Chapter 3

VOLUME ORGANIZATION

3.1 DISK TYPES

A volume is a single physical unit capable of holding information. In this manual, disk volumes are considered and secondary storage media that are organised in the same way as a disk, the CMOS memory and the "simulated disk in primary memory".

3.1.1 Disk Volumes

The following disk types are available for PTS systems:

PTS 6875 - 2.5 Mb fixed and cartridge disk
PTS 6876 - 5 Mb fixed and cartridge disk
PTS 6877 - 80 Mb fixed and cartridge disk
PTS 6961 - 16 Mb fixed and cartridge disk
PTS 6879 - 0.25 Mb flexible disk
PTS 6791 - 1 Mb flexible disk
PTS 6792 - 0.25 Mb flexible disk
PTS 6962 - 16 Mb + 80 Mb fixe and cartridge disk

3.1.2 CMOS Memory

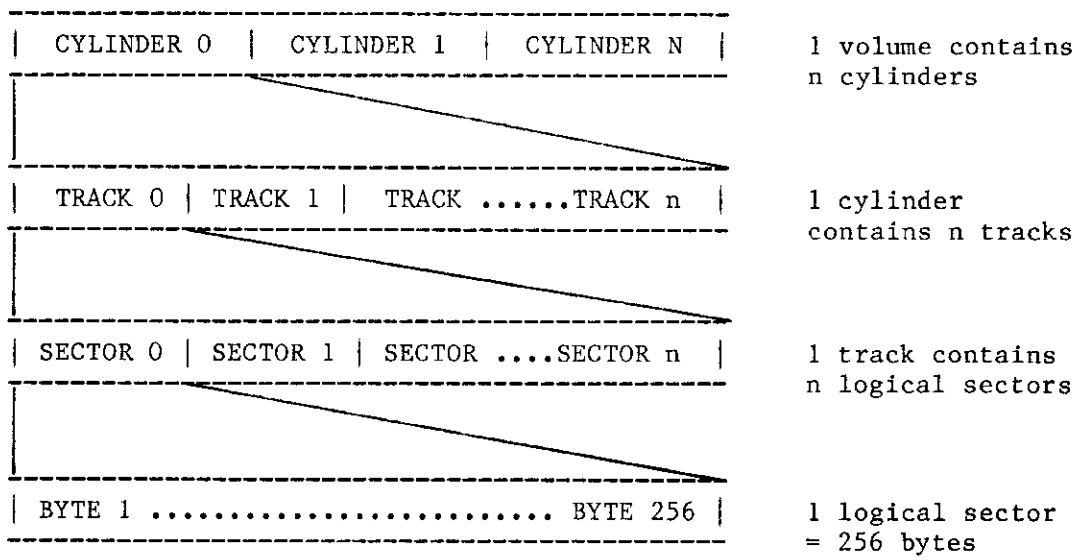
The CMOS memory is approximately 8kb of CMOS RAM, connected to the PTS6911 Workstation Controller (WS11). It can be considered as a peripheral with a very fast access time, and organised in the same way as a disk. The CMOS memory can only contain valid information when the power is on. A back-up battery maintains the contents of the memory during about 48 hours after a power failure. After that time the contents of the CMOS memory are undefined.

3.1.3 Simulated Disk in Primary Memory

A part of the memory may be reserved for use as a very fast access storage. The size is a multiple of 4k bytes and is defined during Monitor generation. Using the simulated disk in primary memory for example for transaction logging will improve the system performance.

3.2 DISK STRUCTURE

Each disk volume is divided into cylinders, each cylinder into tracks, and each track into sectors. This structure is transparent to the application, for the program only addresses records within a file. The programmer must be aware of this structure when constructing files, for it affects the blocking factor, number of file extents on the volume, or number of volumes required for one large file.



3.2.1 Sectors

Disk sectors as seen by the hardware are different from those seen by the software. The hardware is concerned with physical sectors on the disk, while the software handles logical sectors.

- A physical sector is the unit of information transferred between the disk and the primary memory.

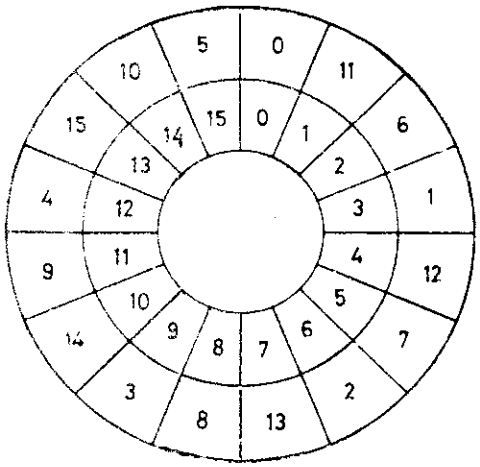
- A logical sector is the unit of information transferred between the disk driver and data management or the application. Depending on the disk type, the logical sector length may be different from the physical sector length.

