X3T9.2/90-22

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JOHN LOHMEYER:

ENCLOSED IS THE LATEST DCS DOCUMENT: THIS IS THE RESULT OF THE SAN DIEGO MEETING AND CAN NOW MOST CERTAINLY SAY THAT IT REPRESENTS COMBINED X3T9.2 AND X3B7.1 INPUTS. ALL PRIOR PROPOSALS (i.e. TI, WD, UNISYS, X3B7.1, ETC.) HAVE ESSENTIALLY BEEN MERGED TO PRECIPITATE THE ENCLOSED MODEL.

I WOULD FURTHER ENCOURAGE DISTRIBUTION, REVIEW AND FEEDBACK ON THIS DOCUMENT BY THE NEXT MEETING AT WHICH TIME I WOULD REQUEST SOME TIME ON THE X3T9.2 AGENDA FOR INPUTS & DISCUSSION.

SUBSEQUANT TO THE REVIEW OF THE "MODEL" DOCUMENT, WE CAN PROCEED TO IMPLEMENT THE MECHANICS OF THE VARIOUS DIAGNOSTIC COMMANDS.

REGARDS

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TI-1418-C

SCSI Diagnostic Model
Rigid Disk Drives

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1.0 Introduction

This document is written with the Rigid Disk Drive product in mind, but conceptually can (and should) be expanded to many (or all) devices specified in the ANSI X3T9.2/131-198x document (SCSI-2, Draft Revision 10B).

Within the document referenced above, great efforts have been made to present a logical interface that can be addressed by many physically different types of devices. But in hiding the physical layer, or at best not standardizing the access to the physical layer, diagnostics becomes a difficult undertaking. Further, as time goes on, if this level of access is not standardized and use of vendor unique and/or advisory parameters becomes more frequent, the ability for a compliant SCSI target to basically lie to the attached initiator will increase. This may not serve the industry's best interests.

The industry has moved to intelligent devices and the days of test points is probably gone. In the case of SCSI, device access has been narrowed down to the SCSI cable itself. (See figure 1.) So, working with this in mind, this document attempts to piece together a Diagnostic Model. This model will present the requirements of Diagnostics and makes no effort to step outside the limits of SCSI as they stand today. As a result, the purpose of Diagnostic SCSI can be stated as follows:

Diagnostic SCSI shall provide all of the functions required to perform device testing and do so through the SCSI connector. This statement does not provide for all of the requisites of device evaluation, as they may not be feasible, and thus drive evaluation is not part of the goal of the model. The delineation between device testing and drive evaluation will be made throughout this document.

2.0 Diagnostic Description

This section is dedicated to outlining and describing a basic overview of how Diagnostic SCSI relates to the normal SCSI mode (herein referred to as Logical SCSI).

2.1 The Diagnostic Mode

The Diagnostic mode of SCSI is a superset of the Logical SCSI mode. Thus, when in Diagnostic mode, all normally available logical functions are still available.

2.1.1 Enabling of Diagnostic Mode

A method shall be provided to turn the Diagnostic mode on and off without powering down the device. Further, a different levels of protection may be defined. For instance, level one might simply permit the use of physical type commands such as physical seek, physical write and physical read. In this case, level two might allow the altering of certain operating paarmeters not normally available to Logical SCSI (Cache page, error recovery, etc., that while in Logical SCSI are simply advisory). Finally, a third level of protection might be provided gating the access to physical level parameters such as window and head offsets.

2.1.2 Disabling of the Diagnostic Mode

The return of the operating mode to Logical SCSI shall be permitted via

Power cycle
Reset
Bus Device Reset message

Upon return to the Logical SCSI mode, the device may post a Unit Attention Condition if it feels that its functional condition may have been compromised while in Diagnostic mode. Correction of this condition may require the correct execution of a Format Unit command. The implementation of this feature is not provided here.

2.1.3 Acknowledgement of Diagnostic Mode Compliance

An indication of the support for Diagnostic mode, as well as what level is available to the user shall be provided. Further, an indication of the current mode shall also be provided. This would include Logical SCSI and Diagnostic SCSI, levels 1, 2 and 3, for example.

Note:: By use of the Write Buffer command, utilizing the mode, which permits code download, the "upgrading" of Diagnostic access level can be controlled.

