**Disk Parameters Calculation:**

**Formula**

1. Usually, the disk manufacturer provides an average seek time in milliseconds.
2. The typical range of average seek time is 4 to 10 msec.
3. If the speed of disk rotation is *p* revolutions per minute (rpm), then the average

rotational delay *rd* is given by

*rd* = (1/2) \* (1/*p*) min= (60 \* 1000)/(2 \* *p*) msec = 30000/*p* msec.

1 rpm = 60 x 1000 / rpm msec

And rd = (1 rpm) /2

1. **Block transfer time (*btt*) =**  *B*/*tr* msec where B is Block size and tr is transfer rate.
2. Transfer rate = track size in bytes / 1 rpm.
3. The average time (*s*) needed to find and transfer a block, given its block address, is estimated by (*s* + *rd* + *btt*) msec.
4. To transfer consecutively *k noncontiguous* blocks that are on the same cylinder, we need approximately *s* + (*k* \* (*rd* + *btt*)) msec.
5. The rotational delay for all but the first block, so the estimate for transferring *k* consecutive blocks is *s* + *rd* + (*k* \* *btt*) msec.
6. **bulk transfer rate (*btr*)** that takes the gap size into account when reading consecutively stored blocks. If the gap size is *G* bytes, then
   1. *btr* = (*B*/(*B* + *G*)) \* *tr* bytes/msec.
7. The estimated time to read *k* blocks consecutively stored on the same cylinder becomes 
   1. *s* + *rd* + (*k* \* (*B*/*btr*)) msec1

k. Blocking factor = Bfr =  **floor(B/R)** where B – block size in bytes and R is record size in bytes.

==================================================================================

**Sample q1:**

Consider a disk with the following characteristics (these are not parameters of

any particular disk unit): block size B=512 bytes, interblock gap size G=128

bytes, number of blocks per track=20, number of tracks per surface=400. A disk

pack consists of 15 double-sided disks.

(a) What is the total capacity of a track and what is its useful capacity (excluding

interblock gaps)?

(b) How many cylinders are there?

(c) What is the total capacity and the useful capacity of a cylinder?

(d) What is the total capacity and the useful capacity of a disk pack?

(e) Suppose the disk drive rotates the disk pack at a speed of 2400 rpm

(revolutions per minute); what is the transfer rate in bytes/msec and the block

transfer time btt in msec? What is the average rotational delay rd in msec? What

is the bulk transfer rate (see Appendix B)?

(f) Suppose the average seek time is 30 msec. How much time does it take (on the

average) in msec to locate and transfer a single block given its block address?

(g) Calculate the average time it would take to transfer 20 random blocks and

compare it with the time it would take to transfer 20 consecutive blocks using

double buffering to save seek time and rotational delay.

**Answer:**

(a)

Using the block size B=512 bytes, interblock gap size G=128 bytes, number of blocks per track=20,

Now calculate 1 block storing capacity = 1 block size + I Gap) =

= (512 +128) = 640 bytes

For 1 track which has 20 blocks and so its storage capacity = (Total track size

= 20 \* (512+128)

= 12800 bytes = 12.8 Kbytes

Useful capacity of a track = 20 \* 512 = 10240 bytes = 10.24 Kbytes

(ie., excluding the gap size)

(b) Number of cylinders = number of tracks = 400

(c) since a disk pack consists of 15 double-sided disks.

Total cylinder capacity = 15\*2\*20\*(512+128)

= 384000 bytes = 384 Kbytes

Useful cylinder capacity = 15 \* 2 \* 20 \* 512

(ie., excluding the gap size) = 307200 bytes = 307.2 Kbytes

(d) since number of tracks per surface=400.

Total capacity of a disk pack = 15 \* 2 \* 400 \* 20 \* (512+128)

= 153600000 bytes = 153.6 Mbytes

Useful capacity of a disk pack = 15 \* 2 \* 400 \* 20 \* 512

(ie., excluding gap size) = 122.88 Mbytes

(e)

Using the above FORMULA H

**Transfer rate = track size in bytes / 1 rpm.**

Transfer rate tr= (total track size in bytes)/(time for one disk revolution in msec)

tr= (12800) / ( (60 \* 1000) / (2400) ) = (12800) / (25) = 512 bytes/msec

Using the above formula G

**Block transfer time (*btt*) =**  *B*/*tr* msec where B is Block size and tr is transfer rate.

block transfer time btt = B / tr = 512 / 512 = 1 msec

Using the above formula G

If the speed of disk rotation is *p* revolutions per minute (rpm), then the average

rotational delay *rd* is given by *rd* = (1/2) \* (1/*p*) min

average rotational delay rd = (time for one disk revolution in msec) / 2

= 25 / 2

= 12.5 msec

Using the above formula

**bulk transfer rate (*btr*)** that takes the gap size into account when reading consecutively stored blocks. If the gap size is *G* bytes, then *btr* = (*B*/(*B* + *G*)) \* *tr* bytes/msec.

