Difference between Enterprise SATA HDDs and Desktop HDDs

In order to fulfil the operational needs, different web hosting providers offer different models of hard drives. While some web hosts provide Enterprise HDDs, which although comparatively expensive, offer significantly enhanced performance, others provide Desktop HDDs, which are essentially the HDDs used in laptops and computers and are not viable for website and application hosting at all.

Still, the lower cost of Desktop HDDs makes them preferred choice of all major web hosting providers, as a 250 GB Desktop HDD costs significantly lesser than a 250 GB Enterprise HDD.

ZNetLive provides Enterprise SATA HDDs with all its dedicated servers.

Amongst any others, one big reason why Enterprise HDDs provide better performance than Desktop HDDs is the difference in their anatomy, built and design.This paper takes an overview of all these design features in general and they ultimately affect your website and application performance.

Difference between Enterprise Class HDD & Desktop HDD

1. **Functional Availability and Workload:** Desktop systems generally have either one hard disk drive or a mirrored set of drives, which are developed to work in a less rigorous environment. The hard drive is accessed only to provide application or program access, swap file access or data retrieval or in order to complete a limited data save for any running application or the OS. The system does not run continuously and shuts down during the weekends or evening hours, or is left idle for long time periods.

   An enterprise class system may typically control a number of drives that are used to increase the redundancy and capacity of a storage subsystem. For e.g., an enterprise system may utilize multiple RAID 5 arrays for holding client data and four drives in a RAID 10 configuration for the OS. The enterprise system manages application and OS related tasks, but also supports client requests at all times as well. The enterprise system performs maintenance tasks like checking forerrors or defects in the hard drives, system backup,

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and others during off peak times. Enterprise class hard drives are developed with sturdy components and drive firmware programming in order to fulfill the requirements of rigorous working of enterprise class drives that generates added vibration and heat in actuators, motors, bearings and platter media.

2. **Price Sensitivity:** As the clients to servers ratio is much higher,desktop systems are very price sensitive. The local drive(s) only have to bear light and occasional loads with clients running user-oriented applications.

   As multiple enterprise applications are being run by the enterprise systems, they are not as price sensitive. Also, they have to manage more workload than desktop systems with more availability and reliability, so they usually have higher drive count. The additional features required to handle the added workload increases the cost of the design of the drive system.

3. **Performance:** Internal mechanisms allowing for fast data access and retrieval areusuallyincorporated inenterprise-class drives for better performance. The features include faster spindle speeds, faster hard drive micro-processor speeds, heavier actuator magnets, faster drive electronic components with more cache memory and denser magnetic media.

4. **Reliability:** Reliability is affected by a number of factors, including bad sector recovery, vibration sensors, rotational vibration and misalignment detection. These are explained below:

4.1. **Bad Sector Recovery:**Data from bad sectors are recovered with great efforts by the desktop drives. Normally desktop system has a single hard drive and a bad sector can lead to a big failure of the OS or an application as no online backup of the sector is provided by the desktop systems. Desktop drives are designed to try and read the sector repetitively in order to recover the data in any bad sector

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before finally reverting with an "un-recoverable read error". In this recovery process, it is possible that bus resets may be ignored by the drive while becoming unresponsive. The user, the OS and the application need to wait for response from the system for long periods of time when the drive disappears from the bus for an extended time period. Several minutes can be taken by a normal desktop drive command timeout and disk access is not allowed when the system retries the command.

In an enterprise scenario, such long recovery timeouts are not permissible as it can affect a number of users and also because RAID systems normally used in enterprise systems have no tolerance for an unresponsive drive. Short command timeout value is one of the features of enterprise-class hard drives. Whenever a drive finds it difficult to read a sector and if the short timeout is surpassed, the drive attempts recovering the missing data from sector checksum if it is available. In case this attempt fails, then the drive notifies the controller, who remaps error related bad sectors and tries recovery of the sector from redundant data on adjoining disks. The recovery efforts continue in the short timeout while the disk access requests by the OS are supported by the system drives. A time period of 7 to 15 seconds is the normal timeout for enterprise class drive and only a few attempts are made at retrieving the bad data. Enterprise class system cannot use desktop-class drives with timeout values of over 30 seconds as performance related issues may arise and might mark drives as offline most of the time, thereby increasing operating system crashes, blue screens, or kernel panics.