All the disk drivers handle multiple logical sector I/O, so it is possible to transfer more than one logical sector with one I/O request.

Physical and logical sector numbering may be different. This depends on the way in which the disk is premarked.

3.2.2. Interlacing

On many disk types the logical sectors are not numbered in physical sequence, but interlaced.
The figure below is an example. The inner ring of numbers represent the numbering of the physical sectors, the logical sectors are interlaced as shown by the outer ring of numbers.



Interlacing is done to save access time on the disk. After a sector has been transferred, the software needs some time to process it before the next sector can be transferred. During this time the disk keeps rotating and when the next transfer can be done the disk head will not be positioned at the adjacent sector, but further. Marking this as the next logical sector avoids waiting for almost one disk rotation.

Interlacing is fully transparent to the user, and sectors are always processed in sequence of logical sector number. The number and length of physical sectors, and the interlacing factor, depend on the disk type.

3.2.3 PTS6875 and PTS6876 Disk Versions

There are two format versions for the disks PTS6875 and PTS6876, the Packed and the Unpacked version. One of them is selected when the disk is formatted by the TOSS utility Create Volume (CRV).

Version 2 - Unpacked
There is one logical sector per physical sector, which provides lower average access times.

Version 3 - Packed
Two physical sectors contain three logical sectors. This version makes more efficient use of disk space. An intermediate buffer is used during transfers, unless both the number of the first logical sector and of the total number of sectors to be transferred are multiples of three. In that case the intermediate buffer is not needed, and access times are lower than for the unpacked version.

Which version is used for the disk need only be specified when the disk is formatted with the TOSS usitility CRV. The information is stored in the Volume Label and read into memory when the disk is on line.

3.3 SURVEY OF DISK CAPACITY

Disk Type	PTS6875		PTS6876	
Format Version	2	3	2	3
Number of cylinders	204	204	408	408
Tracks per cylinder	2	2	2	2
Physical sectors /track	16	16	16	16
Logical sectors/track	16	24	16	24
Bytes/physical sector	258	386	258	386
Bytes/logical sector	256	256	256	256
Maximum logical sector no	6323	9791	12647	19583
Maximum physical sector no	6527	6527	13055	13055

Disk Type	PTS6879 flexible disk		PTS6877 "80Mb"	PTS8863 mini fixed
Disk Version	TOSS	IBM	disk	disk
Number of cylinders	77	77	822	255
Tracks per cylinder	1	1	5	2
Physical sectors/track	26	26	23	52
Logical sectors/track	13	26	69	52
Bytes/physical sector	128	128	768	128
Bytes/logical sector	256	128	256	256
Maximum logical sector no	1000	1932	283589	23399
Maximum physical sector no	2001	73026*	94529	23399

Disk Type	PTS6961 "16+16"	PTS6791 "1 Mb" flexible
Disk Version	CMD disk	disk
Number of cylinders	822	77
Tracks per cylinder	1	2
Physical sectors/track	23	26
Logical sectors/track	69	13
Bytes/physical sector	768	256
Bytes/logical sector	256	256
Maximum logical sector no	56717	3990
Maximum physical sector no	18905	4003

* For the IBM format on the PTS6879 flexible disk, physical sector number has format `ttOss', where tt is track number, O is zero, and ss is the sector number. 73026 corresponds to logical sector number 1923.

3.4 RESERVED AREAS

On cylinder zero, some sectors are reserved on track zero for use by the system software. If this track contains bad spots the volume can not be used.

Track zero on cylinder zero contains:

- Volume Label in sector zero; the identification of the volume.
- IPL loader in sectors starting in sector 1. The number of sectors occupied is device dependent.
- Free Space Administration Table (FSAT)
  When a file must be created or extended, the Free Space Administration Table is searched for free areas large enough to contain the required number of sectors.
- Volume Table of Contents (VTOC), containing the identification of all file extents on the volume.

Volume label and IPL are written by the utility Create Volume (CRV). After that, sectors are reserved for the VTOC and the FSAT. The number of sectors occupied by VTOC and FSAT depends on the number of VTOC entries specified when the utility is run.

