INQUIRY COMMAND ENHANCEMENTS
DRAFT DOCUMENT
LEVEL 3/18/87

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1.0 INTRODUCTION

1.1 SCOPE OF PROPOSAL

This is a proposal for changes to the Inquiry command to support a more useful and powerful data reporting capability which is needed in the service and maintenance of SCSI devices.

1.2 BACKGROUND

This section supplies the background information required to understand what VPD is and why it is needed. This discussion will incorporate the following acronyms which are defined here.

EC Engineering Change.

FRU Field Replaceable Unit. A self-contained modular component of a device which can be uniquely identified and replaced. This could include mechanical components such as cards, power supplies and disk enclosure. It could also include non-mechanical items such as ucode.

VPD Vital Product Data.

VPDI Vital Product Data Identifier

1.2.1 WHAT IS VITAL PRODUCT DATA

As it's name implies, Vital Product Data (VPD) is product data which is unique to a particular device. It is considered vital in both the manufacturing of a device as well as more importantly, in the service of the device at the customers location.

The device product data consists of both general and device specific information. General information such as Manufacturer, Product ID, and FRU list are common among devices of the same product. Device specific information such as serial number and EC levels of the various FRUs are unique to that particular device within the product family. Together, the general and device specific information allow a system to determine not only which FRUs exist, but what EC level they may be at.

The following list provides examples of both general and device specific information.

- Power Supply
- Fans
- Disk Enclosure
- Cards, Boards
- Ucode level, either ROM or RAM based

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1.3 WHY IS VPD NEEDED?

The ability of both systems and devices to support sophisticated service strategies require a means of reporting detailed information. Two service strategies which come to mind point this out.

The first strategy deals with remote service via telecommunications. In this environment, a host system can self-diagnose and automatically (via modem) request service from a service organization without the knowledge or intervention of the user. In such a case, a method for reporting not only general product information (ID and Model) but also the additional device specific information (EC level and FRU ID which failed) unique to that device is needed. In this case, the service engineer has a high probability of successful repair to the device on the first visit. By identifying down to a FRU level, only that FRU and not a complete device replacement needs to be ordered from a central warehouse and transported to the customers location. Finally, by identifying an EC level for other FRUs in the device, functional compatibility with the replacement FRU can be ensured. All of these items add up to a significant savings in service time and ultimately service cost. Although required for remote telecommunications service, this same capability at the device level naturally extends to a more modest scheme were by the host system merely reports the same information directly to the customer who then calls it in kicking off the same scenario as previously described.

The second strategy concentrates more at the device than system level. In the case of small devices such as 5.25 or 3.5, there is precious little board space available. Adding such items as LED(s) and 7 segment displays for diagnostic purposes not only takes up real-estate, but adds cost and is in many cases hidden from view when packaged within a subsystems. In the case of larger devices and complete subsystems, the real-estate for a maintenance panel may not be a concern but the additional cost is. Also, the unpopularity of the typically cryptic front panel display may not support a customer self-service strategy. As an example to illustrate the need for VPD on small devices, take the case were a device can support custom ucode on a per system basis. In repairing such a device, the service engineer needs to know the EC level and version of the original ucode that was running on the system in order to perform a satisfactory repair action. Such information could be gained via a system utility which can make use of CRT displays to go beyond the limitations of a cryptic maintenance panel.

A third comment to make is that in some systems, automatic self-configuration is performed in which not only the device type and model are needed but also the particular devices serial number. SCSI does not have a serial number field defined today and in some cases the current device and model number fields are to small. This proposal will define a way for the developer of SCSI devices to support variable length fields without effecting the current or past versions of SCSI.

With sophisticated device support for both self-diagnostics and FRU identification, a means for reporting this information to the host is needed. This information is essential for a cost effective servicing strategy were it is not physically practical to read VPD information from a device.

