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TO: T10 SBP-3 working group

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RE: RBC-2 commands for extent management

This document contains the core of a set of commands that could be used by RBC-2 devices to manage and access "extents", regions of contiguously addressable logical blocks within a device's medium.

Extents are, in effect, dynamic partitions managed by the device instead of by data structures visible to the initiator. Some of the extents may be identified as accessible *via* a protocol foreign to RBC, *e.g.*, AV/C disks. Methods exist to make extents accessible to RBC while simultaneously preventing access by the foreign protocol and to subsequently return all control over the extent to the other protocol.

Where existing text in RBC would be affected, such as in a table or in a command, the modifications are shown with change bars. For entirely new commands, only the material changed from one revision of this document to the next is highlighted with change bars.

5 Reduced Block Commands

The Reduced Block Command set (RBC-2) for block device logical units is shown in Table 2.

Table 2 - Reduced Block Command set

Command name	OpCode	Command Support		Reference
		Fixed	Removable	
EXTENT DIRECTORY	XXh	O	O	RBC-2
EXTENT MANAGEMENT	XXh	O	O	RBC-2
QUERY EXTENT	XXh	O	O	RBC-2
READ EXTENT-RELATIVE	XXh	O	O	RBC-2
VERIFY EXTENT-RELATIVE	XXh	O	O	RBC-2
WRITE EXTENT-RELATIVE	XXh	O	O	RBC-2
Command Support key: M = support is mandatory; O = support is optional.				

The CONTROL byte (the last byte of the CDB) shall be set to zero.

5.0a EXTENT DIRECTORY command

The EXTENT DIRECTORY command (see Table 2a) provides a means for the initiator to request the directory of extents managed by the RBC device. An extent is a logically contiguous range of blocks identified by an EXTENT ID.

Table 2a - EXTENT DIRECTORY Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (XXh)							
1	Reserved							
2								
3	(MSB)	ALLOCATION LENGTH						
4								(LSB)
5	CONTROL = 00h							

EXTENT DIRECTORY data (see Table 2b) shall be returned to the initiator prior to the return of GOOD status for the command.

Table 2b - EXTENT DIRECTORY data

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			DEFAULT RBC EXTENT				
1								(LSB)
2	(MSB)			DATA LENGTH				
3								(LSB)
4	(MSB)			EXTENT DIRECTORY				
n								(LSB)

The DEFAULT RBC EXTENT specifies the extent ID to which RBC READ (10), READ CAPACITY, VERIFY (10) and WRITE (10) commands are mapped. If DEFAULT RBC EXTENT is zero, there is no default extent for RBC commands. Otherwise, the behavior of the data transfer commands is identical to the corresponding extent-relative commands with an EXTENT ID field equal to DEFAULT RBC EXTENT while a READ CAPACITY command returns capacity data for the extent identified by DEFAULT RBC EXTENT.

The DATA LENGTH field specifies the length in bytes of the following data that is available to be transferred. The value of DATA LENGTH does not include the number of bytes in the DATA LENGTH field itself.

The EXTENT DIRECTORY is a bit map that specifies whether or not particular extents are active and potentially accessible. The most significant bit represents extent ID zero and shall be zero. Subsequent, less significant bits represent sequentially increasing extent IDs. Byte *n* within the extent directory data, where *n* is greater than or equal to four, represents a range of eight extents from extent ID (*n* – 4) modulus 8 to extent ID ((*n* – 4) modulus 8) + 7, in order from the byte's most to least significant bit. If a bit is zero, its corresponding extent is not allocated. Otherwise, the corresponding extent is allocated and may be accessible by extent-relative data transfer commands. The QUERY EXTENT command may be used to obtain more information about the extent's size and other characteristics.

5.0b EXTENT MANAGEMENT command

The EXTENT MANAGEMENT command (see Table 2c) provides a means for the initiator to create, delete or in other ways manage extents on the device media. An extent is a logically contiguous range of blocks identified by an EXTENT ID.

Table 2c - EXTENT MANAGEMENT Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (XXh)							
1	Reserved				ACTION			
2	(MSB)							
3				EXTENT ID				(LSB)
4	(MSB)							
5				DATA FORMAT				(LSB)
6	(MSB)							
7				EXTENT SIZE				
8								
9								(LSB)
10	Reserved							
11	CONTROL = 00h							

The ACTION field specifies the EXTENT MANAGEMENT action requested, as encoded by Table 2d.

