Date: October 10, 2005

To: T10 Committee (SCSI)

From: George Penokie (IBM/Tivoli)

Subject: SAM-4: Addressing more than 16384 logical units

1 Overview

There are storage subsystems that are exceeding the maximum number of LUNs (i.e., 16384) that are possible given the current logical unit number structures defined in SAM-4.

This proposal extends that number by defining one of the six byte extended logical unit addressing code to define a logical unit number structure to allow up to 1.1×10^{12} logical units.

2 SAM-4 changes

2.0.1 Single level logical unit number structure

Table 1 describes a single level subset of the format described in 4.9.5 for SCSI target devices that contain less than 257 logical units. logical unit numbers 255 and below.

Table 1 — Single level logical unit number structure for SCSI target devices that contain less than 257 logical units logical unit numbers 255 and below

Bit Byte	7	6	5	4	3	2	1	0
0	ADDRESS METHOD (00b)		BUS IDENTIFIER (00h)					
1	SINGLE LEVEL LUN (00h to FFh, inclusive)							
2	(MSB)		Null second level LUN (0000h)					
3								(LSB)
4	(MSB)		Null third level LUN (0000h)					
5								(LSB)
6	(MSB)		Null fourth level LUN (0000h)					
7								(LSB)

All logical unit number structure fields shall be zero except the SINGLE LEVEL LUN field (see table 1). The value in the SINGLE LEVEL LUN field shall be between 0 and 255, inclusive. The 00b in the ADDRESS METHOD field specifies peripheral device addressing (see 4.9.5) and the 00h in the BUS IDENTIFIER field specifies the current level (see 4.9.6).

Table 2 describes a single level subset of the format described in 4.9.5 for SCSI target devices that contains less than 16 384 logical units. logical unit numbers 16 383 and below.

Table 2 — Single level logical unit number structure for <u>SCSI target devices that contain less than 16 384 logical units</u> ~~logical unit numbers 16 383 and below~~

Bit Byte	7	6	5	4	3	2	1	0
0	ADDRESS METHOD (01b)		(MSB)					
1	SINGLE LEVEL LUN ~~(0000h to 3FFFh, inclusive)~~							(LSB)
2	(MSB)			Null second level LUN (0000h)				
3								(LSB)
4	(MSB)			Null third level LUN (0000h)				
5								(LSB)
6	(MSB)			Null fourth level LUN (0000h)				
7								(LSB)

All logical unit number structure fields shall be zero except the SINGLE LEVEL LUN field (see table 2). The value in the SINGLE LEVEL LUN field shall be between 0 and 16 383, inclusive. The 01b in the ADDRESS METHOD field specifies flat space addressing (see x.x.x) at the current level.

~~If a SCSI target device contains 256 or fewer logical units, none of which are dependent logical units (see 4.14) or extended addressing logical units (see 2.0.2), then its logical units should be numbered 255 and below, and should have the format shown in table 1 (i.e., peripheral device addressing) but may have the format shown in table 2 (i.e., flat space addressing).~~

~~If a SCSI target device contains 16 384 or fewer logical units, none of which are dependent logical units or extended addressing logical units, then its logical units should be numbered 16 383 and below, and should have the format shown in table 2 (i.e., flat space addressing) but may have the format shown in table 1 (i.e., peripheral device addressing) for logical unit numbers that are less than 256.~~

<u>Table 3 describes a single level subset of the format described in 4.9.5 for SCSI target devices that contain more than 16 383 logical units</u>.

Table 3 — Single level logical unit number structure for SCSI target devices that contain more than 16 383 logical units

Bit Byte	7	6	5	4	3	2	1	0
0	ADDRESS METHOD (11b)		LENGTH (01b)		EXTENDED ADDRESS METHOD (2h)			
1	(MSB)							
3		EXTENDED FLAT SPACE ADDRESS						(LSB)
8	(MSB)							
9		Null third level LUN (0000h)						(LSB)
6	(MSB)							
7		Null fourth level LUN (0000h)						(LSB)

All logical unit number structure fields shall be zero except the EXTENDED FLAT SPACE ADDRESS field (see table 3). The value in the EXTENDED FLAT SPACE ADDRESS field shall be between 00 0000h to FF FFFFh, inclusive. The 11b in the ADDRESS METHOD field with a 2h in the EXTENDED ADDRESS METHOD field specifies extended flat space addressing (see 2.0.5) at the current level. The 10b in the LENGTH field specifies that the LUN is five bytes in length.

