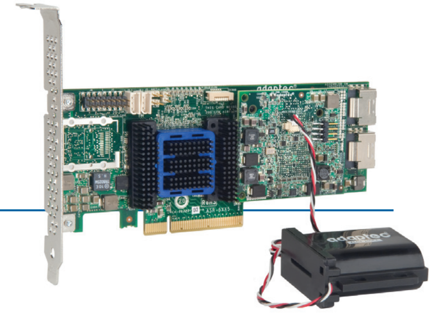
Zero-Maintenance Cache Protection for Series 6, Series 6Q and Series 5Z RAID Controllers



Reduced Data Center Operating Costs and Maximum Protection for Cached Data

IDC estimates that the cost of operating a piece of IT equipment over a four year period may be four times greater than the original cost of acquiring it.

Adaptec Series 6, Series 6Q with maxCache 2.0 and Series 5Z RAID controllers with Zero-Maintenance Cache Protection (ZMCP — pronounced “zemcap”) provide maximum protection for cached data and eliminate the substantial costs and environmental impact of complex, messy and expensive Lithium Ion batteries, while improving cache protection and cache performance.

Why do you need Cache Protection?

The adoption of RAID 5 and 6 continues to grow in enterprise storage systems as users continue to be concerned about optimizing capacity utilization for rapidly growing data sets. However, optimal performance can suffer unless the system is operated with all available caches enabled.

With controller cache enabled, however, data is stored in the controller’s memory and can be lost when a system power outage occurs. The most common protection against this scenario is to backup the controller cache with a battery backup unit (BBU) installed directly on the controller. This battery is used to maintain the data of the on-board memory cache until power can be resupplied to the unit.

A second use for the BBU is in connection with Adaptec’s Intelligent Power Management which is offered on Adaptec Series 6, Series 6Q, Series 5Z, Series 5 and Series 2 RAID controller families. In order for the controller to slow down or stop disk drives there must be no I/O activity to the disk. However, many operating systems do very low, but non-zero, levels of I/O all the time — even when all applications are idle. The on-board memory cache on the Adaptec controllers can play an important role in supporting Intelligent Power Management by absorbing these I/O requests and saving them in memory, instead of spinning up disk drives that would otherwise be idle. Of course, this approach is only fail-safe if the contents of the on-board memory are preserved across a power outage.

Zero-Maintenance Cache Protection

Despite their obvious value, BBUs (available for Series 5) are not the optimal solution: they must usually be purchased separately from the controller card, and require constant monitoring, maintenance and replacement. Old batteries must be disposed of in an environmentally-responsible manner.

Adaptec Series 6, Series 6Q with maxCache 2.0 and Series 5Z controllers offer a different approach: Zero-Maintenance Cache Protection.

The basic idea of ZMCP is to detect the loss of power to the controller and then to copy the data in the on-board controller cache to non-volatile location — in this case NAND flash memory of a type similar to that used in USB thumb drives and solid state disks. This process is supported by a super capacitor that keeps the necessary parts of the controller active for the time required to perform the NAND flash copy.

Once the data has been copied to the flash memory the controller no longer needs power in order to preserve the data.

When power is finally returned to the controller, the data in the flash memory are copied back to the on-board controller cache and operation resumes as normal with all outstanding I/O requests preserved.

Highlights

Low Operating Costs
- No installation, monitoring, maintenance, disposal or replacement costs due to batteries

No Data Loss from Power Failures
- Replaces lithium ion batteries

Maintenance-free Cached Data Protection
- No need to monitor battery charge level
- No shutdown required for battery replacement
- Protects data indefinitely — no need to rush to restart systems “before the battery runs out”
- Stores protected data for years

Instant RAID Cache Protection
- Charges in minutes instead of hours
- RAID performance optimized immediately

Environmentally Conscious
- No toxic battery disposal
- Works in conjunction with Adaptec Intelligent Power Management for industry’s ‘greenest’ solution
- Simplified IATA compliance

Available fully integrated on Series 5Z and Series 6Q RAID controllers and as an add-on kit for Series 6 RAID controllers

ZMCP
ZERO-MAINTENANCE
Cache Protection

Adaptec Zero-Maintenance Cache Protection

ZMCP Benefits Relative to BBUs

While BBUs have been an acceptable cached data protection solution for years, there are numerous hard costs, labor costs and risk factors associated with managing and replacing BBUs after the initial purchase has been made.

Adaptec by PMC RAID controllers with Zero-Maintenance Cache Protection eliminate all these costs.

