



With both the rising costs of energy and growing “green” consciousness, the ability to create energy-efficient storage solutions is rapidly becoming a competitive advantage. This white paper shows you how, today, you can start building very energy-efficient storage subsystems that can be optimized for various applications and usage models.

To meet these energy demands, the Adaptec Series 5 and Series 2 RAID controllers are the first to offer Intelligent Power Management. At the same time, with the current series of Serial ATA (SATA) and Parallel ATA (PATA) hard drives, Hitachi offers the most complete hard drive power management features.

This paper explains how Intelligent Power Management™ works on Adaptec Unified Serial RAID cards, and details the Advanced Power Management features of the Hitachi Deskstar series of hard disk drives. You will also learn how users can benefit from the combination of these advanced features in both the storage controller and hard drives, and how to set up a system that makes optimal use of this powerful and unique feature set.

## Power Needs Can Double the Cost of a System

The power and cooling requirements of hard drives are a primary operating cost in server and RAID environments. In most servers, full power is maintained to every drive at all times, even when inactive. Naturally, this constant full-power state also increases the costs of cooling of the system. At current rates, the cost of operating a server over a typical four-year life is about the same as its initial purchase price.

Even though current servers make storage accessible around the clock, not all of these applications actually require the storage to be accessible 24x7. Typical applications where hard disk drives do not need to run all the time are shown in Table 1.

| Application                                      | Known Example     | Idle Time        | Use   |
|--|-------------------|------------------|---|
| File/Print Servers                               |                   | 75%              | Typically unused during nights/weekends   |
| Media ISPs<br>Photo-sharing ASP<br>Movie-sharing | Netflix,<br>Kodak | Old data<br>-95% | Recently uploaded content accessed frequently. Older content accessed rarely or never—classic long-tail problem |
| Bulk Email                                       | Yahoo             |                  |   |
| Archive & Compliance                             | Zantaz            |                  |   |
| Disk-to-Disk Backup                              |                   | 80%              | Only needs to be active during backups (periodic, nightly) and during recovery (infrequent)                     |
| WAN-based<br>Disaster Recovery                   |                   |                  |   |

Table 1: Typical applications that have extended hard disk idle times

In the idle times, the latest power management features can produce significant cost and energy savings for your customers.

## Taking Energy Savings to the Component Level

Unlike for desktop systems and notebooks, power management has not been offered on a component level for application servers or storage server applications.

Because of that, these benefits have been available only in the solution space built into appliances. With the introduction of Intelligent Power Management on a controller level, Adaptec enables system builders and integrators to build their own energy-efficient solutions optimized for their customers and environment.

## Adaptec RAID Controller Intelligent Power Management

Adaptec Intelligent Power Management for RAID controllers reduces storage energy consumption by as much as 70% without compromising application performance.

With Intelligent Power Management, users can minimize power consumption by alternating between three modes:

1. **Normal Operation**—full power, full RPM
2. **RAID Controller Standby Mode**—low-power mode spins disks at lower RPM
3. **Power-off Mode**—disks not spinning

Intelligent Power Management is administered through Adaptec Storage Manager™, the familiar centralized tool that simplifies control of all Adaptec RAID in any storage environment.

## Hitachi Disk Drive Advanced Power Features

Hitachi Deskstar hard drives offer several different power states that allow performance needs to be met at the lowest possible energy expenditure.

## Online (Random Read/Write)

In the normal ready mode, these drives respond immediately to system requests for data. With the industry’s lowest power requirements, they enable the use of lower cost power supplies and require less cooling than other SATA drives. Hitachi drives achieve these integration benefits while providing industry-leading performance.

## Normal Idle

After a very short period (seconds) the read/write heads are switched off automatically.

## Unload Idle

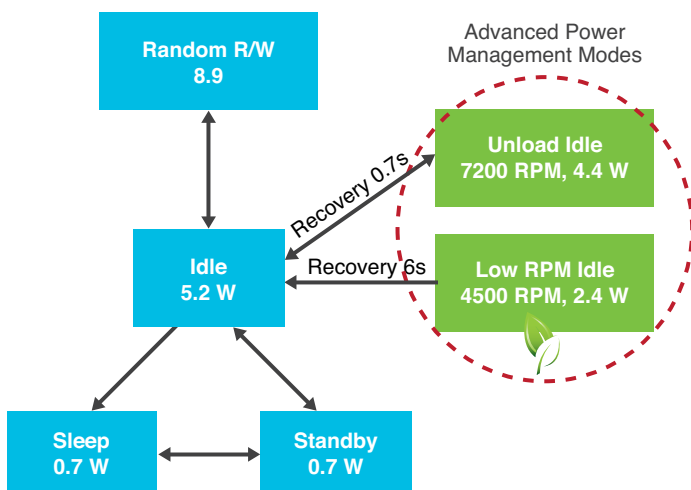
If the drive is idle for several minutes, the heads can be sent to the ramp. Since the servo circuit is disabled, this mode requires 40% less power than the Online mode. With a request for data, the drive quickly returns to the Online mode for rapid access to user data.