2.1.4 The Diagnostic Configuration

As was stated earlier, all functions available during Logical SCSI operations shall also be available during the Diagnostic mode; this includes all mode pages. But a wrinkle exists. This is that whereas in Logical SCSI mode certain fields can be accepted and/or reported as advisory, while operating in Diagnostic mode, these fields must be adhered to. Thus, if a field can really not be changed, then an attempt to do so should result in the command being terminated with CHECK CONDITION status.

Additional Physical Parameters page shall be added to permit the adjusting and/or reporting of the following:

Sector Geography: This would include the size and locations of Servo fields (if not dedicated), Sync fields, ID Fields (and its components), Data fields, ECC fields, CRC fields, Gap fields, etc. (See figure 2) Where fields have no meaning, a zero returned value might be used. Further, this should be done on a zone basis where appropriate.

Entire Cylinder Area: This would provide information regarding the location and number of reserved cylinders, spared cylinders, user cylinders, etc. (See figure 3)

Current Operational Settings: This should include Track Offset, Data Separator Setting, Peak Detection Threshold, other analog offsets, etc. These fields simply are reported.

The concept of protection levels should be applied to distinguish what operating parameters can be modified.

As a final requirement in this area, the device shall have some method to report the limits of settable parameters using some standard units. These units are not prescribed in this document.

2.1.4.1 Restrictions of the Configuration

The target shall have the ability to prevent all users from accessing those areas of the disk(s) which are vital to device operation. ('Vital' is, in this instance, information that if changed may prevent the device from ever operating again.) Thus, if device firmware maintains some "system" cylinders, for example, the existence of these cylinders should be reported, but attempts to access these cylinders may result in the command being terminated in CHECK CONDITION status.

2.1.5 Data Phases

The traditional limitation placed upon Logical SCSI that does not allow for any commands having both a DATA IN and a DATA OUT phase shall be removed.

2.1.6 Single Initiator Operation

While in the Diagnostic mode, only single initiator operation shall be supported.

3.0 Features Functions and Ramifications of Diagnostic SCSI

This section entails the concepts of SCSI Diagnostics. Note that not every concept has to be supported for a target to indicate Diagnostic Compliance.

3.1 Addressing Modes

The Diagnostic SCSI mode requires the addition of two new addressing modes: Absolute and Physical. Refer to figure 4 for details of addressing modes.

3.1.1 Absolute Addressing

The intent of Absolute addressing is to remove all potential mapping which may cloud the exact location of certain data. Thus, the definition of Absolute addressing is that locations are specified relative to some fixed point which will not change over time. The reference point should be the same for all tracks within any one zone. Thus, as an example, absolute sector 16 on head 3 on cylinder 10 is the same linear distance from the fixed reference point (absolute beginning of the track) as is absolute sector 16 on head 5 on cylinder 120, given that cylinder 10 and 120 lie within the same zone.

If absolute addressing cannot be supported, i.e., no fixed reference over time exists or continuously varying frequencies are used, the device must provide a method of reporting this inability.

3.1.2 Physical Addressing (Must be supported)

Using Absolute addressing as a reference, the difference implied by Physical addressing is the introduction of skews, either head or cylinder. It is these skews which may hide the absoulte location of any sector. Note:: Physical addressing with skews of zero is Absolute addressing.

3.1.3 Logical Addressing (Already supported in Logical SCSI)

Using Physical addressing as reference, the difference implied by Logical addressing is the introduction of defect management, which may permit for the revectoring of sector data to some physically different location on the disk. Note:: Logical addressing with no defects detected is Physical addressing.

3.1.4 Data Transfer Modes (Must be supported)

In the Diagnostic mode, the following data must be accessible:

* The logical user data (already made available via Logical SCSI)
* The entire sector minus Gaps (see attached figure 2)

3.1.5 Drive Margins

This feature shall be included to permit that the operational characteristics of the drive be altered. The following items should be made available (via direct command or Physical Parameters page)

Track Offset: Adjusts the head's position relative to track center.

Data Separator Adjustment: Adjusts the window for data capture.

Peak Detection Threshold: Adjusts trigger criteria.

Other Analog Offsets: Adjusts Servo and Data Channel operation.

