To: INCITS Technical Committee T10

From: Kevin Butt, IBM

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Subject: SPC: Time Of Day Settings

1. Revisions

04-271r0 - Initial Version

04-271r1 - Added a model section, change time base of clock to 48.16 (48 bits for seconds.16 bits for fractional seconds). Improve definition of clock format, have a descriptor for each clock that has been set returned.

2. Introduction

The intended use of this Time-Of-Day (TOD) setting is for capture in device logs such that they can be correlated to other devices in the system as well as application logs on the host. As such we see no need for guaranteeing no loss in precision from the transmit time. (i.e. Any losses to accuracy incurred by the time on the link are negligible and need not be accounted for.)

The ADI working group, in answering ADC Letter Ballot comments HP-139 and IBM Roberts-3 (both related to setting time of day to the device) has determined that this belongs in SPC and has given me an action to write and present this proposal to CAP. The direction suggested was to use a Maintenance-In and Maintenance-Out command for SET TIME OF DAY and GET TIME OF DAY commands. In working through this proposal, it is apparent that there are also mode parameters required to make this unambiguous. A model section seems also to be required.

3. Proposal

Add the following sections to SPC-3.

5.12 Device Clocks

5.12.1 Time-Of-Day Clock overview

A time-of-day clock may be used by a device server to assist in correlating the device logs to system logs and application logs. The method in which this correlation is done is outside the scope of this standard.

The time-of-day clock may be set by the devices itself, in which case it represents the time since power-on. The time-of-day clock may also be set by the SET TIME-OF-DAY command, or by out-of-band methods. Out-of-band methods are not described in this standard. If a time-of-day clock is used there shall only be one time-of-day clock per method per device.

Once a time-of-day clock is set it shall begin counting from that time forward.

5.12.2 Time-Of-Day Clock format

The time-of-day clock shall be a binary counter with a 64-bit format.

TABLE 39. Time-Of-Day Clock Format

Byte	7	6	5	4	3	2	1	0
0 : 5	Seconds							
6	Fractional Seconds							
7								

If a device uses a time-of-day clock with less precision than the entire 64 bits, the bits outside the precision shall be set to 0. A value of 00h, is intended to correspond to a time of January 1, 1970, 0:00 AM, Greenwich Mean Time (GMT). Application clients that set the time-of-day clock should use this definition. The device server shall use this definition.

This gives a resolution of approximately 16 usec and a max value of approximately 8.9 Million years.
Some systems have a sensitivity to 32 bit signed values that will roll-over in about 30 years and the next logical size seems to be 64 bits.

6.xx REPORT TIME-OF-DAY command

The REPORT TIME-OF-DAY command (see table xy) requests the the value of the devices time-of-day clock.

The REPORT TIME-OF-DAY command is a service action of the MAINTENANCE IN command. Additional MAINTENANCE IN service actions are defined in SCC-2 and in this standard. The MAINTENANCE IN service actions defined in SCC-2 apply only to logical units that return a device type of 0Ch or the SCCS bit equal to one in their standard INQUIRY data (see 6.4.2).

TABLE xyz. REPORT TIME-OF-DAY command

Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A3h)							
1	Reserved			SERVICE ACTION (0Fh)				
2 : 5	Reserved							
6 : 9	ALLOCATION LENGTH							
10	Reserved							
11	CONTROL							

The ALLOCATION LENGTH field specifies the number of bytes that have been allocated for the returned parameter data. An allocation length that is not sufficient to contain the entire parameter list shall not be considered an error.

If the complete list is required, the application client should send a new REPORT TIME-OF-DAY command with an allocation length large enough to contain the entire list.

The format of the parameter data returned by the REPORT TIME-OF-DAY command is shown in table yyy.

TABLE yyy. REPORT TIME-OF-DAY parameter data format

Byte	7	6	5	4	3	2	1	0
0	TIME-OF-DAY PARAMETER DATA LENGTH (n-3)							
3								
	Time-of-day descriptors							
4	First time-of-day descriptor (see table xxx)							
	:							
	Last time-of-day descriptor (see table xxx)							
n								

The TIME-OF-DAY PARAMETER DATA LENGTH field specifies the number of bytes of parameter data that follow.

Each time-of-day descriptor (see table xxx) contains time-of-day information for a single method.

TABLE xxx. Time-of-day descriptor

Byte	7	6	5	4	3	2	1	0
0	ADDITIONAL DESCRIPTOR LENGTH (n-1)							
1								
2	Reserved					TODCS		
3	Reserved							
4	TIME-OF-DAY							
11								

The time-of-day clock selection (TODCS) field reports the source of the TIME-OF-DAY value returned

TABLE xx. TIME-OF-DAY CLOCK Field

Value	Definition
000b	Time from power-on in time-of-day clock format.
001b	Reserved

TABLE xx. TIME-OF-DAY CLOCK Field

Value	Definition
010b	Time-of-day value of the clock set by a SCSI command
011b	Time-of-day value of the clock set by Out-of-band (e.g. SCSI Protocol Specific) methods
100b - 111b	Reserved

The TIME-OF-DAY field contains the current value of the time-of-day clock.

