Basic Description of the TENEX Disk Structures

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June 21, 1974

Technical Memo

TM.74-27

Introduction:

This memo describes the organization of the TENEX Disk Drive Structure, (one should beware that the terminology used by TENEX is not that normally used by most systems, e.g., what most systems consider cylinders, TENEX calls tracks. And, of course, tracks usually mean that surface readable by one header in a given revolution of the disk).

Organization of Disk

From Figure 1 we obtain the basic disk structure organization. For each disk drive (≡ pack) we have 2Ø surfaces and NTKUN tracks (remember: a track is a cylinder). There are two uses of the word sector:

1) Physical Sector

2) Logical Sector

A surface is divided into three equivalent pie-shaped areas. Each of these areas is a physical sector. Thus, with a TENEX "track" (or our cylinder) we partition each of the 2Ø surfaces into three parts, giving us 6Ø parts altogether. Each of these parts contains 512 words (=1 TENEX Page) and is known as a logical sector. The logical sectors are numbered in the following manner.

Starting with the top surface of the top plate, we have logical sectors Ø, 1, and 2. The bottom surface of the top plate has logical sectors 3, 4, and 5. At the end, the bottom surface of the bottom plate has sectors 57, 58, and 59.

There are two kinds of disk drive:

1) For 114-Drive:

*203 tracks per pack

*Total three drives, i.e., total 609 tracks.

2) For 215-Drive:

*406 tracks per pack

*Total four drives, i.e., total 1624 tracks.