1.3.1 WHY STANDARDIZE VPD COMMANDS?

The need for standardization arises from the fact that SCSI has grown-up. Initially, it was viewed for use only on small computer systems (PC) were the user was capable and amenable to performing device maintenance. This however is no longer the case. As the use of SCSI extends into larger systems, the users role in device maintenance can be reduced. This is occurring just as the ability of those devices to self-diagnose and report problems is increasing. In order to take advantage of these devices and to reduce the user maintenance role, market pressures will force more and more devices and systems to adopt a reduced user role in maintenance. As the number of these devices grow in the marketplace, the need for a common architected manner of reporting this information will become even more evident.

1.4 JUSTIFICATION FOR USING THE INQUIRY COMMAND

This proposal extends the definition of the INQUIRY command to support the added requirements of VPD reporting and updating. The use of the INQUIRY command for reporting VPD has a number of advantages.

1. The current definition of the INQUIRY command already allows it to serve as a mini-VPD command. If another command were defined for this purpose, the Inquiry data would have to be replicated in both making the INQUIRY command essentially useless.

2. The Inquiry command is a special command in SCSI that can execute through a Unit Atn. Typically, device ucode already invests effort to handle the Inquiry command in a special manner. The reporting of VPD data must also be handled in a special manner especially in the case of a broken device which can not load it's executable code from the media. A desire to limit the size of the ROM resident code and reduce the complexity of the SCSI implementation would suggest that limiting the number of special cases such as Inquiry to a minimum.

3. Some device are required to fence themselves after failing power up diagnostics. Although not in the standard, one of the commands (other than Request Sense) which these devices should respond to is Inquiry.

For these reasons, it makes sense to use Inquiry as the basis for the VPD READ capability. For the purposes of Writing VPD to a device, Inquiry could also be used. This would require the breaking with the the arbitrary SCSI convention of allowing only uni-directional data phases per command and define a bi-directional data phase which again would execute through a Unit Atn but even more importantly through a Not Ready even if a device were broken.

Note: During normal operation, it is not anticipated that the Initiator will need the enhanced capability of the Inquiry command. Normally, the Initiator will be content with the summary Inquiry data for system configuration. Use of the enhanced capabilities of the Inquiry command is primarily intended for use when a FRU failure occurs which requires further identification or update of VPD.

Note: The definition of the VPD command could be implemented in the previously mentioned manner by using a vendor unique bit to redefine the command. Those devices which do not implement the VPD definition of INQUIRY would hopefully return Check Condition. This is not full-proof however since some

other devices may actually define the vendor unique field for another purpose and accept the command. Therefore, it is much better to get these bits defined in the standard.

Note: It may appear at first glance that the specification for VPD format should be made in the DESIRED FORMAT field. However, note that this field is commonly used to specify the version of SCSI for other commands and should not be played with unless a previously defined reserved field (i.e. Mode) can serve as a check for older implementations.

Peripheral Device Type: All
Operation Code Type: Mandatory

Table - : Inquiry Command

bit / byte	7	6	5	4	3	2	1	0
0	Op Code = (12h)							
1	LUN			PF	Rsvd = 0			T/L
2	Page Code							
3	Reserved = 0							
4	Allocation Length							
5	Vendor Uniq	Reserved = 0					Flag	Link

The INQUIRY command provides a means of reporting the Vital Product Data (VPD) of the Target and associated LUN(s). VPD is a general term used to describe such items as configuration data (Vendor ID, PRODUCT ID, MODEL, SERIAL NUMBER), manufacturing data (PLANT and DATE of manufacture) as well as detailed information for any number of Field Replaceable Units (FRUs). Each element of VPD has associated with it a VPD Identifier (VPDI) to provide addressability to that piece of information. A VPDI can be associated with a single FRU or with a group of FRUs. A VPDI can also be associated with a single piece of information such as a LUN serial number or with a group of information such as configuration data.

