

White Paper

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Fujitsu Small Form Factor Disk Drive White Paper *The Economic Power of Lower Power Consumption*

You do not have to be an advocate for combating global warming to care about how much energy the systems in your data center consume. The simple profit-and-loss economics of running your business will tell you all you need to know: When your computers use less energy, they cost less to operate and increase your company's profits. It does not get any simpler than that.

However, the progress of technology has worked against that basic model. While today's computers offer higher processor speeds and more memory at a lower acquisition cost than ever before, they cost much more to operate. That's because while newer server-class computers are smaller and more powerful than previous models, their greater processing power, larger memory size, and increased capacity for storage and other peripheral devices make them consume more electricity as they do their work. In addition, their smaller size and greater power has enabled IT managers to easily fulfill increased user demand by increasing the number of servers housed in their data centers.

These more powerful processors and larger-scale memory devices emit more waste heat than earlier models. They have less space in which to dissipate heat, and that heat must dissipate through higher-volume fans. Furthermore, the additional heat dissipated into data centers has to be re-dissipated using ambient air-cooling systems, which today must have higher capacity than ever before.

The problem is not confined to applications servers. Advances in system and network design have allowed mass storage to be created within the network that are external to the servers and desktops they serve, and they too are based on today's very powerful, energy-consuming and heat-producing processors and disk drives. And, network gateway and firewall devices, such as routers and switches, and security appliances of various types contain newer, higher energy-consuming technology

Energy consumption and heat generation are not new problems in the computer industry. Processor, memory, and disk drive designers and engineers have consistently reduced energy demand and heat dissipation even as they have increased computer power and capacity. However, increases in user demand, as well as increases in security needs and network complexity, have dramatically increased the need for computer processing power and storage capacity, and thus the need for more energy.

The growing level of demand makes the expedient solutions of reducing the number of servers, network appliances, and desktop computers, or lowering the processing power and storage capacities of



computers, unavailable. That leaves open the question of how IT managers can cope with such a dramatic rise in energy consumption and heat generation, and, of course, the costs associated with them. One answer is to find and install alternative equipment that demands less energy and produces less heat, but amidst these rising computing power and capacity demands, that is not an easy chore.

A Workable Solution

Fujitsu has addressed the problem of higher energy consumption and heat dissipation with their line of high-performance serial-attached SCSI (SAS) disk drives packaged in a compact, 2.5” form factor. These smaller drives use smaller motors and drive arm actuators that use less energy and emit less heat than larger, 3.5” format drives of equal performance. Their very small size also makes it possible to design computers that contain more of them in the same space that might otherwise house larger format, 3.5” drives. The hard disk drives are not only one inch narrower than the larger hard disks, but they are just over half the height as well.

The small form factor packaging has represented a major breakthrough in computer chassis design because the 2.5” format makes for a smaller footprint in all three dimensions, not just in width. The 2.5” form factor disk drive is smaller in every dimension than the 3.5” drive. The height is 41% smaller, the width 31% smaller, and the depth is 31% smaller. The resulting overall cubic volume is 72% percent smaller, which makes a substantial difference in chassis design opportunities.

Because the new Fujitsu 2.5” form factor SAS hard disk drives are about a quarter the size of the larger hard disk drives, a chassis designed with sufficient cubic volume for 16 3.5” form factor hard disk drives, might be redesigned to hold 48 or more 2.5” hard disk drives without increasing its overall size.

The chart in Figure 1 shows the power consumed by each of these hard disk drives, and it’s clear that the smaller form factor drive takes substantially less power however it is measured. At idle, the 2.5” form factor drive takes 65% less power, and when performing 220 I/O instructions per second, it takes 56% less power. The overall current requirements are also less, especially in 12 volt chassis designs.

Figure 1
Power Consumption

	<u>Enterprise 3.5"</u>	<u>Enterprise 2.5"</u>	<u>Difference</u>
	<u>SAS HDD</u>	<u>SAS HDD</u>	
Power @ Idle (W)	12.8	4.5	65% Less
Power @ 220 IOPS (W)	19.2	8.4	56% Less
Current @ 5VDC (A)	0.95	0.82	14% Less
Current @ 12VDC (A)	1.2	0.36	70% Less

The power consumed by one drive isn't substantial, however when you multiply the consumption by the very large number of drives housed in a modern data center, or across a population of desktops, the power savings of the smaller form factor drives is substantial.

