One of the users of a cluster needs to store a file of size 980 MB in HDFS (Hadoop 2.x) with the default block size and default replication factor. As a Hadoop Administrator, determine the total number of blocks required and the size of each block.

Sol:
The default block size in Hadoop-2.x = 128MB
The default Replication factor = 3
The given file size = 980MB
Total number of blocks required to store 980MB in Hadoop-2.x is 8 blocks, where first 7 blocks will be of size 128MB and last block size will be of 84MB

According to default replication factor (3), each block will be replicated thrice.
Hence, 7 blocks of 128MB each X 3 = 21 blocks. i.e 21 blocks of 128MB
3 blocks of 84MB each

Mr. X deployed an empty Hadoop cluster (i.e no jobs and no data) with default configuration setup without using any compression technique for storing data in HDFS. Each machine in the cluster has 10 disks and each disk has a capacity of storing 1TB of data. Each Machine uses 2 disks for Operating System. As an expert in the Hadoop Administration, compute the total number of nodes required to store 750 TB data in the current cluster scenario

Sol:
Formula to calculate HDFS nodes (H) = c X R X S / (1-i)
Where C — Compression ratio, no compression is 1
R — Replication factor, default is 3
S — Initial size of the data used to move on hadoop
i — Intermediate data transfer factor. default 1/3 or 1/4
Hence, C = 1, R = 3, i = 1/4 and S = 750TB
H = 1 X 3 X S / (1 - 1/4)
= 4 X 750 TB = 3000 TB
Formula for data nodes (n) = H/d, where d is the storage capacity of data node
Here d = 8.
n = 3000/8 = 375 data nodes
But Name Node and secondary name node will be there in hadoop cluster. So, 375 + 2 = 377 nodes are required in Hadoop cluster.

The average seek time in the data node is 25ms and the data transfer rate is 200MB/s. Compute the appropriate block size which makes the seek time as 2% of the transfer rate.

Sol:
The data transfer rate includes the seek time also.
Average seek time = 25ms
Data transfer rate = 200 MB/sec
i.e 200 MB can be transfer in 1 second. This includes the seek time also. So, we need to compute the required seek time in 1 second data transfer.

So, 1 sec —— 200MB
25 ms in one second is 2.5 %
We need to make it as 2 % for seek time..

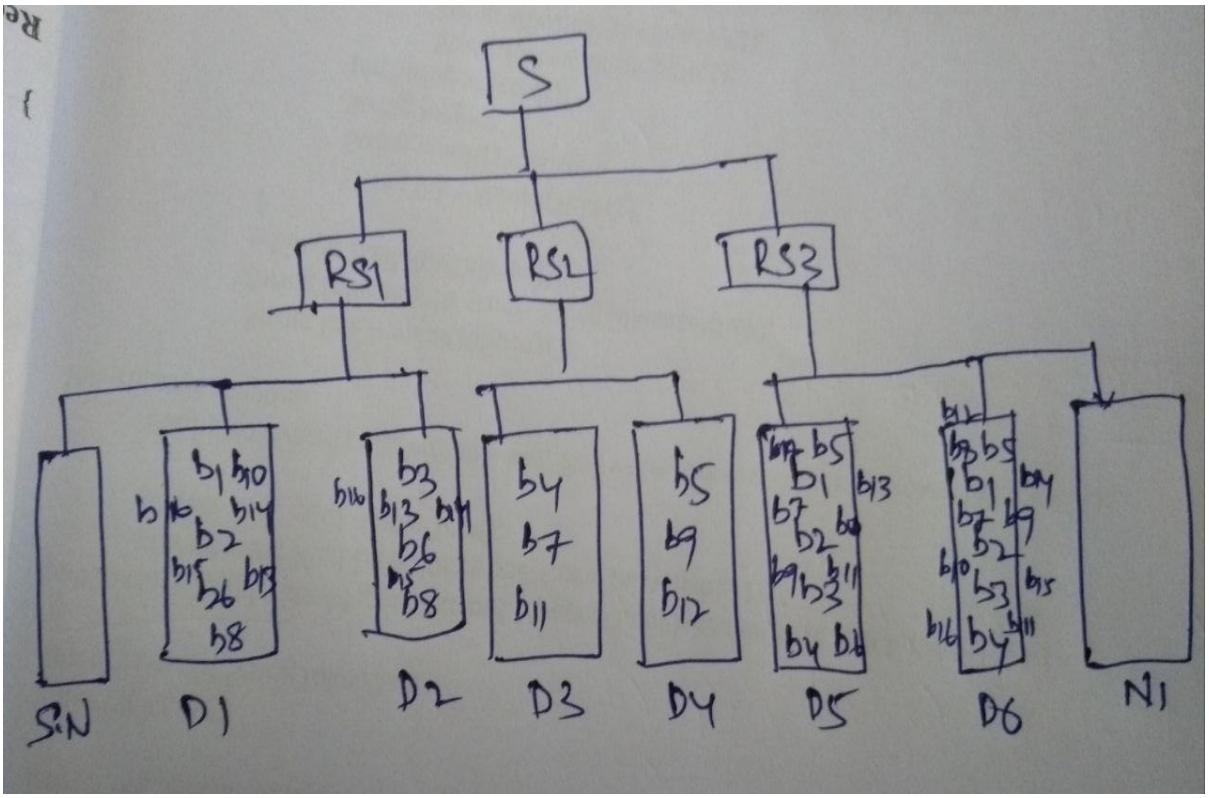
Hence, 2.5% ——- 200 MB
2 % ——- ???
= 2 X 200 / (2.5)
= 400 MB / 2.5
= 160 MB