4.2. **Vibration Sensors:** A majority of enterprise drives utilize a circuit for vibration sensors on the electronic board of the drive. When servo moves the head, these sensors are used for detecting the drive's movement, which offers a dependable method of placing the heads and deciding whether it is safe for writing or reading data. However, if a combined single data/servo processor path is used, then this is lesser beneficial.

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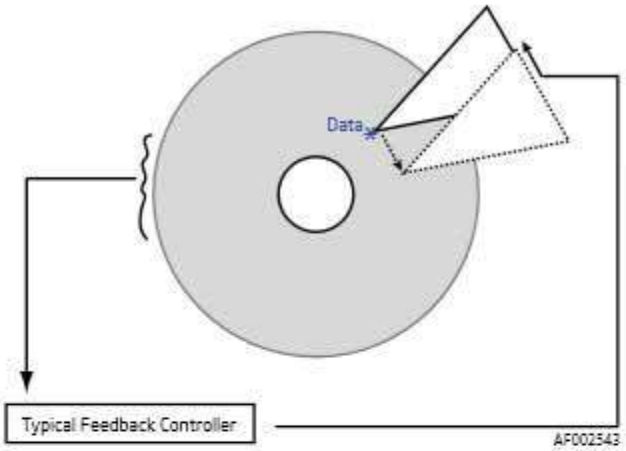
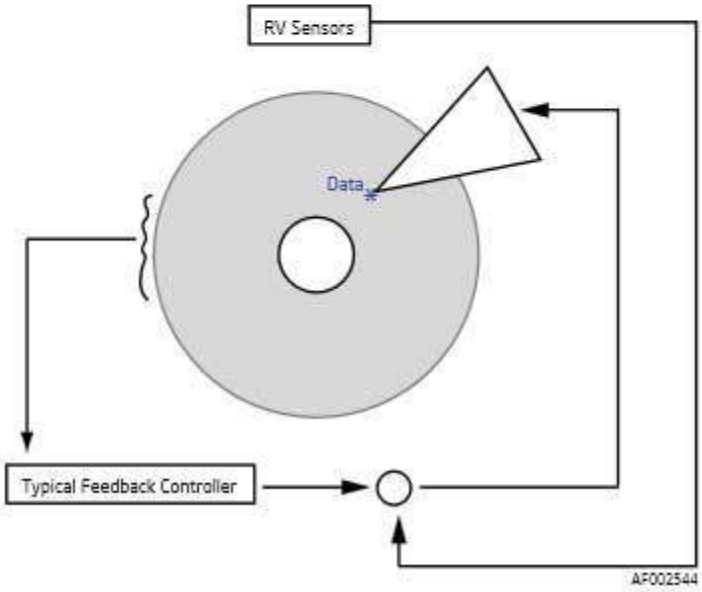
Figure 1: RV Compensation Feedback Mechanisms



No RV Compensation (Desktop-class drive)



RV Compensation (Enterprise-class drive)

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A closed loop feedback system is employed by the enterprise class drive designs in between the spindle(s) and magnetic head for detecting vibration anomalies and respond accordingly.

Enterprise class drives possess better capability for effective vibration detection and its compensation. Desktop class drives possess less advanced mechanisms for compensating errors induced by vibration and this causes more error rate and greater loss of performance.

Symptoms of errors related to vibration include an increased number of logged medium errors, lower performance of the drive and a marked increase in the number of drives marked offline by the I/O controller. Furthermore, high vibration scenario is also known to give rise to corruption of data in many drive models.

4.3. **Rotational Vibration:** Rotational vibration only refers to the vibration in the same plane in which the drive is spinning and is measured in Radians per second per second. Vibration specifications provided by drive makers do not include high vibration frequency ranges and are generally limited to measurements within the rotational plane.

Within a system, moving components like neighboring hard drives and fans act as the source of vibration and can affect the operation of the hard drive. These vibrations affect the normal operation by misaligning the read/write head with respect to the data track when read or write operations are performed. If the vibrations are not corrected or compensated for then data may be read or written off the track. These off track read or write errors can corrupt neighboring track's data leading to incorrect data that cannot be read or located.

A much better vibration compensation technique is offered by enterprise class drives wherein drive's vibration motion is sensed by sensing alignment of the track and position of the head. In order to retry access, the drive either leverages

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added strength of the actuator or pauses so that the spindle motor could spin the targeted location of the media under the head again. However, the time needed for spinning the targeted location back under the head severely impacts performance in some misalignment compensation methods and the amount of loss of performance totally depends on the strength and frequency of vibration.

