

To: T10 Membership
From: Paul Suhler, Seagate Technology
Subject: Proposal to Support Partial Loading & Unloading (T10/99-263r1)
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1 General

This is a modification of my earlier proposal to modify the SSC Load/Unload command to allow loading a cartridge into a drive without threading the tape and to unthread the tape without ejecting the cartridge. At the September meeting, we realized that this concept could be implemented in any command set supporting removable media, and that new SK/ASC/ASCQ combinations would be needed.

This revised proposal has two major sections: the justification for the new functionality (which is unchanged from the previous version) and the specific proposals for the affected command sets. As there has been no expression of interest from anyone in MMC, SMC, and SBC/RBC, I'm only including an outline of the changes that would be required for those.

2 Justification

2.1 THE CASE FOR SPLITTING LOAD

Some tape technologies – AIT and LTO – use cartridges equipped with Medium Auxiliary Memory (MAM), a non-volatile memory used to record medium identification and usage information. This is typically accessed via an RF interface and does not require reading the tape itself. In a library not equipped with a mobile MAM reader, it is necessary to load the cartridge into the drive to read the MAM via the drive's MAM reader.

The current Load command will not only move the cartridge into the drive, but will also prepare the tape for access by threading, adjusting tension, etc. This takes much longer than is required to read the MAM, greatly increasing the time to scan a series of cartridges.

By issuing one command to move the cartridge into the drive and another to prepare the tape for access, the drive operation becomes much more flexible and avoids unnecessary delays.

2.2 THE CASE FOR SPLITTING UNLOAD

It is a requirement of some tape library systems that preparation of a tape cartridge for ejection be done separately from the actual ejection. Since the robot arm (medium transport element – MTE – in SMC terminology) must be positioned at the drive before the command to eject the cartridge is issued, it currently must wait there throughout the process of preparing the tape for ejection. For dual-reel media, this preparation may include retensioning and/or positioning to BOT or EOT; for single-reel media, this preparation means unthreading the tape and winding the tape leader into the cartridge.

The difficulty with the present LOAD UNLOAD command is that it specifies both unthreading and ejection, with no way to separate the two operations. Workarounds include having the MTE wait at the drive throughout the entire process, or implementing a vendor-unique unthread operation usually commanded over the drive's serial interface.

By issuing one command to prepare the cartridge for ejection and another to perform the actual ejection, the MTE can service other requests while the tape is prepared for ejection. Only when the tape is actually ready to be ejected will the MTE be moved to the drive. The sequence would be:

1. Issue modified Unload; cartridge is prepared for ejection.
2. Move MTE to drive.
3. Issue standard Load; cartridge is immediately ejected.
4. Move medium to desired location.

3 Specific Command Set Modifications

3.1 SCSI PRIMARY COMMANDS (SPC)

3.1.1 Autoload Mode Control

When a medium is inserted into a drive, many drives simply load and prepare the medium for access. However, I've encountered some customers who do not want this. Given the above discussion, there are three options:

1. Do not load; wait for Load command..
2. Load to Hold state.
3. Load to Ready state (prepare for access).

I propose that the current behavior be readable and settable via a mode page in SPC, as this behavior would apply to at least three different command sets. The following change to the Control mode page uses bits 0 and 1 of byte 5, which are presently reserved. I hesitate to use bits 4 & 5 of byte 4, as they look like they may have been used in the past, which may lead to problems with legacy applications.

Table 158 -- Control Mode Page

Byte	Bit	7	6	5	4	3	2	1	0
0		PS	Reserved	PAGE CODE (0aH)					
1		PAGE LENGTH (0Ah)							
2		TST			Reserved			GLTSD	RECL
3		QUEUE ALGORITHM MODIFIER				Reserved	QErr		DQue
4		Reserved	RAC	Reserved	SWP	RAERP	UAAERP	EAERP	
5		Reserved						AUTOLOAD MODE	
6		MSB	READY AER HOLDOFF PERIOD						LSB
7									

8	MSB	BUSY TIMEOUT PERIOD	LSB
9			
10	MSB	EXTENDED SELF-TEST COMPLETION TIME	LSB
11			

Table nnn -- Autoload Mode Field

Value	Definition
00b	Medium shall be loaded to the Ready state
01b	Medium shall be loaded to the Hold state
10b	Medium shall not be loaded.
11b	Reserved

3.1.2 Status Reporting

There are two conditions that need to be reported. One is when the medium is inserted and not loaded, as per Autoload Mode 2, the other is when it is in the Hold state, as per Autoload Mode 1. In both cases, the device can be addressed, so a sense Key of Not Ready is inappropriate according to SPC. Therefore, both of these conditions should use sense key Unit Attention. I propose that the following two lines be added to Tables 113 and C.1 ("ASC and ASCQ assignments") of SPC-2.