Hadoop does not support 160MB as block size. So, the nearest block size will be considered. That is 256MB. This is final answer.

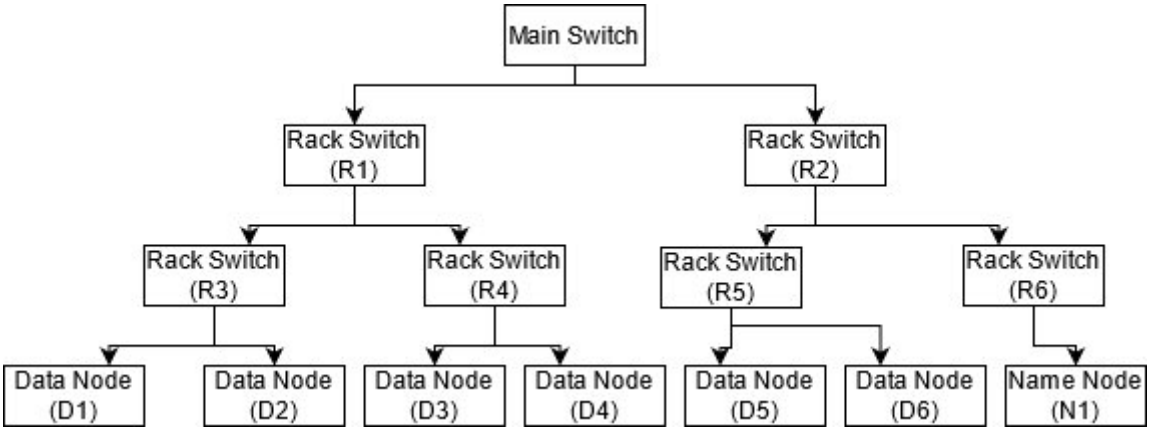
The Hadoop cluster has 6 data nodes (such as D1,D2, D3, D4, D5 and D6) and 1 name node (N1). All Rack-Switches (i.e RS1, RS2, and RS3) are connected to Main Switch (S). Each rack-switch has 3 slots for data nodes connection. The placement of the nodes in the cluster with respect to rack-switches as follows:
(a). RS1 is closer to RS3 than RS2
(b). RS2 is closer to RS3 than RS1
(c). RS3 is closer to RS1 than RS2
Illustrate a mechanism with a neat sketch to store a file having a size of 2 GB in the cluster with a default replication factor.

Sol:
Assume each rack switch is connected to two data nodes.
Here we need to use Rackaware rules for storing blocks in the given Hadoop cluster.
The file size is 2 GB. This can be partitioned into 16 blocks (128MB each). Total number of blocks stored in Hadoop is 16 X 3 = 48 blocks.
Let us assume blocks are b1, b2, b3, ... b16.
if b1 is stored in D1, then the replica of this block can be stored in D5 and D6
if b2 is stored in D1, then replica of this block will be stored in D5 and D6
if b3 is stored in D2, then replica of this block will be stored in D5 and D6
if b4 is stored in D3, then replica of this block will be stored in D5 and D6
if b5 is stored in D5, then replica of this block will be in D1 and D2

Here we are using Rackawareness rules while placing blocks.
One of the solution is:



The deployed Hadoop cluster with default configuration in small organization is shown in the following figure.