The total number of sectors in the reserved area must be a multiple of three. For example, if Volume Label and IPL together occupy 4 sectors, the VTOC and FSAT will be a multiple of 3 sectors plus 2.
CRV creates an FSAT with at least the same number of entries ad the number of entries in the VTOC. The number of VTOC entries per sector is 6, the number of FSAT entries per sector is 32.

This results in the following number of entries in the FSAT:

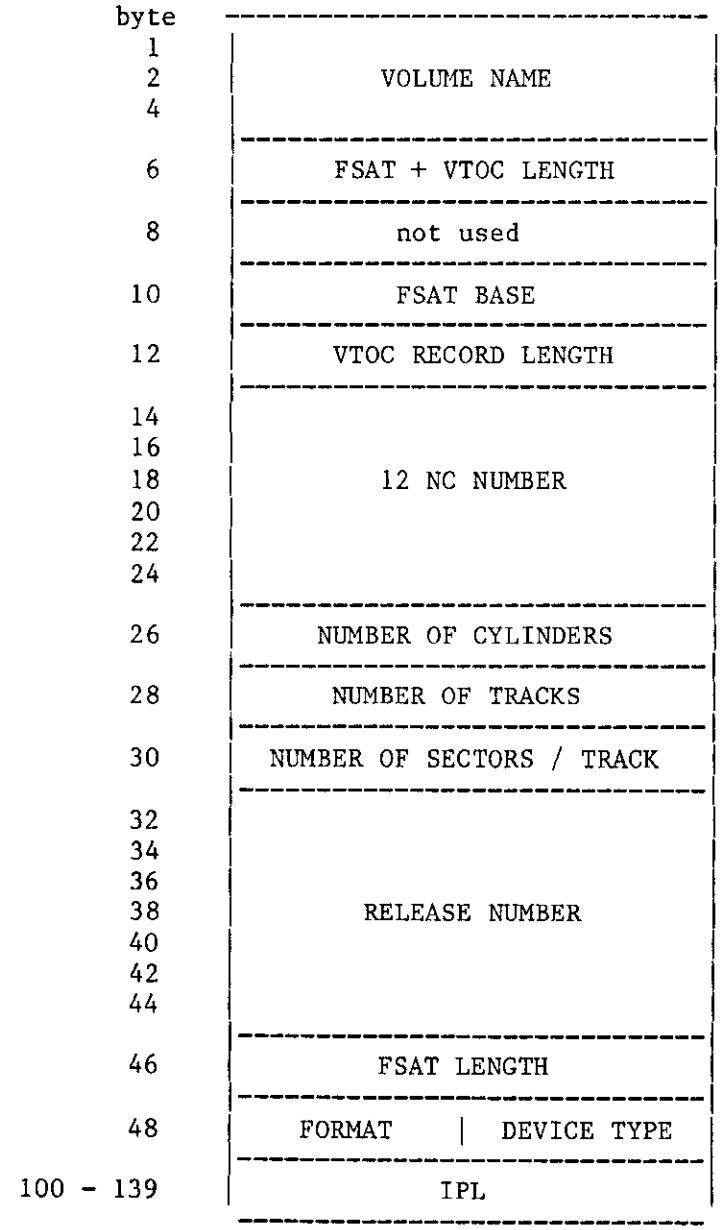
No of VTOC entries	VTOC sectors	FSAT sectors	No of FSAT entries
1 - 6	1	1	32
7 - 12	2	3	96
13 - 18	3	2	64
19 - 24	4	1	32
25 - 30	5	3	96

The layout of Volume Label, Free Space Administration records and Volume Table of contents is described in the following sections.

3.4.1 Volume Label

The volume label is located on cylinder 00, track 00 sector 00 of all disk types.

The format of the volume label is shown below:



The fields have the following meaning:

VOLUME NAME
A string of 6 characters, left adjusted and padded with spaces. Spaces are not allowed within the volume name. Volume names must be unique within a system.

FSAT + VTOC LENGTH
Number of sectors occupied by the Free Space Administration plus Volume Table of Contents.

FSAT BASE
The address of the sector on which the FSAT starts.

VTOC RECORD LENGTH
The size of one VTOC record, in bytes. The status character is not included.

12 NC NUMBER
Reserved for the 12 NC number of the disk.

NUMBER OF CYLINDERS
The number of cylinders available for the user

NUMBER OF TRACKS
Number of tracks per cylinder. This is equal to the number of disk surfaces that are used.

NUMBER OF SECTORS PER TRACK
This is the number of logical sectors per track.

RELEASE NUMBER
This field contains the text "TOSS RELEASE xx.yy" where xx is the release number and yy is the level.

FSAT LENGTH
Number of sectors used for the administration of free areas on the volume.

