

CinemaStar/Set-Top Box Design Considerations Podcast Supporting Q&A

Hitachi remains committed to developing the technologies that specifically enhance hard drive functionality, performance and reliability for consumer electronics (CE) applications.

1) What are the main differences that systems integrators need to be aware of in designing a hard drive into a STB/DVR versus that of a traditional IT application, such as a PC.

There are several key considerations:

- System architecture – Unlike PCs, there is little commonality among DVR designs in terms of the hardware and software. Therefore, each individual design needs to be understood to optimize the hard drive specifically for that design. The hard drive needs to be able to adapt to the particular usage environment of a given design.
- Temperature – Again, unlike traditional IT applications, the STB system may run hotter and it is usually stored in less ventilated environments – the TV cabinet, along with other home theater equipment. As a result, this system needs to incorporate a hard drive that is designed for high reliability in this higher temperature environment.
- Workload – The workload in the STB environment can often be an all-day operation as a result of the record buffer for instant rewind. This means a DVR may read and write hundreds of gigabytes per day compared to perhaps only a few gigabytes per day in most PCs. The CinemaStar hard drive is designed and tested for long-term reliability in this 24x7 operational environment.
- Data size – PCs perform mostly small data access operations, while the majority of video streaming in a DVR is large data sizes. This means the buffer architecture needs to be adaptable to ensure performance in a variety of access patterns.
- Data flow – Video data error management requirements are very different in DVR applications than in those of the PC. In a video streaming application, a few dropped pixels will not likely be noticed by the viewer so data error recovery can be optimized for time rather than causing a delay in the video data flow. The CinemaStar hard drive has specific error-correction features that system designers can take advantage of to optimize system functionality.

Overall, in the physical environment, the mechanical mounting, and shock and vibration protection need to be considered to ensure the hard drive is protected in operation and when the system is being moved or shipped.

2) Why is it important to consider and account for aspects such as shock and vibration in designing a hard drive-based STB?

First, when the unit is being moved for initial goods shipment or within the home environment, it needs to be packaged and handled with care to prevent hard drive damage from external shocks and vibrations.

CinemaStar hard drives have head load/unload technology, which means that the head arm is removed from above the disk surface when the hard drive is not powered on. This prevents head-to-disk impact during a shock.

Secondly, during operation, common shocks in a household environment can occur, such as bumps by a vacuum cleaner or knocks while dusting. In addition, vibrations caused by the TV's sound system or the STB cooling fan can cause interference. The CinemaStar 7K1000 has the highest operating shock level in its class, and incorporates feed-forward servo control, which vastly improves performance under vibration conditions.

Of course, system design is also important. Such simple things as rubber feet on the bottom of the unit can help to absorb shock and vibration, as well as improve ventilation.

3) Can you provide more information on how temperature affects the STB design and how the CinemaStar hard drive addresses temperature considerations?

Clearly, the better the system is designed to cool the hard drive, the more reliable it will be.

Using a variable-speed fan is one cooling option for the system. This fan can respond to changes in the temperature that the hard drive reports back to the system. A variable-speed fan can keep the acoustics low the majority of the time but can ensure that the hard drive does not become too hot if temperatures rise. In addition, simple measures, such as designing lots of ventilation holes into the system casing, will make a significant difference.

The power savings design and features of the CinemaStar hard drive significantly improve its overall power consumption. The hard drive's tiny Femto slider (the read head) has a smaller mass, and therefore, requires less energy to move. This coupled with the silent-seek feature, which allows the actuator to move more slowly, makes for one cool drive.

Depending on the STB design, there may be opportunities to further decrease heat and power consumption, and increase overall reliability by using the power mode control features of the HDD. For example, when the HDD is not in record or playback mode, it can be programmed to automatically enter lower power states, as an example, turning off some of the electronics, then parking the head safely on the unload ramp, or even stopping the motor. All of this can be achieved through the Advanced Power Management feature set.

4) What are the design considerations to account for with respect to acoustics?

The CinemaStar hard drive's silent-seek mode helps to improve the overall system acoustic level and delivers the "bedroom quiet" acoustic performance that the DVR market demands.

Silent-seek technology changes the way the arm moves from video stream to video stream, making seek operation much smoother. The user does not hear the clicking sounds often heard with PC or notebook hard drives. The arm motion is optimized so the hard drive still provides the performance required for multi-stream video applications.

On the system design side, the mechanical mounting of the hard drive and fan, using damping isolation materials and incorporating rubber feet will all help to prevent audible resonances from developing within the system chassis.

Hitachi's Design Studios can assist with testing shock and vibration, and locating resonances that may be contributing to acoustic noise.

5) Can you further explain how power plays a role in STB system design?

It is important that the power supply unit provides the power stability to ensure reliable hard drive operation. We've seen some designs where the power supply quality was significantly outside of the hard disk drive specification. Hitachi engineers are on hand to help assess power supply quality under real-world system operations.

6) Can you provide a final word on the breadth of services offering by Hitachi's Design Studios?

Hitachi's Design Studios can model application scenarios – even before the customer has their final design – to explore system design architecture, and hard drive suitability and functionality. We can also test partial and full prototypes of systems for vibration, shock, acoustics, streaming efficiency, interface, power, mounting design, thermal management and error handling. All these services are available today, and our engineering teams have a broad base of experience in AV hard drive systems and the many design considerations to be made.

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