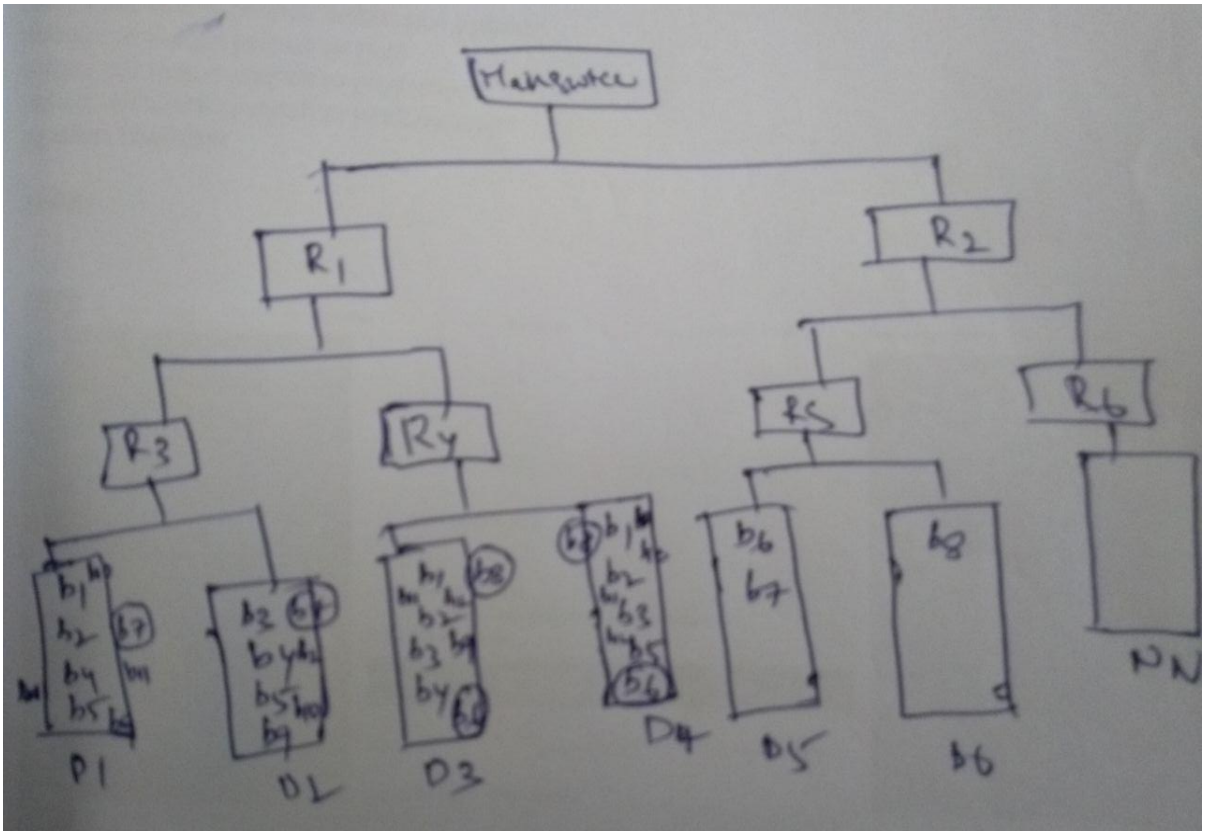
One of the clients wants to store 1.5 GB file in the cluster. Apply the Rack-awareness rules for storing the file in the above cluster and illustrate the same with pictorial form.

Sol:
Here we need to use Rackaware rules for storing blocks in the given Hadoop cluster.