Table 2d - EXTENT MANAGEMENT action codes

Code	Name	Description
0	CREATE EXTENT	Create an extent with the data format and size specified.
1	DELETE EXTENT	Delete the extent identified by EXTENT ID an release its medium allocation.
2	LOCK EXTENT	Lock the extent identified by EXTENT ID for exclusive access by RBC commands.
3	UNLOCK EXTENT	Unlock the extent identified by EXTENT ID and release exclusive access.
4	DEFAULT RBC EXTENT	Set the default RBC extent to that specified by EXTENT ID.
5 - 15		Reserved

When the ACTION field specifies CREATE EXTENT, the contents of the EXTENT ID field are unspecified. Otherwise it shall contain an extent ID previously obtained by means of an EXTENT MANAGEMENT command with an ACTION of CREATE EXTENT.

The usage of the DATA FORMAT field is to be determined by the working group.

NOTE A value of zero should probably indicate an unspecified format, that is, there is no foreign protocol (such as AV/C) that can independently access and make sense of the data in this format. How many recording formats are there for AV/C? If vendor-dependent formats are permitted, how are they to be distinguished from each other?

The contents of the EXTENT SIZE field are specified only when the ACTION field equals CREATE EXTENT, in which case the device is requested to create an extent with at least as many blocks as specified by EXTENT SIZE

When the EXTENT MANAGEMENT command action is CREATE EXTENT, the ASSIGNED EXTENT ID (see Table 2e) shall be returned to the initiator prior to the return of GOOD status for the command.

Table 2e - ASSIGNED EXTENT ID

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			ASSIGNED EXTENT ID				
1								(LSB)

The ASSIGNED EXTENT ID field specifies the extent ID assigned by the device when an extent is successfully created.

5.1a QUERY EXTENT command

The QUERY EXTENT command (see Table 3a) provides a means for the initiator to request information about a particular extent managed by the RBC device.

Table 3a - QUERY EXTENT Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (XXh)							
1	(MSB)			EXTENT ID				
2								(LSB)
3	(MSB)			ALLOCATION LENGTH				
4								(LSB)
5	CONTROL = 00h							

The EXTENT ID field identifies the extent for which extent descriptor data is requested.

EXTENT DESCRIPTOR data (see Table 3b) shall be returned to the initiator prior to the return of GOOD status for the command.

Table 3b - EXTENT DESCRIPTOR data

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				EXTENT ID				(LSB)
2	(MSB)							
3				DATA FORMAT				(LSB)
4	(MSB)							
5								
6				EXTENT SIZE				
7								(LSB)
8	(MSB)							
9				DATA LENGTH				(LSB)
10								
n				EXTENT NAME				

The EXTENT ID field identifies the extent described by the extent descriptor data.

The usage of the DATA FORMAT field is to be determined by the working group.

The contents of the EXTENT SIZE field are specified only when the ACTION field equals CREATE EXTENT, in which case the device is requested to create an extent with at least as many blocks as specified by EXTENT SIZE

The DATA LENGTH field specifies the length in bytes of the following data that is available to be transferred. The value of DATA LENGTH does not include the number of bytes in the DATA LENGTH field itself.

The EXTENT NAME field is a variable-length field whose usage and meaning is determined by data format. It permits the name of an extent visible *via* another protocol to be correlated with the extent ID used by RBC-2 commands.

5.3 READ CAPACITY command

The READ CAPACITY command (see table 5) provides a means for the initiator to request either the current capacity of the entire RBC device or, if the device supports extent management, the capacity of the current default RBC extent.

Table 5 - READ CAPACITY Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (25h)							
1	Reserved						TOTAL	Reserved
2	Reserved							
3								
4								
5								
6								
7								
8								
9	CONTROL = 00h							

The TOTAL bit specifies the nature of the READ CAPACITY data requested by the initiator. If the device does not support extent management the TOTAL bit shall be ignored and the returned capacity data shall describe all of the device's addressable media. Otherwise, for devices that support extent management, a zero TOTAL bit specifies that the device shall return capacity data for the default RBC extent while a TOTAL bit equal to one specifies that the device shall return the total capacity of the device's addressable media. In the latter case, this shall include addressable media not allocated to any extent..

READ CAPACITY data (see Table 6) shall be returned to the initiator prior to sending GOOD status for the command.

Table 6 - READ CAPACITY data

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1	RETURNED BLOCK ADDRESS							
2								
3								(LSB)
4	(MSB)							
5	BLOCK LENGTH IN BYTES							
6								
7								(LSB)

For devices that do not support extent management or if the TOTAL bit in the READ CAPACITY command is one, the BLOCK LENGTH IN BYTES and the RETURNED BLOCK ADDRESS are those of the last

logical block of the media present in the device. Otherwise, the BLOCK LENGTH IN BYTES and the RETURNED BLOCK ADDRESS are those of the last logical block of the default RBC extent for the media present in the device.