Monitoring

BBUs have a finite usable charge and require close monitoring of battery health and charge levels. If the charge level deteriorates below a certain level, immediate corrective action must be taken to replace the battery to avoid any chance of data loss.

– *Adaptec RAID controllers utilize NAND flash memory that doesn't degrade over time, eliminating the need for monitoring.*

Instant Protection

BBUs usually have to be charged before they can actually be used – a process that can take as long as 9 hours. During this initial period users will experience lower response times from the storage subsystem, as cache is not enabled until the battery charge is complete. This can result in lost productivity.

– *Zero-Maintenance Cache Protection is based on a capacitor which charges while the system is booting. By the time your server has booted, it is already fully protected.*

Corrective Action on Power Loss

BBUs are typically rated to provide 72 hours of protection. This means that in theory you have up to 72 hours to reboot a server whose power has failed. Unfortunately, the lifespan of BBUs isn't infinite and their ability to hold 72 hours worth of charge gradually deteriorates over time. As a result you may have substantially less time to recover power to a server than the expected 72 hours. Depending on when an outage is discovered, you may have to take emergency action to recover data.

– *Using current NAND Flash technology, Adaptec RAID controllers can store protected data for years with no degradation. You can re-power your servers whenever it is most convenient for your business.*

Replacement

BBUs need replacing every 1-2 years. Even when planned well, this usually requires the system to be taken offline and opened. In addition to system downtime, this process adds maintenance and personnel overhead.

– *Zero-Maintenance Cache Protection needs no regularly scheduled maintenance in a typical server lifespan, increasing system uptime and dramatically reducing the overall total cost of ownership.*

Disposal

Once BBUs have been replaced, the old ones require a careful disposal process that adheres to strict hazardous material standards. Even when disposal criteria are properly followed, the toxic chemicals of the batteries are still introduced into the environment with potentially harmful consequences.

– *Adaptec RAID controllers face less restrictive disposal regulations, eliminating related costs and dramatically reducing adverse environmental effects.*

ZMCP Saves you Real Money

While the logic behind the Zero-Maintenance Cache Protection approach is relatively compelling, the actual financial impact is even more so.

To compute these savings we must look at the ways that people approach their existing BBU solutions. An interesting and appropriate analogy is to look at the way that people treat the oil in their cars.

At one end of the spectrum are the folk that take meticulous care of their oil, changing it every 3,000 miles, just as it says in the owner's manual. They continually monitor the oil and "engine check" lights in their vehicles, and schedule oil changes to work around their busy schedules.

At the other end of the spectrum are the folk that only react when the oil light comes on. At this point they interrupt the normal activities of themselves and their passengers and rush off to change the oil, hoping that the car won't seize up on them while they're actually driving to the nearest gas station.

We can use these analogies to compute the benefit of the ZMCP solution.

Savings for the meticulous BBU user

In this model we assume several things about the way that the owner handles a card with a BBU

- They purchase a new battery every year, as recommended, and keep a couple of replacements on hand all the time to take care of unexpected events.
- They carefully schedule downtime for their users to change the battery. They attempt to deploy a replacement device to take up the load while the primary server is out of action. Several folks in the IT department must usually coordinate their efforts to make this happen.
- Replacement batteries are allowed to fully charge before putting a system back into operation.
- Systems are continuously monitored to detect a failing battery.

Adaptec Zero-Maintenance Cache Protection

In this case we can assume that the chance of losing data due to a power failure happening while the battery is out of action is very small. To compute the cost of this methodology we include:

- Capital expense of purchasing batteries — one per year for four years, plus one extra to take care of unexpected issues.
- Operating IT cost to install the initial device, plan downtime, replace batteries and re-charge them.
- Potential "overtime" or "disruption" costs when a power failure occurs and systems have to be turned back on within the 72-hour battery charge window — potentially disrupting other activities, or occurring during the night, on a weekend or over a holiday period. Even in the best case, the pressure to re-power systems has an impact.
- Productivity impact on other users.

In an ideal world, the chance of losing data in the latter example would be zero due to all the planning. However, in reality it never is — people don't get the "memo", or they can't modify their plans to take alternative actions. For the sake of this analysis, however, we assume that only a small number of people are impacted, and then only to a small degree.