6.yy SET TIME-OF-DAY command

The SET TIME-OF-DAY command (see table xx) is used to provide the device with an estimate of the time-of-day. The time-of-day set by this command shall remain in effect until one of the following occurs:

a) Another SET TIME-OF-DAY command is received;

b) The TODM field of the Control Extension mode page is set to 01b or 11b and a protocol specific method of changing the time-of-day is received; or

c) Hard reset.

The time-of-day set by this command shall not be affected by an I_T nexus loss and should not be affected by a Logical Unit reset.

The SET TIME-OF-DAY command is a service action of the MAINTENANCE OUT command. Additional MAINTENANCE OUT service actions are defined in SCC-2 and in this standard. The MAINTENANCE OUT service actions defined only in SCC-2 apply only to logical units that return a device type of 0Ch or the sccs bit equal to one in their standard INQUIRY data..

TABLE xx. SET TIME-OF-DAY command

Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A4h)							
1	Reserved			SERVICE ACTION (0Fh)				
2	Reserved							
5								
6	ALLOCATION LENGTH							
9								
10	Reserved							
11	CONTROL							

The PARAMETER LIST LENGTH field specifies the length in bytes of the SET TIME-OF-DAY parameter list (see table zzz) that shall be contained in the Data-Out Buffer. A parameter list length of zero indicates that the Data-Out Buffer shall be empty. This condition shall not be considered as an error.

TABLE xxx. SET TIME-OF-DAY parameter list format

Byte	7	6	5	4	3	2	1	0
0	ADDITIONAL LENGTH (n-1)							
1								
2	Reserved							
3	Reserved							
4	TIME-OF-DAY							
11								

The ADDITIONAL LENGTH field indicates the number of bytes that follow in the SET TIME-OF-DAY parameter list.

The TIME-OF-DAY field shall contain the current time-of-day value in Time-Of-Day Clock Format (see Table 39). If the high order byte is set to any number greater than X'F0', the device server shall return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN PARAMETER LIST.

7.4.7 Control Extension mode page

The Control Extension mode page (see table 233) is a subpage of the Control mode page (see 7.4.6) provides controls over SCSI features that are applicable to all device types. The mode page policy (see 6.7) for this subpage shall be shared. If a field in this mode subpage is changed while there is a task already in the task set, it is vendor specific whether the old or new value of the field applies to that task.

TABLE 239. Control Extension mode page

Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (0Ah)					
1	SUBPAGE CODE (01h)							
2	PAGE LENGTH (1Ch)							
3								
4	Reserved		TODM			TODCO	TODCS	IALUAE
5	Reserved				INITIAL PRIORITY			
6	Reserved							
31								

The PS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.4.5.

An implicit asymmetric logical unit access enabled (IALUAE) bit set to one specifies that implicit asymmetric logical unit access state changes (see 5.8.2.7) are allowed. An IALUAE bit set to zero specifies that implicit asymmetric logical unit access state changes be disallowed and indicates that implicit asymmetric logical unit access state changes are disallowed or not supported.

A time-of-day changeable via SCSI (TODCS) bit set to one specifies that the time-of-day clock is changeable via the SET TIME OF DAY command. A TODCS bit set to zero specifies the time-of-day clock is not changeable via the SET TIME-OF-DAY command.

A time-of-day changeable via out-of-band methods (TODCO) bit set to one specifies that the time-of-day clock is changeable via out-of-band methods. A TODCO bit set to zero specifies that the time-of-day clock is not changeable by out-of-band methods.

A time-of-day method (TODM) field specifies the method to used to set the time-of-day clock. Table x shows the useage of the TODM field.

TABLE X. TIME-OF-DAY METHOD Field

Value	Definition
000b	Use internal clock as time-of-day clock
001b	Use last time-of-day setting received by any method
010b	SCSI command method overrides protocol specific method
011b	Out-of-band (e.g. SCSI Protocol Specific) method overrides SCSI command method
100b - 111b	Reserved

The INITIAL PRIORITY field specifies the priority that may be used as the task priority (see SAM-3) for tasks received in any I_T_L nexus where a priority has not been modified by a SET PRIORITY command (see 6.29). If a MODE SELECT command specifies an initial priority value that is different than the current initial priority then the device server shall set any priorities that have not be set with a SET PRIORITY command to a value different than the new initiator priority value to the new priority. The device server shall generate a unit attention condition for any I_T_L nexus that receives a new priority with an additional sense code of PRIORITY CHANGED.

ADCr06b

Add the following rows to Table 5.

TABLE 5. — Command set for automation drive interface

Command name	Operation code	Required	Reference	Notes
REPORT TIME-OF-DAY	A3h/0Fh	Optional	SPC-3	
SET TIME-OF-DAY	A4h/0Fh	Optional	SPC-3	