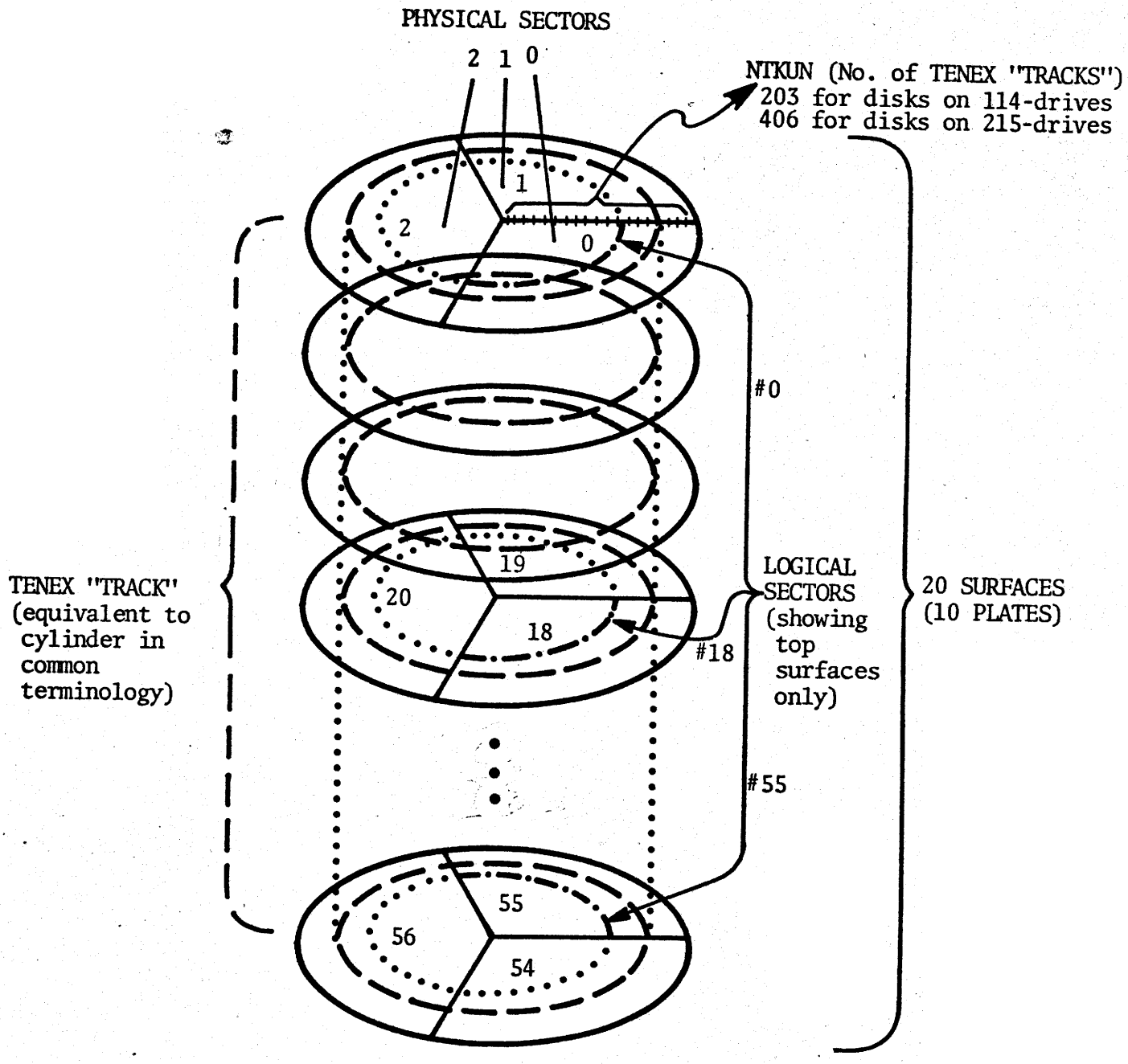


Figure 1: TENEX DISK DRIVE (OR PACK)

There are two kinds of disk drives used for TENEX:

(1) With 114-drives, pack sizes are: NTKUN = NTKUN4 = 203 (CYLINDERS≡TRACKS)

(2) With 215-drives, pack sizes are: NTKUN = NTKUN5 = 406 (CYLINDERS≡TRACKS)

Address Representation

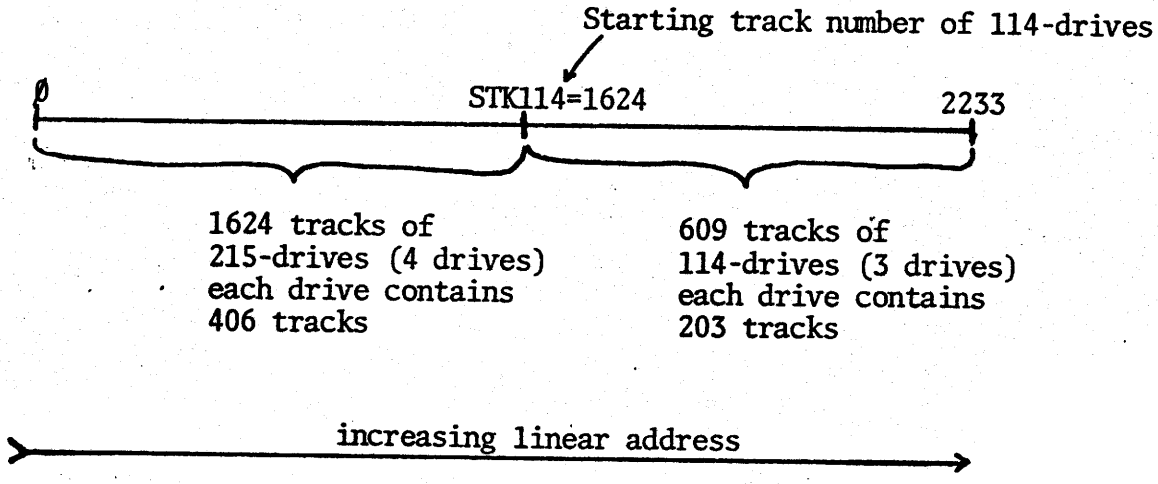
We have two kinds of addresses to describe the location of a page.

1) linear address

2) Disk pack oriented address, AKA hardware form address.

Bits Ø-15 of the linear address are not used. The algorithm for the conversion of the linear address to a hardware form address is described below:

The 215-Drives are numbered ahead of the 114-Drives :



1) Get the track # and logical sector # by dividing the linear address by the number of logical sectors per track. (The track # is the integral part and the logical sector # is the remainder of the division.)

