1. An application specifies a requirement of 200 GB to host a database and other files. It also specifies that the storage environment should support 5,000 IOPS during its peak workloads. The disks available for configuration provide 66 GB of usable capacity, and the manufacturer specifies that they can support a maximum of 140 IOPS. The application is response time sensitive, and disk utilization beyond 60 percent does not meet the response time requirements. Compute for the number of disks that should be configured to meet the requirements of the application.

$$disks\ required = \max(D_C, D_P)$$
$$disks\ required = \max\left(\frac{200GB}{66GB}, \frac{5000\ IOPS}{140IOPS \times 0.6\ utilization}\right)$$
$$disks\ required = \max(4,60)$$
$$disks\ required = 60$$

2. The average I/O size of an application is 64 KB. The following specifications are available from the disk manufacturer: average seeks time = 5 ms, 7,200 RPM, and transfer rate = 40 MB/s. Determine the maximum IOPS that could be performed with this disk for the application and the IOPS at 70% utilization.

$$T_S = average\ seek\ time + rotational\ latency + internal\ transfer\ time$$
$$T_S = 5ms + \frac{0.5}{\frac{7200}{60}} + \frac{64KB}{40MB/s}$$
$$T_S = 5ms + 4.17ms + 1.6ms$$
$$T_S = 10.77ms$$

$$S = \frac{1IOPS}{0.01077ms} \times 0.7utilization$$
$$S = \frac{1IOPS}{0.01077ms} \times 0.7utilization$$
$$S = 64IOPS$$

3. An application has 1,000 heavy users at a peak of 2 IOPS each and 2,000 typical users at a peak of 1 IOPS each. It is estimated that the application also experiences an overhead of 20 percent for other workloads. The read/write ratio for the application is 2:1. Calculate RAID corrected IOPS for RAID 1/0, RAID 5, and RAID 6.

$$IOPS\ at\ peak\ workload = (1000 \times 2) + (2000 \times 1)$$
$$IOPS\ at\ peak\ workload = 4000$$
$$IOPS\ at\ peak\ workload\ with\ overhead = 4000 \times 1.2$$
$$IOPS\ at\ peak\ workload\ with\ overhead = 4800IOPS$$

$$read\ operations = 4800IOPS \times \frac{2}{3}$$
$$read\ operations = 3200IOPS$$

$$write\ operations = 4800IOPS - 3200IOPS$$
$$write\ operations = 1600IOPS$$

$$RAID\ 1+0\ corrected\ IOPS = 3200 + (1600 \times 2)$$
$$RAID\ 1+0\ corrected\ IOPS = 6400IOPS$$

$$RAID\ 5\ corrected\ IOPS = 3200 + (1600 \times 4)$$
$$RAID\ 5\ corrected\ IOPS = 9600IOPS$$

$$RAID\ 6\ corrected\ IOPS = 3200 + (1600 \times 6)$$
$$RAID\ 6\ corrected\ IOPS = 12800IOPS$$

Compute the number of drives required to support the application in different RAID environments, if 10K RPM drives with a rating of 130 IOPS per drive were used.

$$disks\ required\ for\ RAID\ 1+0 = \frac{6400IOPS}{130IOPS}$$
$$disks\ required\ for\ RAID\ 1+0 = 50$$

$$disks\ required\ for\ RAID\ 5 = \frac{9600IOPS}{130IOPS}$$
$$disks\ required\ for\ RAID\ 5 = 74$$

$$disks\ required\ for\ RAID\ 6 = \frac{12800IOPS}{130IOPS}$$
$$disks\ required\ for\ RAID\ 6 = 99$$

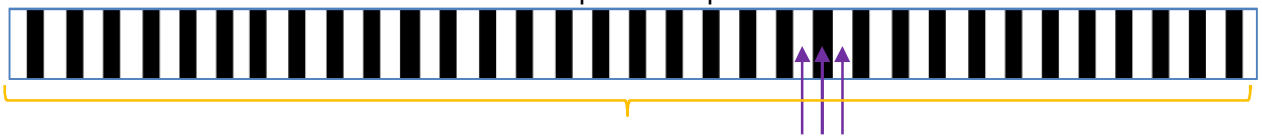
4. What is the stripe size of a five-disk RAID 5 set with a strip size of 32 KB? What is the strip size of a five-disk RAID 0 array with the same strip size?

$$stripe\ size\ of\ a\ 5-disk\ RAID\ 5\ set = 32KB \times 4$$
$$stripe\ size\ of\ a\ 5-disk\ RAID\ 5\ set = 128KB$$

NOTE: 1 disk is used for parity so only 4 are used for storage

$$stripe\ size\ of\ a\ 5-disk\ RAID\ 0\ set = 32KB \times 5$$
$$stripe\ size\ of\ a\ 5-disk\ RAID\ 0\ set = 160KB$$

Guide to remember the difference between stripe and strip:



***Stripe** is composed of multiple **strips**.*