Both a mandatory and an optional level of implementation is defined for the INQUIRY command. The mandatory level is backward compatible with earlier versions of SCSI and allows the Initiator to determine the bus configuration at power-up time. The optional level allows the Initiator to request detailed VPD information from the Target or associated LUN required to service a device. The content of the detailed VPD is vendor unique and can not be interpreted by a host operating system without having intimate knowledge of the device. However, defined within this standard is a reporting format which permits the creation of device independent host system software to display VPD information associated with a defective FRU such as would be indicated in byte 14 of the Request Sense data.

The Page Format (PF) bit of zero indicates that Inquiry data format is as specified in ANSI X3.131-1986. A PF bit of one indicates that the Inquiry data format is as specified in this document.

The Target or LUN (T/L) bit of 1 indicates that the requested VPD should come from the Target specified at selection time while a value of 0 indicates that the requested VPD should come form the LUN specified in the Identify message.

The Page Code (PC) field specifies which page to return. It is only valid when the PF bit is one. The page codes are defined in Figure 1 on page 6.

Page Code	Description
00h	List of VPD Identifiers
01h - 3Fh	Reserved
40h - 7Fh	Vendor Unique
80h - FFh	FRU code as returned in Request Sense data byte 14

The ALLOCATION LENGTH field indicates the MAXIMUM number of bytes that the Initiator has allocated for the returned INQUIRY data. An Allocation length of zero indicates that no INQUIRY data shall be transferred and is not considered an error. The Target shall terminate the DATA IN phase when either all available INQUIRY data bytes have been transferred to the Initiator or the allocation length has been transferred.

2.1.1 SPECIAL EXECUTION RULES

Inquiry is a special command in SCSI which will always execute even when a Unit Attention condition exists. If an INQUIRY command is received from an initiator with a pending unit attention condition (before the target reports CHECK CONDITION status), the target shall perform the INQUIRY command and shall not clear the unit attention condition.

The ability for the Inquiry command to execute at all times is vital when a device error occurs. In such a case, normal command execution may be prohibited and a CHECK CONDITION would be returned. The follow-up sense data would contain the failing FRU ID. Execution of the optional mode of the Inquiry command will then allow the initiator to obtain detailed VPD information for the device and the FRU in error.

2.1.2 ESTABLISHING COMMUNICATION VERSION LEVEL (PF=0)

The Inquiry command is used to establish the SCSI version level at which communication between two devices will take place. This becomes increasingly important as the number of SCSI versions grow and permits newer devices which can support multiple SCSI versions, to effectively negotiate a common version level with an older device on the bus.

The established version level is only defined between the two devices participating in the negotiation and does not apply to other devices on the bus. Thus, it is possible for a multi-protocol device 'A' to communicate with device 'B' at a version 1 level and device 'C' at version 2 level.

> **Note:** This assumes that the differences between SCSI versions does not effect the basic bus timings and link level protocol. If later versions do define different timings, this may limit a device from supporting multiple versions on the same physical bus.

For a T/L=PF=0, the Page Code field not only defines to the Target the version number of SCSI to which the format of the returned Inquiry data should conform,

it also defines to the Target the version level of SCSI under which all further communication with that Initiator should occur. If the Initiator specifies a Page Code which is not supported by the Target, then the Target should not return CHECK CONDITION but rather return the data formatted at the Target's highest version level and indicate that level in the Response Data Format field (byte 3) of the data phase.

Note: If the Initiator can not accommodate the Target's version level, then it is the responsibility of the Initiator to re-issue the command with a lower PC value (it is assumed that the Initiator started with the highest) until an agreed upon version level is reached between the initiator and the Target. Whenever the Target can not support the Initiators proposed version level, the Target should continue to return it's highest level until a supported version level is presented by the Initiator. (This is the only means of indicating to a lower level Initiator the true capabilities of the Target).

Note: Rather than return a supported version level of SCSI, pre-version 2 devices may return CHECK CONDITION for a non-supported page code when PF=0.

2.1.3 RESPONDING TO UNSUPPORTED PAGE CODES (PF=1)

Support for PF=1 is optional. If it is not supported by a Target, then CHECK CONDITION should be returned.