FORMAT
Device dependent parameter indicating which interlacing pattern is used to map the sectors on the physical addresses.

DEVICE TYPE
An 8 bit integer indicating:

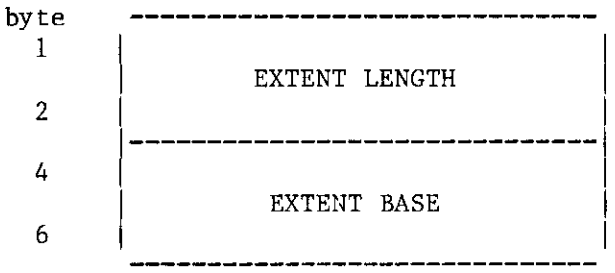
```
 1 = PTS 6875    2.5 Mb disk
 2 = PTS 6876      5 Mb disk
 3 = PTS 8863      6 Mb mini fixed disk
 4 = PTS 6877     80 Mb disk
 5 = PTS 6961     16 Mb disk
 6 =               Simulated disk in CMOS memory
 7 = PTS 6872    0,25 Mb flexible disk
 8 = PTS 6879    0,25 Mb flexible disk
 9 = PTS 6791      1 Mb flexible disk
10 =                Simulated disk in primary memory
```

IPL
IPL is device dependent code used by the Initial Program Loader for that disk type.

All unused fields contain hexadecimal zeroes (X'00').

3.4.2 Free Space Administration Table

The Free Space Administration Table (FSAT) entries describe the start address and length of all free extents on the volume. The format of each entry is shown below. Unused entries contain all zeroes (X'00').



The fields have the following meaning:

EXTENT LENGTH

The size of the free extent, in number of sectors.

EXTENT BASE

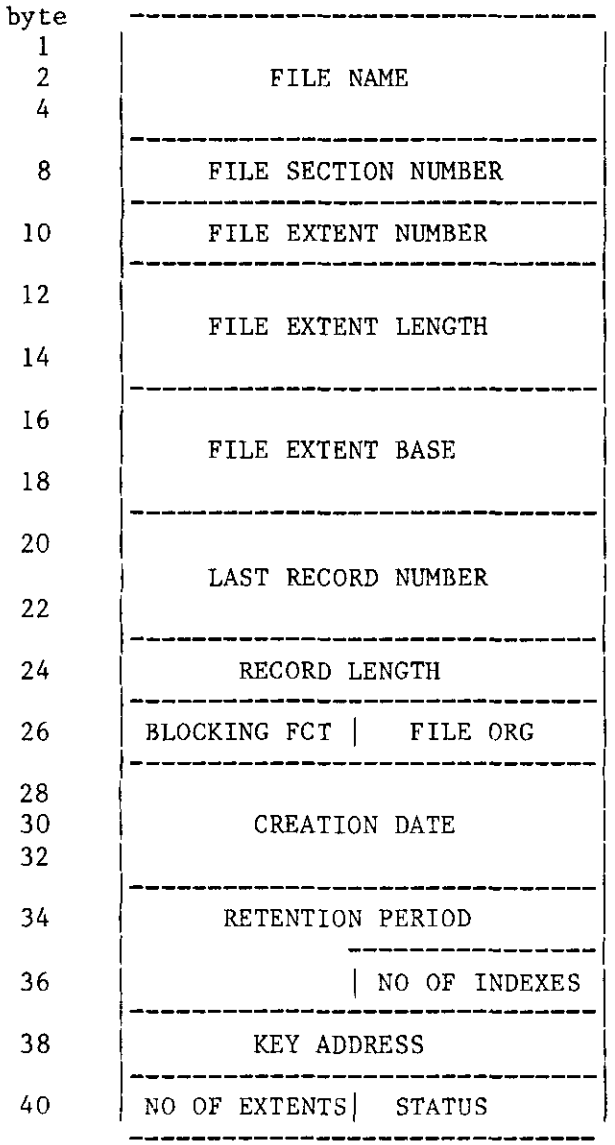
Logical sector number of the first sector in this free extent.

3.4.3 VTOC Records

Each VTOC record is 42 bytes long (41 bytes data + 1 status byte) and they are blocked 6 per sector. One record exists for every used extent in each file.

The VTOC is accessible only through Monitor routines. The Read File Parameter instruction will make the information about the file available to the application.

VTOC records have the following layout:



The fields have the following meaning:

FILE NAME
A string of 8 characters, left-adjusted and padded with spaces. This field must be set to spaces (X'20') for unused entries. No spaces are allowed within the File Name. Some file names are reserved for use by the system, see section 3.6
On one volume, all VTOC entries with the same file name are regarded as describing extents of the same data file.