bulk transfer rate btr= tr \* ( B/(B+G) )

= 512\*(512/640)

= 409.6 bytes/msec

(f)

Using the above formula

**The average time (*s*) needed to find and transfer a block, given its block address, is estimated by (*s* + *rd* + *btt*) msec.**

average time to locate and transfer a block = s+rd+btt

= 30+12.5+1 = **43.5** msec

(g)

So now using calculated from previous step

time to transfer 20 random blocks = 20 \* (s + rd + btt) = 20 \* **43.5** = 870 msec

time to transfer 20 consecutive blocks using double buffering = s + rd + 20\*btt

= 30 + 12.5 + (20\*1) = 62.5 msec

(a more accurate estimate of the latter can be calculated using the bulk transfer

rate as follows:

time to transfer 20 consecutive blocks using double buffering

= s+rd+((20\*B)/btr) = 30+12.5+ (10240/409.6) = 42.5+ 25 = 67.5 msec)

=================================================================================

**Sample q2:**

Let us say we have XAT supplier company has stored info on files.

A **Supplier file** has *rec* = 1000 records of *fixed length.*

Each record has the following fields/cols (in bytes) :

**sup# (10), part# ( 10) , pname(200) pdescp(700) and a deletion marker byte.**

The file is stored on the disk whose parameters are given as block size *B* = 1024 bytes; interblock gap size *G* = 200bytes; number of blocks per track = 25; number of tracks per surface = 500. A disk pack consists of 18 double-sided disks, seek time s= 20msec, rotational delay rd = 12.5 and rpm=2000 msec.

**Answer:**

1. **Calculate the record sizein bytes.**

**Record size = 10 + 10+ 200+ 700 +1 = 921 bytes.**

1. **Calculate the blocking factor and the number of file blocks *b*, assuming an unspanned organization.**

**Understand unspanned ie., if the last record cannot fit in that block that whole record is stored in the next consecutive or stored in a different block.**

**Table

Description automatically generated**

**Using formula from above**

Blocking factor = Bfr =  **floor(B/R)**

where B – block size in bytes and R is record size in bytes.

**Where B = block size**

Given in the problem block size *B* = 1024 bytes; interblock gap size *G* = 200bytes; number of blocks per track = 25; number of tracks per surface = 500.

**B = 1024 bytes**

**Bfr = floor(B/R) = floor(1024/921)= floor(1.113) = 1.**

**(ie., 1 record in one block)**

**Therefore for 1000 records we need 1000 blocks.**

**b = ceil(rec/ bfr) = ceil(1000/1) = 1000 blocks.**

1. **Calculate the average time it takes to find a record by doing a linear search on the file**

**Using the formula:**

**The average time to do linear search is searching half the total file blocks**

**Hbs= b/2**

**The average time to do linear search = Hbs = b/2= 1000/2=500 blocks.**

Total track size = 25 \* (1024+200) = 30600 bytes

Time for 1 revolution of disk (ie 1 rpm) = 60 x 1000 / rpm = 60 x 1000/2000 = 30 msec

**(i)The file blocks are stored contiguously, and double buffering is used;**

= **s+rd+(Hbs \*B/btr)**

**where Hbs = 500, tr = track size/ 1 rpm = 30600 bytes /30 msec, calculate btr = (B/(B+G)) x tr , seek time s=20 msec, rd= 12.5.**

**tr = 30600/30 = 1020 bytes/msec**

Given in the problem block size *B* = 1024 bytes; interblock gap size *G* = 200bytes; number of blocks per track = 25; number of tracks per surface = 500.

**btr = ( 1024/(1024 + 200)) x 1020 = 853 bytes/msec**

**so** , **s+rd+(Hbs \*B/btr) = 20 + 12.5 +( 500 x 1024/853) = 632.7msec**

**(ii) the file blocks are not stored contiguously.**

**Similarly calculate using the following equation:**

**= Hbs \*( s+rd +btt)**

**where btt = B/tr where tr = number of bytes on a track/ 1 rpm = 30600 bytes /30 msec**

**, Hbs =500 and B =1024**

**Btt = 1024 /( 30600/30) = 1.004**

Given seek time s=20 msec, rd= 12.5.

**So , = Hbs \*( s+rd +btt) = 500 \* (20 +12.5 +1.004) = 18252 msec.**

1. **Assume that the file is ordered by part#; by doing a binary search, calculate the time it takes to search for a record given its part# value.**

**= ceil(log 2b) \*(s+rd+btt)**

Since b is 1000 blocks .(calculated above)

**= ceil (log 21000) x (20+12.5+ 1.004) = ceil (log 21000) x (33.504) = 9.9 x33.504 = 331.7 msec**

**NOTE : Write the units after computed values.**