When PF=1 and the Initiator specifies a page code which is not supported by the Target, then a CHECK CONDITION shall be returned.

Note: The Initiator can determine the supported page codes of the Target and LUN by requesting the summary VPD format (PF=1, Page Code = 0).

2.1.4 UNSUPPORTED LUN SPECIFICATION

For page code zero, a device shall respond to an unsupported LUN by returning the summary Inquiry data with device type 7F (Logical Unit Not Present).

For page codes other than zero (where non-summary data format is being requested), the response to an unsupported LUN is identical to that of other commands. (CHECK CONDITION with ILLEGAL PARM sense key).

2.1.5 NOTES

Note: The summary INQUIRY data should be returned even though the peripheral device may not be ready for other commands. This suggests that the summary data should be available without requiring a media access. In addition, the optional modes of the Inquiry should also be executable especially in the case of a hardware error were a FRU failure has been identified by the Request Sense data and detailed VPD information is requested by the Initiator.

Note: In the implementation of some systems, the prompt response to an Inquire command is required to determine the bus configuration. In such systems,

stringent timeout limitations may exist which require that the Inquiry command execute without delays for motor start-up or internal device diagnostics. In such a case, the system should limit itself to requesting only summary VPD data within the timeout period.

Note: There is no attempt to define the location or method of storing INQUIRY data for the Target and LUN(s). Target VPD data could be stored in the Target or on 1 or more LUNs. Likewise, the LUN VPD could be stored in the Target, on the same LUN or on a different LUN under the Target. The method of saving the VPD data could include hard-wired, switches, EEPROM, media, etc. The availability of the data may also be a function of the storage location and method as accessibility to the data may require a motor spin-up or completion of diagnostics. Time critical requirements are an implementation consideration and not addressed in this standard.

Note: Another device type 'Target' should be defined. It is needed when the summary VPDI list is requested from the Target.

Note: The mechanism for storing and/or processing of the VPD data is vendor unique and assumes a detailed knowledge of the Target/LUNs design.

Note: It is possible to combine multiple FRUs under a single VPDI. It is also possible for a single FRU to appear in more than one VPDI. Such implementations are vendor unique and are not described in this standard.

2.1.6 SUMMARY VPD FORMAT (PF=0, PAGE CODE=N)

Table 7-8: Summary VPD Format

bit byte	7	6	5	4	3	2	1	0
0	Peripheral Device Type							
1	RMB	Device Type Qualifier						
0	ISO Version		ECMA Version			ANSI-Approved Versn		
3	Reserved = 0				Response Data Format			
4	Additional Length (n-4)							
5 7	Reserved							
8 15	Vendor ID							
16 31	Product ID							
32 35	Product Revision Level							
36 55	Vendor Unique							
56 95	Reserved							
96 255	Vendor Unique							

The Summary VPD Format is the only mandatory command mode. It is typically used at power-up time to configure the bus. The RDF field identifies the level of SCSI to which the following data is formatted. The RDF field also indicates the version of level to be used for all further communications with the Initiator.

The INQUIRY data contains 36 required bytes, followed by a variable number of vendor unique parameters. Bytes 0 thru 7 are value fields while byte 8 thru 36 are ASCII character fields. The definition for these fields is not repeated here but can be found in the version 2 SCSI standard.

Note: In order to assist in the writing of generic host software, bytes 36 thru 55 should be ASCII fields capable of being directly displayed on the operator console.

Note: Each ASCII field is left justified with an ASCII blank used to indicate End Of Field. Also, the ASCI characters should be limited to those graphics codes in the range of 20h thru 7Fh.

Note: Recent debate has surfaced over which Product ID, Vendor ID and Revision Level is returned in the summary Inquiry data when a device may consist of a subsystem manufactured by company x (Target) with components (LUNs) manufactured by companies y and z. The information being returned should be associated with that portion of the subsystem which handles communications on the SCSI bus. All other subsystem components can be considered FRUs and reported in the vendor unique area of the summary command or in the optional detailed VPD implementations defined to this standard. Also note that the use of the T/L bit for the optional modes does away with the ambiguity of which component of the system is reporting the data.