If the device does not contain media, then it shall return status of CHECK CONDITION (02h), sense key of NOT READY (02h), and an ASC of LOGICAL UNIT NOT READY (04h). The ASCQ shall reflect the current state of the device or media.

5.3a READ EXTENT-RELATIVE Command

The READ EXTENT-RELATIVE command (see Table 6a) requests that the device transfer data to the initiator. The most recent data value written in the addressed block within the extent shall be returned.

Table 6a – READ EXTENT-RELATIVE Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (XXh)							
1	Reserved							
2	(MSB)							
3				RELATIVE BLOCK ADDRESS				
4								
5								(LSB)
6	Reserved							
7	(MSB)							
8				TRANSFER LENGTH				(LSB)
9	(MSB)							
10				EXTENT ID				(LSB)
11	CONTROL = 00h							

The RELATIVE BLOCK ADDRESS field specifies the first block, within the extent, of the range of logical blocks that shall be read.

The TRANSFER LENGTH field specifies the number of contiguous blocks of data that shall be transferred. A TRANSFER LENGTH of zero indicates that no blocks shall be transferred. This condition shall not be considered an error. Any other value indicates the number of blocks that shall be transferred.

The EXTENT ID field specifies the extent upon which the RELATIVE BLOCK ADDRESS is based.

5.6a WRITE EXTENT-RELATIVE Command

The WRITE EXTENT-RELATIVE command (see Table 11a) requests that the device transfer data from the initiator and write it on the medium.

Table 11a – WRITE EXTENT-RELATIVE Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (XXh)							
1	Reserved				FUA	Reserved		
2	(MSB)							
3				RELATIVE BLOCK ADDRESS				
4								
5								(LSB)
6	Reserved							
7	(MSB)							
8				TRANSFER LENGTH				(LSB)
9	(MSB)							
10				EXTENT ID				(LSB)
11	CONTROL = 00h							

A FORCE UNIT ACCESS (FUA) bit of zero indicates that the device may satisfy the command by accessing the cache memory if the WCD bit in RBC mode page 06h (see 5.8.3) is set to zero. For write operations, logical blocks may be transferred directly to the cache memory. GOOD status may be returned to the initiator prior to writing the blocks to the medium. Any error that occurs after GOOD status is returned is a deferred error.

A FUA bit of one indicates that the device shall access the media in performing the command prior to returning GOOD status. A WRITE command shall not return GOOD status until the blocks have actually been written on the media (i.e. the data is not write cached).

If the device supports write caching, FUA support shall be implemented. If write caching is NOT supported then the FUA bit may be ignored.

The RELATIVE BLOCK ADDRESS field specifies the first block, within the extent, of the contiguous range of blocks that shall be written.

The TRANSFER LENGTH field specifies the number of contiguous blocks of data that shall be transferred. A TRANSFER LENGTH of zero indicates that no blocks shall be transferred. This condition shall not be considered an error. Any other value indicates the number of blocks that shall be transferred.

The EXTENT ID field specifies the extent upon which the RELATIVE BLOCK ADDRESS is based.

5.7a VERIFY EXTENT-RELATIVE Command

The VERIFY EXTENT-RELATIVE command (see Table 12a) requests that the device verify the data written on the medium.

Table 12a – VERIFY EXTENT-RELATIVE Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (XXh)							
1	Reserved							
2	(MSB)							
3				RELATIVE BLOCK ADDRESS				
4								
5								(LSB)
6	Reserved							
7	(MSB)							
8				VERIFICATION LENGTH				(LSB)
9	(MSB)							
10				EXTENT ID				(LSB)
11	CONTROL = 00h							

The RELATIVE BLOCK ADDRESS field specifies the first block, within the extent, of the contiguous range of blocks that shall be verified.

The VERIFICATION LENGTH field specifies the number of contiguous blocks of data that shall be verified. A VERIFICATION LENGTH of zero indicates that no blocks shall be verified. This condition shall not be considered an error. Any other value indicates the number of blocks that shall be verified.

The EXTENT ID field specifies the extent upon which the RELATIVE BLOCK ADDRESS is based.

The VERIFY command verifies that the data previously written on the medium is readable without any uncorrectable errors at the time of execution of the command. It does not guarantee the information is complete or valid.