Sector Layout: Adjusts individual sector fields (Sync, ID, etc., see figure 2)

3.1.6 Disk Erasure

Where possible, a method shall be provided to remove all indication that any format operations have ever occurred. This erasure operation shall affect all writable portions of the drive (or selected sections of the drive). This prevents (permits) the non-erasure of such areas as embedded servo and reserved ("system") cylinders. This feature may be used to create a relative measure of merit from drive to drive.

The erasure feature shall include (where permissable) both DC Erase (with specified polarity) and AC Erase (high frequency).

3.1.7 Limited Format (Must be supported)

This feature permits the (re-)formatting of a limited area of disk space. This should, at a minimum, provide for single sector and single track formatting. Format parameters (skews, sector layout, data patterns, etc.) should be specifyable for these commands. These functions permit the use of a restricted area for destructive activity, while still maintaining the integrity of user data areas.

3.1.8 Translate Address (Must be supported)

The traditional mechanism within Logical SCSI for this function is provided via SEND DIAGNOSTICS and RECEIVE DIAGNOSTIC RESULTS and translates between physical (Cylinder, Head and Sector or Bytes From Index) and logical (Logical Block Number) formats. This method, while it may be established is cumbersome, for it requires two transactions, one for DATA OUT and another for DATA IN. Further, with the introduction of Absolute addressing, a hole has been created. Thus the Diagnostic SCSI mode shall provide for direct commands to perform translation between logical and/or physical and/or absolute modes.

3.1.9 Defect Management (Must be supported)

The concept and functions of Defect Management as prescribed by Logical SCSI implementations shall not be altered when Logical SCSI commands are issued while executing in Diagnostic mode. But, if a Diagnostic command is executed, the entire Defect Management scheme shall be bypassed. Using this, a Format (Unit, Track or Sector) operation may be required to insure the ability of sequential disk access (i.e., reformat with skews set to 0, even if it means interleaving) to otherwise spared disk areas.

Note: One of the requirements of efficient disk testing is the ability to sequentially access all sectors on a drive. This requires the removal of all mapping schemes to get to actual sectors that is imposed by the LBA structure of Logical SCSI.

3.1.10 Error Recovery (Must be supported)

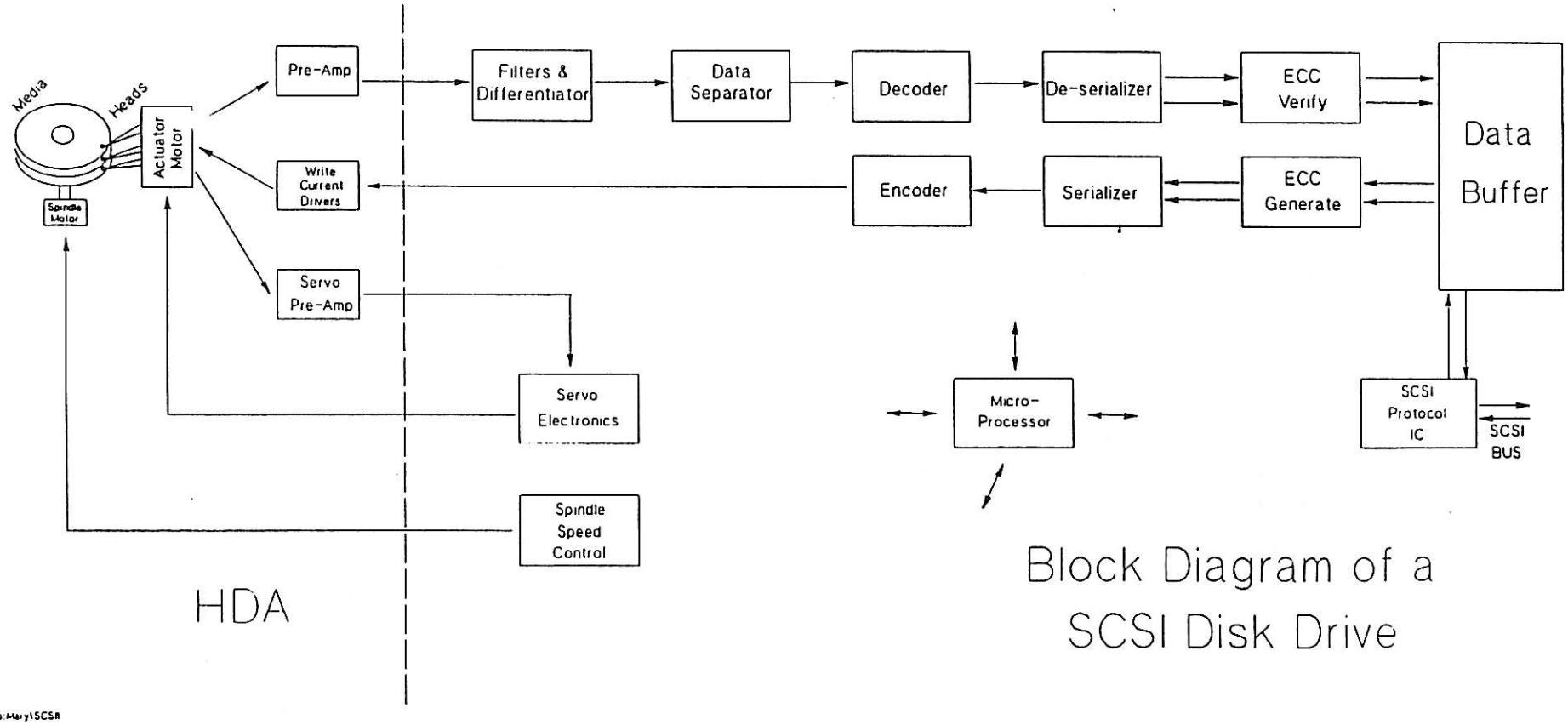
In keeping with the goal of "No lying when in Diagnostic mode", all Error Recovery normally imposed by Logical SCSI shall be removed when execution in Diagnostic mode is performed. The following areas of Error Recovery are affected by the above requirement:

* ECC (Error Correction Code)
* Read and Write Retries
* Seek Recovery

In all of the cases listed above, the errors shall simply bve reported upon detection.

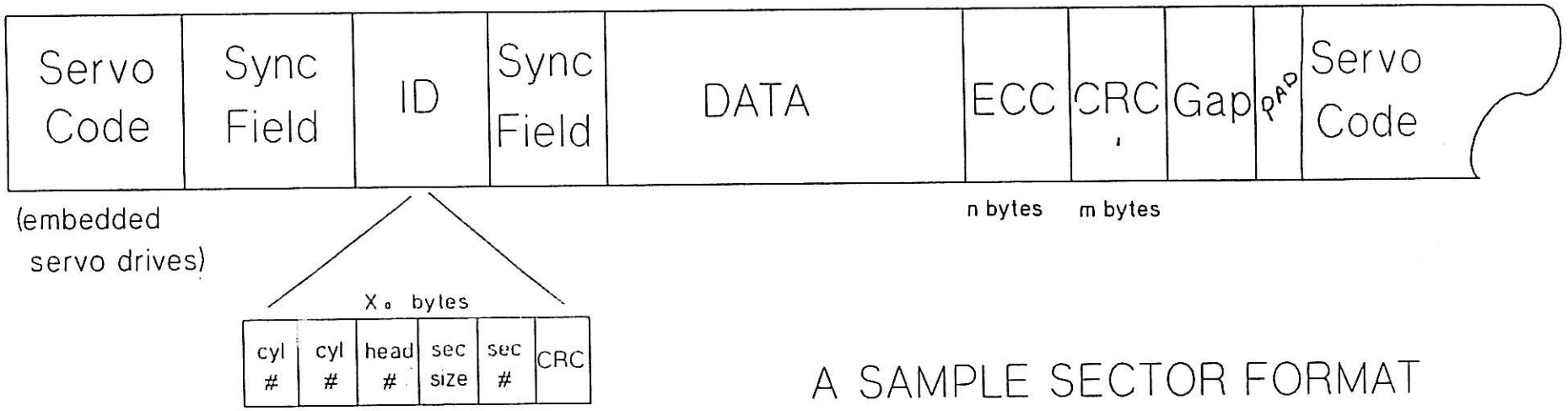
4.0 Conclusion

Intelligent devices are a reality of today. This intelligence, in the case of Rigid Disk Drives, permits the managing of the physical layer of the drive by the drive itself. But, this does not preclude this same device from making this layer available to the SCSI if it was so designed into the product. Further, in the case of SCSI, this can be done without any new electrical definitions, if we as an industry choose it to be that way. If this indeed can be proven to be the case, then we propose that the resulting SCSI command, message and status modifications be made to the existing document to provide for the desires set forth in this document.