2) If the track is on a 114-Drive [track # $\geq$ STK114] then compute the drive # and track # within the 114-Drive.

Otherwise, compute the drive number and the track number within the 215-drive.

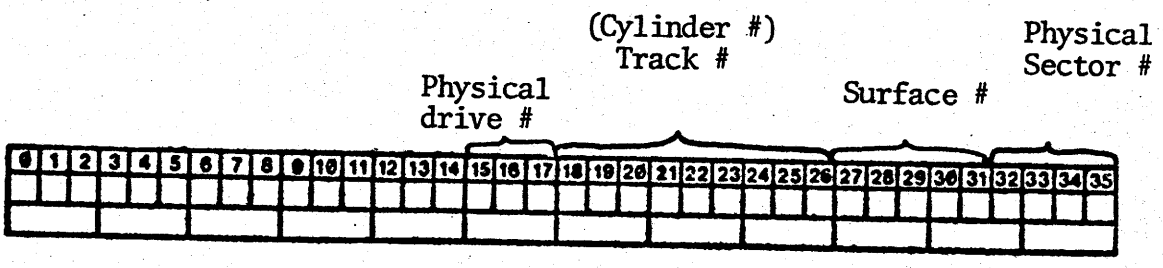
For the 215-drives there are 406 tracks/drive, while for the 114-drive there are 203 tracks/drive. Thus, for the 215 drives, one divides the track number by the number of tracks per 215-drive (406). The integral part is the drive number, with the remainder being the track number within that drive. We do similarly for the 114 drive, except that the number of drives per 114 drive is 203, and also take into account the fact that the 114 drives come after the 215 drives. These are done separately, because the two kinds of drives have different number of tracks per drive;

3) Compute the surface number and physical sector number by dividing the logical sector number of step 1 by the number of physical sectors per surface (3). The surface number is the integral amount and the physical sector number is the remainder of the division.

An example using an actual linear address being converted to hardware form is given in the appendix.

Note: The drive number computed in step two is known as an internal drive number which is converted to a physical drive number by a one to one mapping (using a table.) Right now, the internal drive number is identical to the physical drive number. But it can be changed by modifying the table map.

After doing some shifting and packing we obtain the following hardware form address:



Hardware Form Address

Note: The physical drive number starts with the first drive of 215-drives to the last drive of 114-drives. (Maximum number for drive number is 10_8)

Track Allocation

The TENEX disks track allocation are shown in Figure 2.