4.4. **Misalignment Detection:** Multiple servo wedges are incorporated in the track by most drives. These wedges are continuously monitored by drive firmware (hardware & software) so as to decide upon the head's location with respect to the track. In case of detection of a misalignment, read or write needs to wait so that target location spins again under the head.

Most of the desktop class drives possess either a single combination of servo/data path processor or fewer servo wedges. Single processor makes it difficult for the drive to servo the head when writing is being done to the media. Also, most desktop drives are more prone to RV (rotational vibration) errors as they lack firmware compensation algorithms or a dedicated servo and data path processors, and thus there's a loss in performance because of vibration.

However, drive firmware of a majority of enterprise class drives employ dedicated servo and data path processors alongwith servo algorithms to accomplish compensation.

4.5. **Data Integrity:** An important feature ofenterprise-class system is end-to-end error detection implementation. Checksum and parity is included at each stage of data transmission inside the system. This enables detection of errors as well as their correction and data retransmission. Desktop class systems normally do not provide end to end error detection, although it is employed in certain subsystems. For example Error Correction Code (ECC) is not employed by desktop systems in drive memory buffers or system memory. However, error detection is employed by enterprise class systems at every stage of data transmission inside the system, including ECC support in drive memory buffers and system memory.

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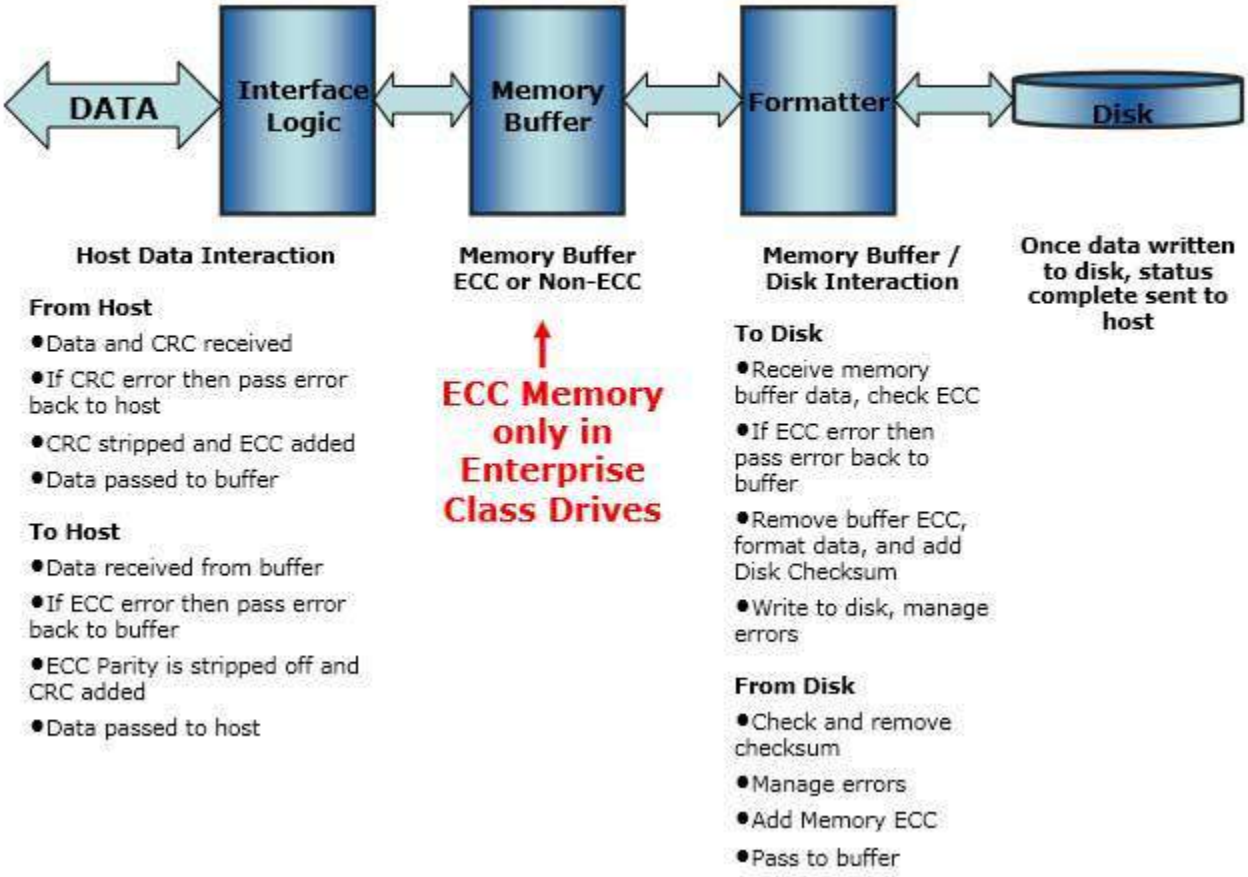
Figure 2: Data Protection Within the Hard Drive Electronics