Block Diagram of a SCSI Disk Drive

Figure 1



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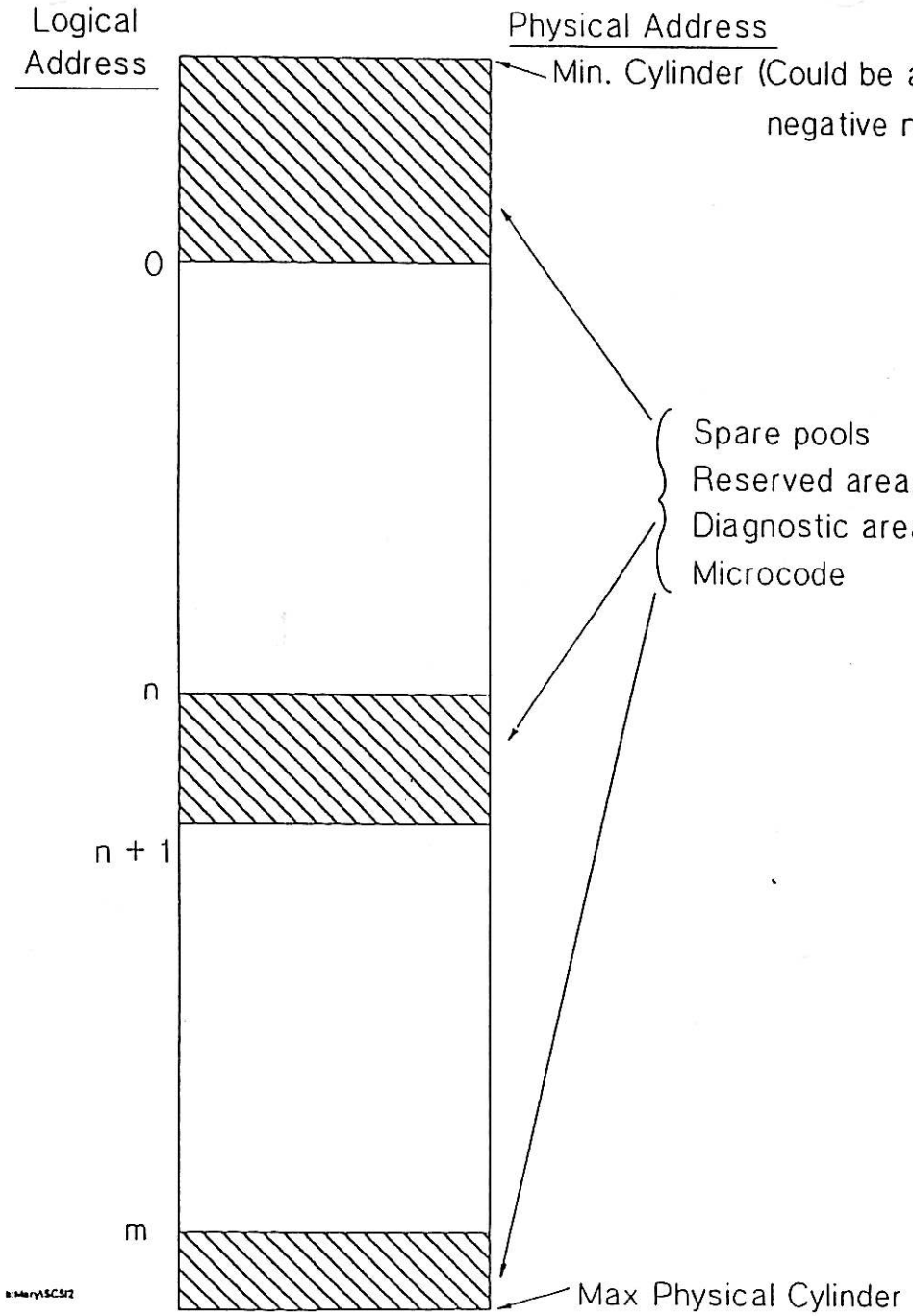
A SAMPLE SECTOR FORMAT