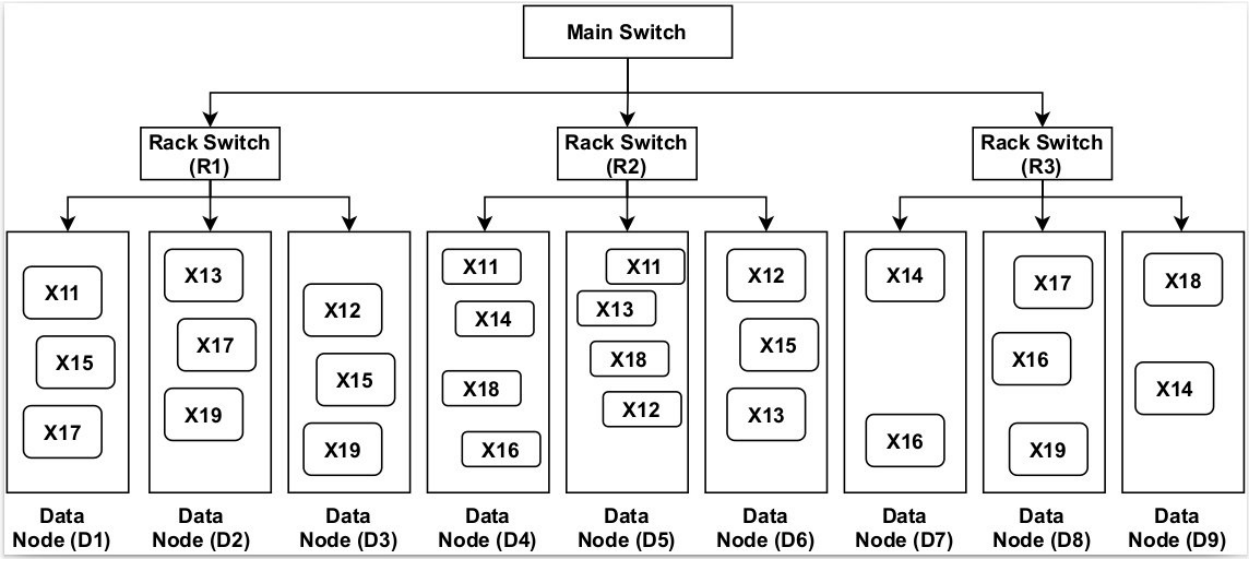
The file size is 1.5 GB. This can be partitioned into 12 blocks (128MB each). Total number of blocks stored in Hadoop is 12 X 3 = 36 blocks.
Let us assume blocks are b1, b2, b3, ... b12.

if b1 is stored in D1, then the replica of this block can be stored in D3 and D4
if b2 is stored in D1, then replica of this block will be stored in D3 and D4
if b3 is stored in D2, then replica of this block will be stored in D3 and D4
if b4 is stored in D3, then replica of this block will be stored in D1 and D2
if b5 is stored in D4, then replica of this block will be in D1 and D2
if b6 is stored in D5, then the replica of this block can be stored in either D1 and D2 or D3 and D4
if b7 is stored in D5, then the replica of this block can be stored in either D1 and D2 or D3 and D4
if b8 is stored in D6, then the replica of this block can be stored in either D1 and D2 or D3 and D4
if b9 is stored in D3, then replica of this block will be in D1 and D2
if b10 is stored in D4, then replica of this block will be in D1 and D2
if b11 is stored in D1, then replica of this block will be in D3 and D4
if b12 is stored in D2, then replica of this block will be in D3 and D4

One of the solution is:



The following figure shows the Hadoop cluster with default configurations. Illustrate the procedure to maintain cluster replication factor as 3 in case of the Rack-Switch (R1) failure.



Sol:

if R1 fails, then D1, D2 and D3 data nodes are also lost. Hence, the blocks in these data nodes should be stored in another datanodes to maintain replication factor as 3.

Hence, we need to store X11, X12, X13, X15 (twice), X17 (twice), X19 (twice).

For X11::
X11 is available in D4 and D5. So we need to place X11 in any one of the data nodes D7, D8 and D9

Fox X12::
X12 is available in D5 and D6. So we need to place X12 in any one of the data nodes D7, D8 and D9

Fox X13::
X13 is available in D5 and D6. So we need to place X13 in any one of the data nodes D7, D8 and D9

Fox X15::
case - 1: X15 is available in D6. So we can place one more X15 in either D5 or D6 and another X15 can be placed in any one of the data nodes D7, D8 and D9
case - 2: X15 is available in D6. We can place two X15 in data nodes by choosing two data nodes from set of D7, D8 and D9.

Fox X17::
case - 1: X17 is available in D8. So we can place one more X17 in either D7 or D9 and another X17 can be placed in any one of the data nodes D4, D5 and D6

case - 2: X17 is available in D8. We can place two X17 in data nodes by choosing two data nodes from set of D4, D5 and D6.

Fox X19::
case - 1: X19 is available in D8. So we can place one more X19 in either D7 or D9 and another X19 can be placed in any one of the data nodes D4, D5 and D6
case - 2: X19 is available in D8. We can place two X19 in data nodes by choosing two data nodes from set of D4, D5 and D6.

one of the solution is as follows: