February 14, 1987

William E. Burr, X3T9.2 Chairman
National Bureau of Standards
Room A-216, Bldg. 225
Gaithersburg, MD 20899

Dear Bill,

Attached is proposed wording for the REQUEST SENSE command which I believe will resolve my objections to Jeff Stai's proposal on adding error count reporting to the field pointer byte field (reference X3T9.2/86-97). I have renamed these three bytes the "Sense-Key Specific Bytes". Their meaning depends on which sense key is returned and they are not defined (vendor unique) if the upper bit is not set to one. I have retained the field pointer byte definition for ILLEGAL REQUEST and have included Jeff's definition for RECOVERED ERROR and MEDIUM ERROR. Definitions for other sense keys are reserved.

Also included are some wording changes suggested at the recent working group meetings.

Regards,

John Lohmeyer

cc: Ron Engelbrecht

Proposal for Sense-Key Specific Bytes (plus other miscellaneous items) 2/14/87

7.1.2. REQUEST SENSE Command

  Peripheral Device Type: All
  Operation Code Type: Mandatory

Table 7-3: REQUEST SENSE Command

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Allocation Length							
5	Vendor Unique		Reserved				Flag	Link

The REQUEST SENSE command (Table 7-3) requests that the target transfer sense data to the initiator.

The sense data shall be valid for a CHECK CONDITION status returned on the prior command. This sense data shall be preserved by the target for the initiator until retrieved by the REQUEST SENSE command or until the receipt of any other command for the same logical unit from the initiator that issued the command resulting in the CHECK CONDITION status. Sense data shall be cleared upon receipt of any subsequent command to the logical unit from the initiator receiving the CHECK CONDITION status. [Expand to include "contingent allegiance" concepts]

The allocation length specifies the maximum number of bytes that the initiator has allocated for returned sense data. An allocation length of zero indicates that no sense data shall be transferred. This condition shall not be considered as an error. The target shall terminate the DATA IN phase when allocation length bytes have been transferred or when all available sense data have been transferred to the initiator, whichever is less.

The REQUEST SENSE command shall return the CHECK CONDITION status only to report fatal errors for the REQUEST SENSE command. For example:

(1) The target receives a nonzero reserved bit in the command descriptor block.
(2) An unrecovered parity error occurs on the DATA BUS.
(3) A target malfunction prevents return of the sense data.

If any nonfatal error occurs during the execution of the REQUEST SENSE command, the target shall return the sense data with GOOD status.

Following a fatal error on a REQUEST SENSE command, sense data may be invalid.

Table 7-4: Error Codes 70h and 71h Sense Data Format

Bit Byte	7	6	5	4	3	2	1	0
0	Valid	Error Code (70h or 71h)						
1	Segment Number							
2	Filemark	EOM	ILI	Reserved	Sense Key			
3 - 6	(MSB)	Information Bytes						(LSB)
7	Additional Sense Length (n-7)							
8 - 11	(MSB)	Command Specific Information Bytes						(LSB)
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit Code							
15 to 17	SKSV	Sense-Key Specific Bytes						
18 to n	Additional Sense Bytes							

A valid bit of zero indicates that the information bytes are not as defined in this standard. A valid bit of one indicates the information bytes contain valid information as defined in this standard.

Error code values of 00h to 6Fh are not defined by this standard. Their use is not recommended. The sense data format for error codes 70h (current errors) and 71h (deferred errors) are defined in Table 7-4. Error code values of 72h to 7Eh are reserved. Error code 7Fh is set aside for a vendor unique sense data format.

The segment number contains the number of the current segment descriptor if the extended sense is in response to a COPY, COMPARE, or COPY AND VERIFY command. Up to 256 segments are supported beginning with segment zero.

The filemark bit indicates that the current command has read a filemark. This bit is only used for sequential-access devices.