Note: For this mode, data should be made available without delay resulting from media spin-up or for the completion of all internal device diagnostics. Once the ability to be selected is established, the execution of this command should not be delayed for mechanical or diagnostic reasons.

2.1.6.1 Summary List of VPD Identifiers (PF=1, PC=0)

bit / byte	7	6	5	4	3	2	1	0
0	Peripheral Device Type							
1	Return Control Info							
2	Return Page Code							
3	Reserved							
4	List Length							
5	VPDI 1							
.	.							
.	.							
.	.							
n+4	VPDI n							

This mode requests that a summary list of VPD Identifiers for either the Target (T/L=1) or for a LUN (T/L=0) be sent to the Initiator.

The Peripheral Device Type field is returned for the particular Target or LUN.

The Return Control Info field returns the value of byte 1 of the CDB which contains the PF and T/L bits.

The Return Page Code field returns the value of byte 2 of the CDB.

The List Length field indicates the length of the list which is being returned to the Initiator. This value does not include bytes 0 thru 3. A length of 0 indicates that their are no VPDI(s) to report and is not considered an error.

The VPDI field has an entry for each VPD Identifier in the list. The value assigned to VPDI codes for a particular piece of VPD information is vendor unique.

Note: Limitations in the size of the data transfer phase limits the maximum number of VPDIs in the list to 252 which is considered adequate.

Note: It is not intended that the Initiator process byte 1 bits 5-7 as a LUN number. Version 2 SCSI devices do not use this field but rather make exclusive use of the Identify message for determining the LUN number.

2.1.6.2 Read Detailed VPD Information (PF=1, PC=VPDI)

bit / byte	7	6	5	4	3	2	1	0
0	Peripheral Device Type							
1	Return Control Info							
2	Return Page Code							
3	Reserved							
4	ASCII Data Length (n)							
.	ASCII VPD DATA							
.								
.								
5+n	Additional Information Length							
6+n	Vendor Unique Data							
.								
.								
.								

This mode requests that detailed VPD for the VPD Identifier of either the Target (T/L=1) or the LUN (T/L=0) be sent to the Initiator. The VPD Identifier is specified in the DF field. The format of the data returned to the Initiator is as follows:

The Peripheral Device type field is returned for the particular Target or LUN.

The Return Control Info field returns the value of byte 1 of the CDB which contains the PF and T/L bits.

The Return Page Code field returns the value of byte 2 of the CDB.

The ASCII DATA LENGTH field indicates the amount of ASCII VPD available for the specified VPD IDENTIFIER. This value only includes bytes 4 through the Additional Information Length byte. A length field value of 0 indicates that their is no ASCII data to return and is not considered an error.

The ASCII VPD DATA field contains ASCII VPD for the specified VPD IDENTIFIER. This field will allow the direct display of VPD on the system console by the Initiator. This field allows for device independent Initiator code to be written to display pertinent VPD for a Target or LUN without requiring any interpretation of the data on the part of the Initiator.

The ADDITIONAL INFORMATION LENGTH field specifies the amount of vendor unique data to follow the ASCII data.

The VENDOR UNIQUE DATA field is vendor unique and could contain other formats of the same ASCII data such as EBCDIC, BCD or value fields.

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3.0 OTHER NEEDED CHANGES

The Request Sense command has a problem with distinguishing between LUN and Target FRU data. An example is the case in which a FRU call out for a hardware error indicates that loadable ucode has failed. The question is, did it appen to the Target or the LUN? Another example is a hardware error were a FRU is called out which has idéntical VPDI for a Target subsystem and a LUN. Which is it that was reported?

Addressability of Targets is also needed in the ucode download command for the same reason as described above.

Must address the need for a VPD update command. This code be similar to Mode Select as it relates to Mode Sense.