An Enterprise class drive not only uses ECC for data moving through drive memory, but also employs additional error detection methods for transmitted data within the drive electronics. In the desktop drives, there's no way to detect a data error occurring inside the memory as this data protection feature inside drive memory is not there. The error gets transferred to the adjacent stages in the drive electronics or to the host device or to the drive media. Detection of this error type is very difficult and it can affect reliability of client data or stability of the operating system adversely.

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4.6. **Variable Sector Size:** A majority ofenterprise class hard drives (especially SAS and SCSI hard drives) possess the capability of varying the sector size within limits. These drives leverage a 528 byte sector of total sector capacity and allow the I/O controller, like RAID controller to set 512 bytes in sector's data portion and to utilize the rest for a sector checksum. Because of this, the I/O controller can verify the sector data against the checksum and thus get data recovered quickly from the checksum. This error can be tracked by the I/O controller and can remap bad areas of the drive in its memory. Drives possess the capability of tracking and remapping errors through sector parity.

Variable sector size is not used by desktop (SATA and IDE) drives and the sector is locked at 512 bytes, although a very small area at each sector's end is reserved for parity. This single parity is enough for error detection, but this data is insufficient to recover data or rebuild the sector in case of unreadable sector. It is only used by drive for internal error detection mechanism.

Variable sector size capability is being implemented by some vendors in the enterprise class SATA drives.

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Table 1: Feature Reference

Drive Comparison Table

Feature	Enterprise	Desktop
Spindle Motor	Higher RPM	Moderate to lower RPM
	Tighter run-out (spindle end movement)	Lower specification for run-out
	Spindle anchored at both ends	Spindle anchored at one end
Media	Full media cert	Lower media specification and density
Head Stack Assembly	Structural rigidity	Lighter weight design
	Lower inertial design	Higher inertial design
Actuator Mechanics	Larger magnets	Smaller magnets
	Air turbulence controls	No air turbulence compensation
	RV sensors and closed loop RV suppression	No RV sensors or suppression - limited to servo wedge track alignment
Electronics	Dual processors (dedicated servo and data path processors)	Single processor
	Performance optimization	No performance optimization
	Advanced error handling	Standard error handling
	Advanced firmware algorithms	Standard firmware algorithms

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Drive Comparison Table

Feature	Enterprise	Desktop
Performance		
Latency and Seek Time	5.7 msec @ 15K rpm	13 msec @ 7200rpm (or slower)
Command Queuing and Reordering	Full	Limited
Rotational Vibration Tolerance	Up to 21 rads/sec/sec	Up to 5 to 12 rads/sec/sec
Typical I/Os per sec/drive (no RV)	319	77
Typical I/Os per sec/drive (20 rad/sec/sec RV)	310	<7
Duplex Operation	Full	Half
Customization		
FW Code	Extensive	Limited
Variable Sector Sizes	Yes (SCSI/SAS only)	No
LEDs	Yes	No
Reliability		
MTBF	1.2M hours at 45 degrees C, 24X7 100% duty cycle.	700K hours at 25 degrees C and 8X5, 10%-20% duty cycle
Internal Data Integrity Checks	End to End	Limited, none in memory buffer
Maximum Operating Temperature	~60 degrees C	~40 degrees C
Warranty	~5 years	~1 to 3 years

Conclusion

With the changes in drive technology, customers get different product options that can be utilized in desktop or enterprise environment. Hard drives are designed with a wide variety of features that can impact data integrity and system uptime. Some web hosting providers

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may differentiate enterprise HDDs from desktop HDDs by not testing certain enterprise-class features, validate the drives with different test criteria, or disable enterprise-class features on a desktop class hard drives so they can market and price them accordingly.

It can be difficult to get detailed information and specifications on different drive modes. While ZNetLive does not recommend any specific version of HDDs, we encourage you to keep abreast with the latest technology and discuss your requirements in detail with us for us to help you provide the service with features best suited for your deployment application.

ZNetLive provides Enterprise SATA HDDs by default with all its dedicated servers.