FILE SECTION NUMBER
A binary value numbering the file sections. File section numbering starts from zero.

FILE EXTENT NUMBER
A binary value numbering the extents within each file-section. File extent numbering starts from zero.

FILE EXTENT LENGTH
A binary value representing the number of sectors in the file extent.

FILE EXTENT BASE
A binary value representing the logical sector number of the fist sector in the extent.

LAST RECORD NUMBER (LRN)
For Standard files, LRN is a binary value which is the relative key of the last used record in the file written by Write Sequential instructions. There may be "free" and "used" records in the file between the LRN and the end of the physical file area.

For indexed files of S-type, LRN is the relative key of the last data record written by Write Indexed Direct instructions.

For an index file of S-type, LRN is the relative key of the last index record in the last used partition.

For a master index file of S-type, LRN ids the relative key of the last used master index record.

For EDM files (both D and I files), LRN is the relative key of the first record in the free record chain.

For L and X files, LRN is a binary value representing the number of used sectors.

RECORD LENGTH
A binary value representing the number of bytes per record. This is a fixed value for all records in the file and does not include the status byte. For L-files the record length is always 256, for X files it is a multiple of 256.

BLOCKING FACTOR
A binary value representing the number of records per block. For I, L and X files the blocking factor is always 1.

FILE ORGANISATION
One character indicating the file type:
- S - File of S-type
- D - the data part of an EDM (E) file
- I - for the index part of an EDM (E) file
- L - library file or load file
- B - bad spot file
- X - non-standard file

NUMBER OF INDEXES
For the indexed files of S-type this is a binary value representing the number of index files belonging to this data file.
For other file types the field contains zero.

KEY ADDRESS
A binary value representing the first character position of the symbolic key in the data record. This field is only used for index files of S-type and is set to zero for other file types.

NUMBER OF EXTENTS
A binary value representing the number of extents of the file that contained on this volume. This number is only set in the VTOC record of the first extent.

STATUS
A single character indicating whether this VTOC record is used (X'FF') or free (X'00'). This character is not included in the VTOC RECORD LENGTH defined in the volume label.

CREATION DATE
A string of 6 ISO-7 characters representing the creation date of the file. Recommended format can be either YYMMDD or YYDDD, left adjusted, where
- YY = last two digits of the year
- MM = month of the year
- DD = day of the month
- DDD = day of the year

The format is not checked by the system software.

RETENTION PERIOD
A string of 3 ISO-7 characters representing the number of days that this file is to be retained.
The contents of this field is not checked or used by the system software.

3.5 VOLUME CREATION

A disk volume to be used on the PTS system must be initialised and formatted by the TOSS utility Create Volume (CRV). This utility is described in the TOSS Utilities Reference Manual, module M8A.

The utility writes a Volume Label and an empty VTOC, and FSAT and an IPL on track zero. Defective sectors are assigned to a badspot file.

3.5.1 BADSPOT file (B-file)

A Badspot file is a dummy file which includes all defective sectors on a volume, so that these are not used for the real files. When a new volume is formatted with the TOSS utility Create Volume, the quality of each sector is checked. Unusable sectors are included in a B file, registered as such in the Volume Table of Contents and withdrawn from the Free Space Administration Table.
The BADSPOT file can contain up to 18 extents. If the disk contains too mny defective sectors, it can not be used.

3.6 RESERVED FILE NAMES

File names exists of up to 8 ISO-7 characters. The rules for the file names of indexed file structures in SDM and EDM and the rules for L file names are described below.
Within TOSS systems, some file names are reserved.

3.6.1 Standard Data Management Files

The file name of the data file is specified when the file is created. It may consist of up to 8 characters, the first 6 are significant and must be unique. The file names of the index files consist of "In" followed by the first 6 characters of the data file name, where "n" is the number of the index. The file names of the master files consist of "Mn" followed by the first 6 characters of the data file name, where "n" is the number of the index.

3.6.2 Extended Data Management Files

The file name of the D file is specified when the file is created. It may consist of up to 8 characters, the first 6 are significant and must be unique. The file name of the I file consists of "I$" followed by the first 6 characters of the D file name.

When EDM is used, the following file names are reserved: "TLOGFILE", "FLOGFILE", "I$0000" and file names starting with "$$$$".

3.6.3 System File Names

File names with the format "$XXXX:nn" are reserved for load files and configuration files and must not be used for TOSS files.

"XXXX" represents up to four ISO-7 characters and "nn" are two numeric ISO-7 characters.