The end-of-medium (EOM) bit indicates that an end-of-medium condition (end-of-tape, beginning-of-tape, out-of-paper, etc) exists on a sequential access device or printer device. For sequential-access devices, this bit indicates that the unit is at or past the early-warning end-of-tape if the direction was forward or that the command could not be completed because beginning-of-tape was encountered if the direction was reverse. Direct access devices shall not use this bit; instead, these devices shall report attempts to access beyond the end-of-medium as ILLEGAL REQUEST sense key (see Table 7-7).

The incorrect length indicator (ILI) bit indicates that the requested logical block length did not match the logical block length of the data on the medium.

The sense keys are described in Tables 7-7 and 7-8.

The contents of the information bytes are device-type or command specific and are defined within the appropriate section for the device type or command of interest. Unless specified otherwise, these bytes contain:

(1) The unsigned logical block address associated with the sense key, for direct-access devices (Type 0), write-once read-multiple devices (Type 4), and read-only direct-access devices (Type 5).

(2) The difference (residue) of the requested length minus the actual length in either bytes or blocks, as determined by the command, for sequential-access devices (Type 1), printer devices (Type 2), and processor devices (Type 3). (Negative values are indicated by two's complement notation.)

(3) The difference (residue) of the requested number of blocks minus the actual number of blocks copied or compared for the current segment descriptor of a COPY, COMPARE, or COPY AND VERIFY command.

The command-specific information bytes contain information that depends on the command which was executed. Further meaning for these bytes is defined within the command description. See COPY, COMPARE, COPY AND VERIFY, SEARCH DATA, and REASSIGN BLOCKS commands.

The additional sense length specifies the number of additional sense bytes to follow. If the allocation length of the command descriptor block is too small to transfer all of the additional sense bytes, the additional sense length is not adjusted to reflect the truncation.

The additional sense codes and the additional sense code qualifiers are defined in the appropriate appendix [but should be defined within the standard] to provide additional information related to the condition that caused the CHECK CONDITION status.

Nonzero values in the field replaceable unit field are used to define a device-specific mechanism or unit that has failed. A value of zero in this field shall indicate that no specific mechanism or unit has been identified to have failed or that the data is not available. The format of this information is not specified in this standard.

The sense-key specific bytes are described in section 7.1.2.1, below.

The additional sense bytes may contain command-specific data, peripheral-device-specific data, or vendor-unique data that further defines the nature of the CHECK CONDITION status.

7.1.2.1. Sense-Key Specific Bytes

The meaning of the sense-key specific bytes depends on which sense key is returned and whether the sense key specific valid (SKSV) bit is one. If the SKSV bit is zero, then these bytes are not defined by this standard. These bytes are reserved for sense keys not described below.

If the sense key is ILLEGAL REQUEST and if the SKSV bit is one, then the sense key specific bytes shall be defined as shown in Table 7-5. These fields point to the illegal parameter.

Table 7-5: Field Pointer Bytes

Bit Byte	7	6	5	4	3	2	1	0
15	SKSV	C/D	Reserved	Reserved	BPV		Bit Pointer	
16	(MSB)			Field Pointer				
17								(LSB)

A command/data (C/D) bit of zero indicates that the illegal parameter is in the command descriptor block. A C/D bit of zero indicates that the illegal parameter is in the data parameters sent by the initiator during the DATA OUT phase.

A bit pointer valid (BPV) bit of zero indicates that the bit pointer field is not valid. A BPV bit of one indicates that the bit pointer field specifies which bit of the byte designated by the field pointer field is in error. When a multiple-bit field is in error, the bit pointer field shall point to the most-significant (left-most) bit of the field.

The field pointer field indicates which byte of the command descriptor block or of the parameter data was in error. Bytes are numbered starting from zero, as shown in the tables describing the commands and parameters. (IMPLEMENTORS NOTE: Bytes identified as being "in error" are not necessarily the place that has to be changed to correct the problem.)

If the sense key is RECOVERED ERROR or MEDIUM ERROR and if the SKSV bit is one, then the sense key specific bytes shall be defined as shown in Table 7-6.

These fields identify the actual number of retries used in attempting to recover from the error condition.