Computing the overall cost, therefore, we have:

Item Per Server	Impact over 4 years	Cost per item	4 year cost*
Batteries	5	$175 each	$875
IT manpower			
Initial Installation	.5 hours	$20/hour	$10
Downtime Preparation	1.5 staff-hours, 3 times	$30/hour	$135
Battery Replacement	1 hours, 3 times	$20/hour	$60
Monitoring	30 seconds per day	$20/hour	$240
Productivity loss	5 people, 15% impact	$40/hour	$800
Activity Cost on Power Loss	3 hours, 30% chance of occurring, 8 incidents	$50/hour	$360
Total			**$2,480**

** Based on single server model.*

Savings for the on-demand replacement BBU user

The second model to consider is the BBU user who waits for the alert light to come on before doing anything. The major difference between this case and the last one is due to the unplanned nature of the replacement, and consequently the number of people it affects. Think again of the oil change analogy but instead of a personal car, consider the impact on something larger, say a bus. In this case, when the oil change light comes on, the driver has to pull over to the side of the road and stop, and everyone on the bus is impacted. Whatever they were planning to do has to be put on hold while the problem is resolved.

To compute the impact of this scenario we make the following assumptions:

- A replacement battery had been purchased at the time of the initial installation and is sitting on a shelf somewhere, ready to go. Another new battery is purchased to replace this one.
- A "mini-panic" occurs when the alert happens. The server is immediately taken out of service and because this is an unplanned event a relatively large number of people have their daily work affected. They may be forced to be idle until the affected system is brought back online, or perhaps they can work on something else, but the net result is some impact on their productivity.
- Because users are waiting to get back on the affected system, replacement batteries are NOT allowed to fully charge before putting the server back into operation. This minimizes the amount (and cost) of downtime for each replacement, but exposes the system to potential data loss while the battery is charging. We assume the system takes two hours to fix, and users are allowed access after another 3 hours — a net total of 5 hours of lost work for each affected user.
- Systems are continuously monitored to detect a failing battery.

Item	Impact over 4 years	Cost per item	4 year cost
Batteries	3	$175 each	$525
IT manpower			
Initial Installation	.5 hours	$20/hour	$10
Downtime Preparation	0	$30/hour	$0
Battery Replacement	2 hours, once	$20/hour	$40
Monitoring	30 seconds per day	$20/hour	$240
Productivity loss	40 people, 100% impact, 5 hours each incident	$40/hour	$8,000
Activity Cost on Power Loss	3 hours, 30% chance of occurring, 8 incidents	$50/hour	$360
Lost Business Cost	2 hours of system downtime, $50M per year, 10% impact	$570/hour	$1,140
Total			**$10,315**

We also include an impact on the business itself since this type of downtime is unscheduled. The cost of these instances is hard to compute, and analyses performed by (self-interested parties) tend to be hysterical in nature — sometimes as high as $500,000 per hour or more. We take a much more conservative approach and simply assume that the impacted device has a 10% impact on a business valued at $50 million per year.

Note that this number is optimistic for a number of reasons. Apart from the fact that we've assumed a pretty rapid response to the incident and that users are allowed back onto it before it is fully protected again, we've not taken into account the fact that this strategy actually exposes the system to data loss.

Adaptec Zero-Maintenance Cache Protection

Estimating the cost of lost data is extremely hard to do. For example, in smaller companies it may take more than 24 hours to actually recover lost data causing further loss in productivity and revenue. In some instances there is an additional financial impact due to the cost of replacing/repairing whatever business impact may be caused by the loss — for example helping customers for whom banking or credit card transactions have gone missing.

In order to not offer ridiculous numbers that depend to a large degree on the nature of individual businesses, we simply comment that the strategy noted here has about a 1 in 700 chance of suffering data loss (assuming that the system is exposed for around 6 hours, and two power failures occur per year).

The Bottom Line on Total Cost of Ownership (TCO)

Obviously there are other scenarios that we could consider.

A favorite is to think of the driver who simply never changes their oil — they drive the car and hope that it makes it through. Sometimes you win, and the car makes it, sometimes you don't and the engine needs to be replaced.

Regardless of these, we have considered two reasonable cases and the net result is:

Methodology	Cost over 4-year Lifetime
Taking proper care of your BBU	$2,480
Reacting to BBU emergencies	$10,315 (Plus data loss risk)
Zero Maintenance Cache Protection	Cost of the ZMCP module

Conclusion

By eliminating costly BBU technology and related expenses, the Adaptec Series 6 (6Gb/sec), Series 6Q with maxCache 2.0 (6Gb/sec) and Series 5Z (3Gb/sec) family of RAID controllers with Zero Maintenance Cache Protection offer the industry's most complete and efficient data protection solution available today.

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