b:mary\SCSI3

Figure 2



AN EXAMPLE OF A DISK CYLINDER MAP

Total # of Physical Cylinders =

Max Physical Cylinder - Min Cylinder +1

Figure 3

Examples of
SCSI Addressing Modes

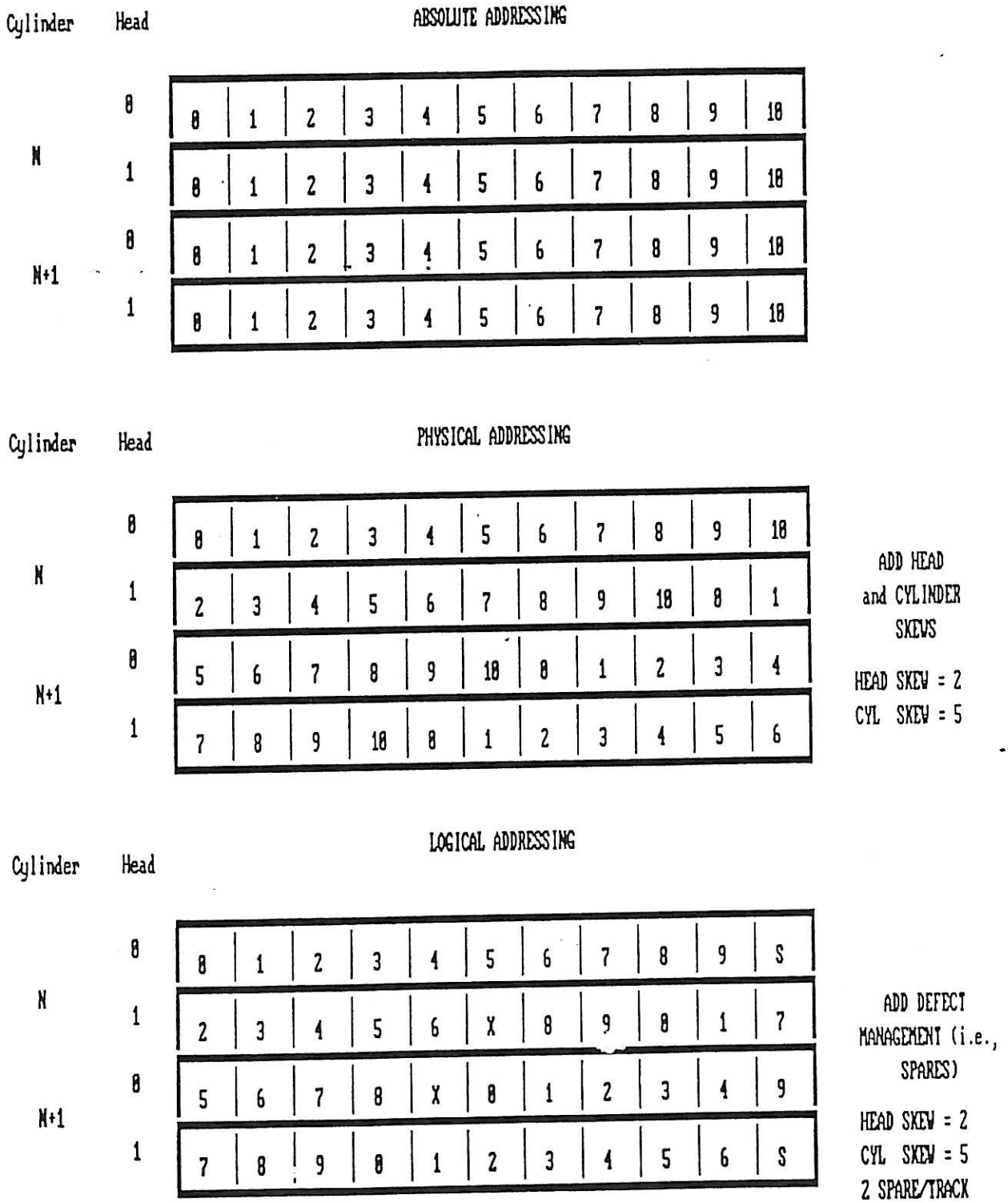


Figure 4.