Table 7-6: Actual Retry Count Bytes

Bit Byte	7	6	5	4	3	2	1	0
15	SKSV			Reserved				
16	(MSB)			Actual Retry Count				
17								(LSB)

The actual retry count field returns implementation-specific information on the actual number of retries used in attempting to recover an error or exception condition. It is recommended that this field relate to the retry count fields specified within the error recovery parameters page of the MODE SELECT command.

7.1.2.2. Deferred Errors

Error code 70h indicates that the CHECK CONDITION status returned is the result of an error or exception condition on the command that returned the CHECK CONDITION status. Error code 71h indicates that the CHECK CONDITION status returned is the result of an error or exception condition not related to the command that returned the CHECK CONDITION status (deferred error). The current command has not been performed. After the target detects a deferred error condition on a logical unit, it shall report CHECK CONDITION status to the next initiator that attempts to access that logical unit (not necessarily the same initiator that caused the deferred error). The error code in extended sense shall be set to 71h. [Do we need to include a field that identifies which initiator caused the deferred error?]

7.1.2.3. Reporting Log Information

If logging of statistical information about the device or medium is implemented, under certain circumstances the log information is appended to the sense data as additional sense bytes. Refer to the PER and ALS bits in the error recovery and reporting page of the MODE SELECT command for more information.

Table 7-7: Sense Key (0h-7h) Descriptions

Sense Key	Description
0h	NO SENSE. Indicates that there is no specific sense key information to be reported for the designated logical unit. This would be the case for a successful command or a command that received a CHECK CONDITION status because one of the filemark, EOM, or ILI bits is set to one. [Update?]
1h	RECOVERED ERROR. Indicates that the last command completed successfully with some recovery action performed by the target. Details may be determinable by examining the additional sense bytes and the information bytes.
2h	NOT READY. Indicates that the logical unit addressed cannot be accessed. Operator intervention may be required to correct this condition.
3h	MEDIUM ERROR. Indicates that the command terminated with a nonrecovered error condition that was probably caused by a flaw in the medium or an error in the recorded data. This sense key may also be returned if the target is unable to distinguish between a flaw in the medium and a specific hardware failure (sense key 4h).
4h	HARDWARE ERROR. Indicates that the target detected a nonrecoverable hardware failure (for example, controller failure, device failure, parity error, etc) while performing the command or during a self test.
5h	ILLEGAL REQUEST. Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands (FORMAT UNIT, SEARCH DATA, etc). If the target detects an invalid parameter in the command descriptor block, then it shall terminate the command without altering the medium. If the target detects an invalid parameter in the additional parameters supplied as data, then the target may have already altered the medium.
6h	UNIT ATTENTION. Indicates that the removable medium may have been changed or the target has been reset. See 6.1.3 for more detailed information about the unit attention condition. [Needs updating.]
7h	DATA PROTECT. Indicates that a command that reads or writes the medium was attempted on a block that is protected from this operation. The read or write operation is not performed.

Table 7-8: Sense Key (8h-Fh) Descriptions

Sense Key	Description
8h	BLANK CHECK. Indicates that a write-once read-multiple device or a sequential-access device encountered blank medium or format-defined end-of-data indication while reading or a write-once read-multiple device encountered a nonblank medium while writing.
9h	Vendor unique. This sense key is available for reporting vendor unique conditions.
Ah	COPY ABORTED. Indicates a COPY, COMPARE, or COPY AND VERIFY command was aborted due to an error condition on the source device, the destination device, or both. (See 7.1.4.2 for additional information about this sense key.)
Bh	ABORTED COMMAND. Indicates that the target aborted the command. The initiator may be able to recover by trying the command again.
Ch	EQUAL. Indicates a SEARCH DATA command has satisfied an equal comparison.
Dh	VOLUME OVERFLOW. Indicates that a buffered peripheral device has reached the end-of-medium and data remains in the buffer that has not been written to the medium. A RECOVER BUFFERED DATA command(s) may be issued to read the unwritten data from the buffer. [Update?]
Eh	MISCOMPARE. Indicates that the source data did not match the data read from the medium.
Fh	This sense key is reserved.