## Low RPM Idle

When longer periods of non-use occur, additional power savings are possible. In this mode, in addition to head unload from the media, the spindle motor can be slowed to a lower spin rate (approximately 50% of normal). This action further reduces the power needed for the drive, as much as 20%–30% less than the Unload mode. This mode offers a good balance between power savings and time to get back to the normal Online mode.

## Hard Drive Standby

One final mode enables the greatest power saving state, from the disk drive perspective. In this case, as above, the heads are moved to the ramp. In hard drive Standby mode, power is removed from the disks. Stopping the disks results in 25% savings over the Low RPM mode. In this mode, only a few key circuits remain active, significantly reducing the power requirement. The active circuits enable the drive to accept commands and return to the Online mode. The standby drive can be brought to the Online mode if, for example, one of the active drives is removed from the system. This mode is especially useful in RAID environments where one drive serves as a spare.



Power Data are for Deskstar EK71000 1TB

Each of these four stages of readiness offers power and cooling benefits for the system. The accompanying table shows the percentage of savings for each mode.

| Mode         | E7K1000 1TB<br>(3 disks) | 7K1000.B<br>320GB (1 disk) |
|--------------|--------------------------|----------------------------|
| Random R/W   | 8.9W                     | 6.2W                       |
| Normal Idle  | 5.2W (-42%)              | 3.6W (-42%)                |
| Unload Idle  | 4.4W (-51%)              | 3.1W (-50%)                |
| Low RPM idle | 2.4W (-73%)              | 1.9W (-69%)                |

Table 2: Power savings per mode for typical Hitachi drives

## Time Required to Get Back Online—Critical for Many Storage and Server Applications

In many applications, the time required for the drives, and with this the whole RAID array, to get back to online mode is critical. With the additional power states supported by Adaptec Intelligent Power Management and Hitachi Ultrastar and Deskstar (SATA and PATA) series of hard disk drives, the user has additional options beyond spinning down the hard disk drives completely.

As you can see in Table 3 below, the Hitachi Low RPM mode needs only between 3–6 seconds to get back online compared to 8–14 seconds with drives in disk drive standby.

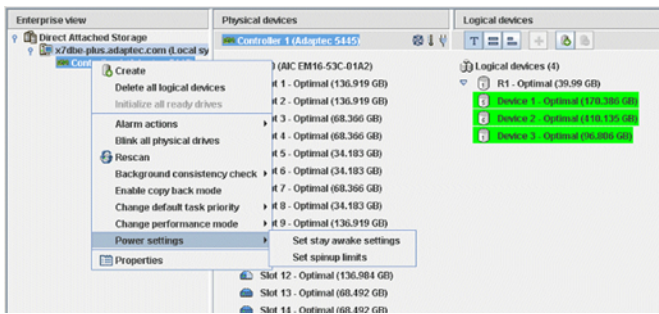
| Back to Random R/W | From Unload Idle | From Low RPM Idle | From Hard Drive Standby |
|--------------------|------------------|-------------------|-------------------------|
| 320GB (1 disk)     | 0.7 seconds      | 3 seconds         | 8 seconds               |
| 1000GB (3 disks)   | 0.7 seconds      | 6 seconds         | 14 seconds              |

Table 3: Time needed by hard disk(s) to get back to online (full performance) mode

Adaptec Intelligent Power Management supports the Low RPM state by offering a RAID Controller Standby mode in Adaptec Storage Manager. This allows users to decide how long a delay getting back to Online mode an application will support, and gives them the choice of powering off the drives (Power-off mode) for energy savings of up to 70% or to keep the drives spinning in Low RPM mode and reduce the amount of time to get back to full performance.

There may be situations in which power management may not be an appropriate choice at all times, such as servers which sit idle all night, but are used heavily during the day. Intelligent Power Management lets you adjust to these fluctuations by setting a blackout period in which power management is completely disabled.

Using the Adaptec Series 5 and Series 2 Unified Serial RAID Controllers with Intelligent Power Management in conjunction with Hitachi Deskstar hard drives provides an ideal combination for creating energy-efficient storage solutions.



Adaptec Storage Manager Power settings

## Battery-backed Cache

Adaptec Series 5 controllers take the equation between energy efficiency and performance one step further by offering battery-backed cache on the controller that can be used to buffer some of the I/O. Using these controllers, you can delay spinning the drives back up for an extended period by keeping data in the battery-backed cache. This is particularly important when you are using an operating system or tools that make periodic low-frequency access to storage for simple bookkeeping purposes—for example, updating a single timestamp or Windows registry entry. In those environments, the Series 5 controller can maximize your power savings, even on your operating system's boot volume, without sacrificing data integrity or reliability.

## Conclusion

Today's storage solutions must solve the challenge of saving power while providing appropriate performance. Until now, you could only achieve power reduction in the application space in your solution. But, Adaptec Intelligent Power Management and Hitachi Advanced Power Management features allow you to build in much more effective power management at the component level.

The combination of Adaptec Series 5 and Series 2 Unified Serial RAID Controllers and Hitachi hard drives make it possible for users to adjust power levels and performance to find the right balance for their applications. In hard drive Standby/power down mode this can save about 90% of power per hard drive. For applications that need to return to optimum performance faster, customers can combine the hard drives' low RPM Idle with the RAID Controller's Standby mode to save up to 70% per disk and get back up to speed in less than half the time.

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