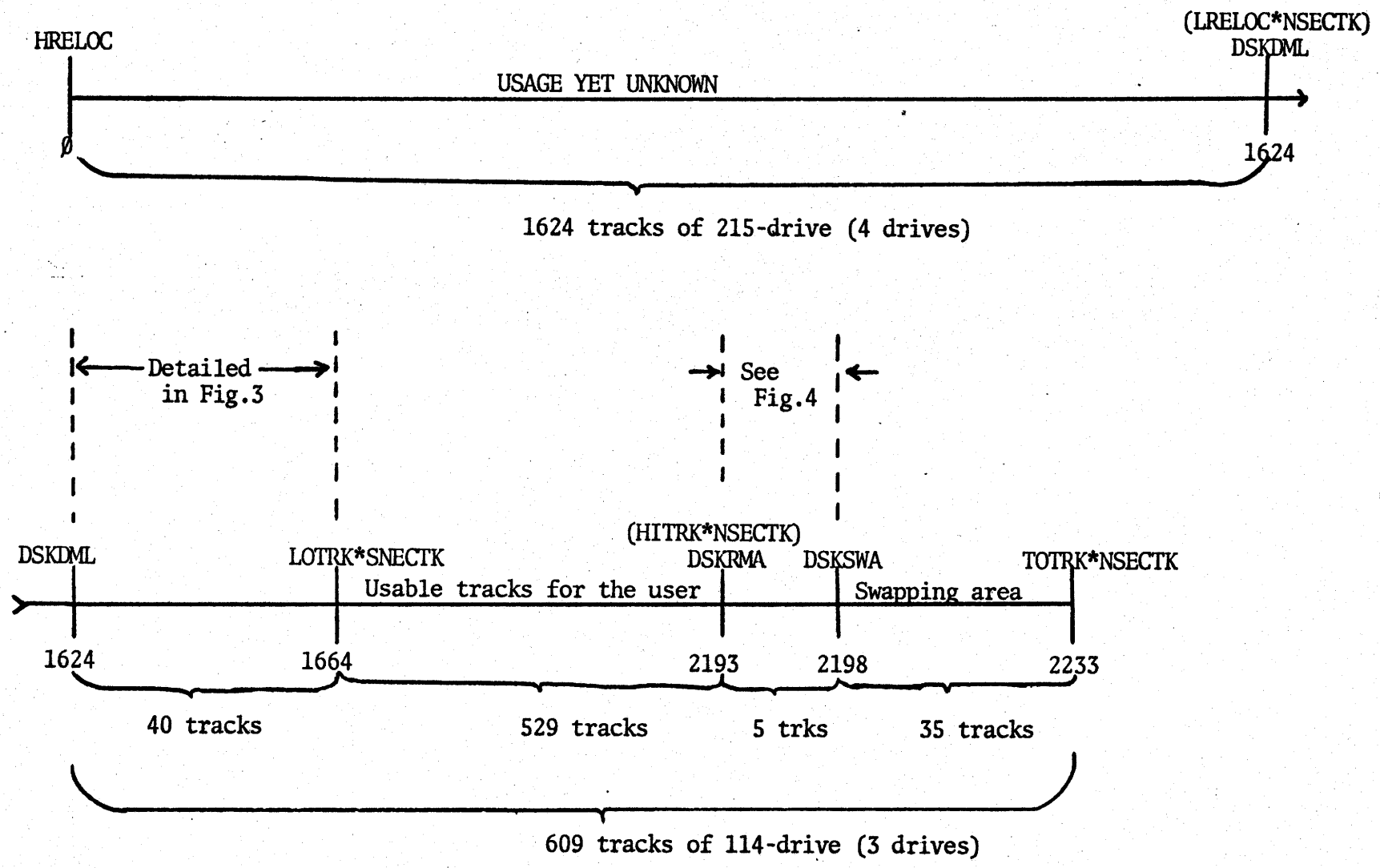


Figure 2: Track Allocation of TENEX Disk for KI System

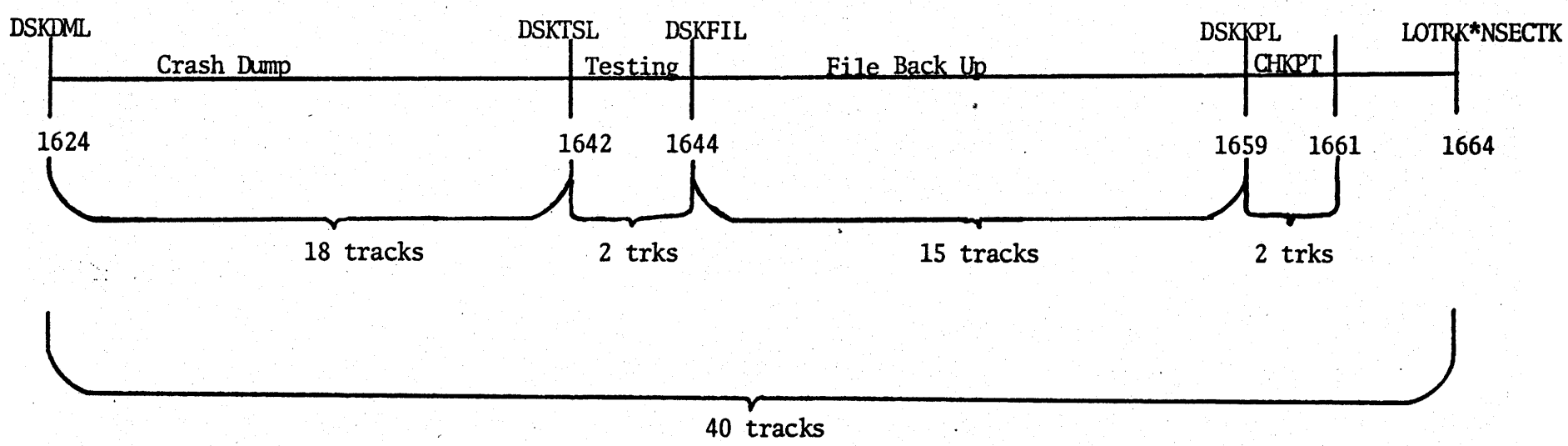


Figure 3:

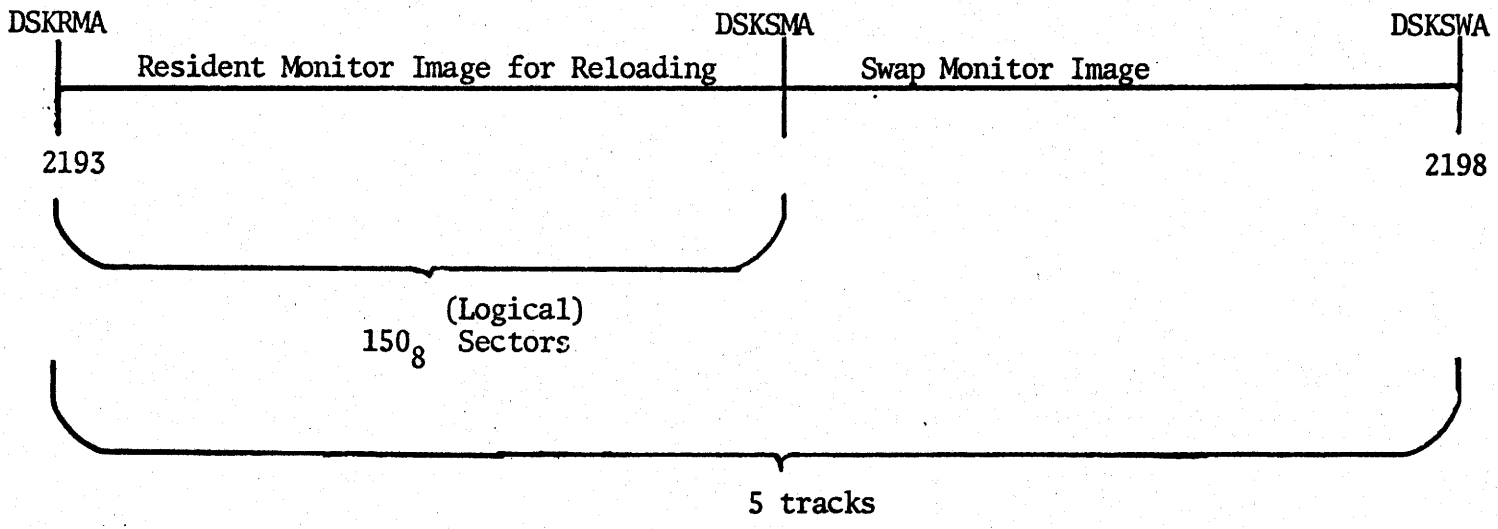


Figure 4:

Appendix: Converting Linear Address to Hardware Form Address, an example

For example, assume the linear address is 119313, the conversion is performed according to the steps described under the topic of address representation

1) The linear address is divided by number of sector/track:

$\frac{119313}{60} = 1988$ Remainder: 33

Track number — Logical Sector #

2) 1988 is greater than STK114 (=1624). Hence it is on a 114-drive.

$\frac{1988 - 1624}{203} = 1$ Remainder: 161

Track Number

Total # of 215-drive

$1 + 4 = 5$

Internal drive #

3) Dividing the logical sector # by number of physical sector per surface (= 3):

$\frac{33}{3} = 11$ Remainder: Ø

Surface Number — Physical sector #