If a SCSI target device contains 256 or fewer logical units, none of which are dependent logical units (see 4.14) or extended addressing logical units (see 2.0.2), then the SCSI target device's logical unit numbers:

    a) should have the format shown in table 1 (i.e., peripheral device addressing);
    b) may have the format shown in table 2 (i.e., flat space addressing); or
    c) may have the format shown in table 3 (i.e., extended flat space addressing).

If a SCSI target device contains more than 256 logical units and fewer than 16 384 logical units, none of which are dependent logical units (see 4.14) or extended addressing logical units (see 2.0.2), then the SCSI target device's logical unit numbers:

    a) should have the format shown in table 2 (i.e., flat space addressing); or
    b) may have the format shown in table 3 (i.e., extended flat space addressing).

If a SCSI target device contains more than 16 384 logical units, none of which are dependent logical units (see 4.14) or extended addressing logical units (see 2.0.2), then the SCSI target device's logical unit numbers:

    a) should have the format shown in table 3 (i.e., extended flat space addressing);
    b) may have the format shown in table 2 (i.e., flat space addressing) for up to 16 385 of the logical units within SCSI target device; or
    c) may have the format shown in table 1 (i.e., peripheral device addressing) for up to 256 of the logical units within SCSI target device.

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2.0.2 Extended logical unit addressing

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The EXTENDED ADDRESS METHOD field combined with the LENGTH field (see table 4) specifies the type and size of extended logical unit address found in the EXTENDED ADDRESS METHOD SPECIFIC field.

Table 4 — Logical unit extended addressing

EXTENDED ADDRESS METHOD Code(s)	LENGTH Code(s)	Description	Reference
0h	00b - 11b	Reserved	
1h	00b	Well known logical unit	2.0.3
1h	01b - 11b	Reserved	
2h	01b	Extended flat space addressing	2.0.5
2h	00b, 10b, 11b	Reserved	
23h - Eh	00b - 11b	Reserved	
Fh	00b - 10b	Reserved	
Fh	11b	Logical unit not specified	2.0.4

2.0.3 Well known logical unit addressing

A SCSI target device may support zero or more well known logical units (see 4.10). A single SCSI target device shall only support one instance of each supported well known logical unit. All well known logical units within a SCSI target device shall be accessible from all SCSI target ports contained within the SCSI target device.

Well known logical units are addressed using the well known logical unit extended address format (see table 5).

Table 5 — Well known logical unit extended address format

Bit Byte	7	6	5	4	3	2	1	0
n	ADDRESS METHOD (11b)		LENGTH (00b)		EXTENDED ADDRESS METHOD (1h)			
n+1	W-LUN							

The W-LUN field specifies the well known logical unit to be addressed (see SPC-3).

2.0.4 Logical unit not specified addressing

Logical unit not specified addressing (see table 6) shall be used to indicate that no logical unit of any kind is specified.

Table 6 — Logical unit not specified extended address format

Bit Byte	7	6	5	4	3	2	1	0
0	ADDRESS METHOD (11b)		LENGTH (11b)		EXTENDED ADDRESS METHOD (Fh)			
1	FFh							
2	FFh							
3	FFh							
4	FFh							
5	FFh							
6	FFh							
7	FFh							

2.0.5 Extended flat space addressing method

The extended flat space addressing method (see table 7) specifies a logical unit at the current level.

The contents of all hierarchical structure addressing fields following a flat space addressing method addressing field shall be ignored.

Table 7 — Extended flat space addressing

Bit Byte	7	6	5	4	3	2	1	0
n	ADDRESS METHOD (11b)		LENGTH (10b)		EXTENDED ADDRESS METHOD (2h)			
n+1	(MSB)							
n+3		EXTENDED FLAT SPACE ADDRESS						(LSB)

The EXTENDED FLAT SPACE ADDRESS field specifies a current level logical unit.