolete)	No extra delay for medium movement *shall* occur
STOP PLAY/SCAN	No extra delay for medium movement *shall* occur
START STOP UNIT	The current slot selected *shall* be moved into the play position
TEST UNIT READY	No extra delay for medium movement *shall* occur

Table 13 - Delayed Load Operation by command (Continued)

Command	Allowed Action
VERIFY (12)	Delay in processing command is allowed
WRITE (10)	Delay in processing command is allowed
WRITE BUFFER	No extra delay for medium movement *shall* occur
WRITE CD	Delay in processing command is allowed
WRITE DVD STRUCTURE	Delay in processing command is allowed
WRITE and VERIFY (12)	Delay in processing command is allowed

6.6 Prevent / Allow processing

There are two techniques for Prevent / Allow, either all the discs shall be prevented from being ejected by the user or each disc individually shall be prevented. If the Logical Unit reports support for Software Slot Selection, then each slot shall be individually controlled by the Prevent / Allow command. Note that changer devices that use a Cartridge and not individually controlled slots should not report the Software Slot Selection capability.

6.7 Error Reporting

If any of the following conditions occur during the execution of a command, the C/DVD Changer shall return CHECK CONDITION status. The appropriate sense key and additional sense code shall be set. The following list illustrates some error conditions and the applicable sense keys. The list does not provide an exhaustive enumeration of all conditions that may cause the CHECK CONDITION status.

Table 14 - Error Conditions and Sense Keys for Changer Mechanisms

Condition	Sense Key
Invalid Slot Number	ILLEGAL REQUEST
Unsupported option requested	ILLEGAL REQUEST
Load or Unload to invalid slot or no Disc in source location	ILLEGAL REQUEST
ATAPI Device reset or medium change since last command	UNIT ATTENTION
Self diagnostic failed	HARDWARE ERROR

In the case of an invalid Slot number, the sense data information field shall be set to the Slot number of the first invalid address.

When an error condition is reported to the host, the disc in the selected slot shall be moved into me play position.

Attempts to eject a Disc if the changer type is cartridge and there is a Disc in the playing position shall be rejected with a Sense Key 05, (ILLEGAL REQUEST) Sense Code 01 (MECHANICAL POSITIONING OR CHANGER ERROR).