ASC	ASCQ	D	T	L	P	W	R	S	O	M	C	A	E	B	K	Description
3Ah	03h	D	T			W	R		O	M				B		MEDIUM LOADABLE
3Ah	04h	D	T			W	R		O	M				B		MEDIUM AUXILIARY MEMORY ACCESSIBLE

3.2 SCSI STREAM COMMANDS (SSC)

Splitting of the Load and Unload operations can be accomplished either by specifying a new command or by modifying an existing one. This proposal is to do the latter.

This proposal suggests that a reserved bit in byte 4 of the LOAD UNLOAD CDB be defined to cause the drive to prepare the cartridge for ejection without actually ejecting it or to load the cartridge without preparing it for access. Specifically, bit 3 will be named HOLD. When the LOAD bit is zero and HOLD is one, the cartridge will be held in the drive. When the LOAD bit is one and HOLD is one, the cartridge will be loaded but not threaded. When the HOLD bit is zero, the cartridge will be handled according to the current command specification.

Following is the modification to Table 9 of the SSC specification and of the relevant text. Changes and additions are shown in red.

Table 9 -- LOAD UNLOAD Command

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (1Bh)							

1	Reserved				IMMED
2	Reserved				
3	Reserved				
4	Reserved	HOLD	EOT	RETEN	LOAD
5	Control				

If the LOAD bit is set to one **and the HOLD bit is set to zero**, the medium in the logical unit shall be loaded and positioned to the beginning-of-partition zero. If the LOAD bit is zero **and the HOLD bit is zero**, the medium in the logical unit shall be positioned for removal at the extreme position along the medium specified by the EOT bit. Following successful completion of an unload operation, the device server shall return CHECK CONDITION status with the sense key set to NOT READY for all subsequent medium-access commands until a new volume is mounted or a load operation is successfully completed.

If the LOAD bit is set to one and the HOLD bit is set to one and the medium has not been moved into the logical unit, then the medium shall be moved in, but not positioned for access; EOT and RETEN shall be zero. Following successful completion, the device shall return CHECK CONDITION with the sense key set to UNIT ATTENTION and ASC and ASCQ set to MEDIUM AUXILIARY MEMORY ACCESSIBLE. The Medium Auxiliary Memory shall be accessible.

If the LOAD bit is set to zero and the HOLD bit is set to one and the medium is in the logical unit, then the medium shall be positioned as specified by the RETEN and EOT bits or shall be unthreaded (whichever is appropriate for the medium type) but shall not be ejected. The Medium Auxiliary Memory shall be accessible.

3.3 SCSI-3 BLOCK COMMANDS (SBC)

The SBC Start Stop Unit command seems the appropriate place to implement this functionality. The START and LOEJ (Load/Eject) bits are currently defined as:

A load eject (LOEJ) bit of zero requests that no action be taken regarding loading or ejecting the medium. A LOEJ bit of one requests that the medium shall be unloaded if the START bit is zero. A LOEJ bit of one requests that the medium is to be loaded if the START bit is one.

A START bit of zero requests that the block device be stopped (media shall not be accessed by the application client). A START bit of one requests the block device be made ready for use.

There is one more combination of these two bits, START bit of zero and LOEJ bit of zero

3.4 MULTIMEDIA COMMANDS (MMC)

In the Load/Unload Medium command (A6h), byte 4 bit 2 will be defined as HOLD. When LOUNL = 1, START = 1, and HOLD = 1, move the medium into the drive to the Hold state. (An alternative would be to use the remaining reserved combination of LOUNL + START (01b) for this function.)

When LOUNL = 1, START = 0, and HOLD = 1, prepare the medium for ejection by returning it to the Hold state.

3.5 SCSI BLOCK DEVICE COMMANDS (SBC) AND REDUCED BLOCK DEVICE COMMANDS (RBC)

In the Start Stop Unit command (1Bh), byte 4 bit 2 will be defined as HOLD. When LOEJ = 1, START = 1, and HOLD = 1, move the medium into the drive to the Hold state.

When LOEJ = 1, START = 0, and HOLD = 1, stop the device and prepare the medium for ejection by returning it to the Hold state. (Is this meaningful? Are there any operations to be carried out beyond those already done when LOEJ = 0 and STOP = 0?)

4 Open Issues

1. Should initiators be able to discover whether the Hold state -- i.e., the above Load/Unload modifications -- are implemented by a device? (This would avoid trying a command with the HOLD bit set and having it fail with an illegal field.) If so, how should this be communicated -- standard Inquiry data?
2. Should the Autoload Mode bits be in some mode page other than Control?
3. Some text is still needed to explain the two new ASC/ASCQs in terms of whether Load and MAM access commands can be accepted.