Figure 2
Power Cost Example

	<u>Enterprise 3.5"</u>	<u>Enterprise 2.5"</u>	
	<u>SAS HDD</u>	<u>SAS HDD</u>	<u>Difference</u>
One hour (KWH)			
One Hard Disk Drive	0.0128	0.0045	-0.0083
1,000 Drives (KWH)	12.8000	4.5000	-8.3000
Cost @ \$0.128/KWH	\$1.638	\$0.576	-\$1.062
24 Hours (KWH)			
One Hard Disk Drive	0.3072	0.1080	-0.1992
1,000 Drives (KWH)	307.2000	108.0000	-199.2000
Cost @ \$0.128/KWH	\$39.322	\$13.824	-\$25.498
One Week (KWH)			
One Hard Disk Drive	2.1504	0.7560	-1.3944
1,000 Drives (KWH)	2150.40	756.00	-1,394.40
Cost @ \$0.128/KWH	\$275.251	\$96.768	-\$178.483
One Year (KWH)			
One Hard Disk Drive	111.8208	39.3120	-72.5088
1,000 Drives (KWH)	111820.80	39312.00	-72,508.80
Cost @ \$0.128/KWH	\$14,313.06	\$5,031.94	-\$9,281.13

Figure 2 shows that if there are 1,000 disk drives operating at idle for one hour, and electricity costs \$0.128 per kilowatt-hour, then electricity used in that hour will cost \$1.64 with the 3.5" format hard disk drives, and \$.576 for the 2.5" format hard disk drives. The 2.5" hard disk drives save \$1.064 per hour, or \$25.498 per day. That works out to \$178.43 per week or \$9,281.12 per year, which is a substantial amount of money in any business. The savings are even greater when the disk drives are busy, which they usually are.

Fujitsu 2.5" SAS in Server Applications

When Fujitsu 2.5" SAS hard disk drives replace larger hard disk drives in server systems, the difference in power consumption is substantial. As an example, let's compare a blade server with up to four 2.5" Fujitsu SAS hard disk drives vs. four equivalent 3.5" models.

Let's assume when the larger hard disk drives are installed in the servers, they are equipped with 650 watt power supplies, but the 2.5" SAS hard disk drives would allow system designers to reduce the power supplies to 450 watts per blade, reflecting a 31% decrease in overall system power consumption. The size of the power supplies reflects the power requirements of these servers systems operating at peak load. Figure 3 shows the savings in power and cost of equipping such a blade server with Fujitsu 2.5" SAS hard disk drives.

Figure 3
Blade Servers

	Fujitsu Enterprise SAS Hard Disk Drives		
	3.5"	2.5"	Difference
One Hour (KWH)			
One Server	0.65	0.45	-0.2
250 Servers	162.5	112.5	-50
Cost @ \$0.128/KWH	\$20.80	\$14.40	-\$6.40
24 Hours (KWH)			
One Server	15.6	10.8	-4.8
250 Servers (KWH)	3,900	2,700	-1,200
Cost @ \$0.128/KWH	\$499	\$346	-\$154
One Week (KWH)			
One Server	109.2	75.6	-33.6
250 Servers (KWH)	27,300	18,900	-8,400
Cost @ \$0.128/KWH	\$3,494	\$2,419	-\$1,075
One Year (KWH)			
One Server	5,678	3,931	-1,747
250 Servers (KWH)	1,419,600	982,800	-436,800
Cost @ \$0.128/KWH	\$181,709	\$125,798	-\$55,910

If one server is operating at peak load, the smaller power supply used for the small format hard disk drives will reduce consumption by only 200 watts per hour, but if a bank comprised of 250 of them is fully loaded, the reduction is 50,000 watts, or 50-kilowatt hours.

The 50 kilowatt-hour reduction translates into a savings of \$6.40 per hour of operating costs. Over the course of a day, that is a savings of \$153.60 or \$1,075.30 per week. In a year, a company switching to 250 blade servers equipped with 2.5" Fujitsu SAS hard disk drives can save as much as \$55,910.40. Even if the systems' average load is 50% of peak, the savings would be substantial.

Conclusion

There is a major business opportunity to save money, and a major environmental opportunity to use less energy, by substituting small form factor Fujitsu 2.5" SAS hard disk drives for larger format drives. Not only do they consume less direct energy as they do their work, they emit less heat, which saves on cooling costs. They also take up less space, which will allow you to pack more computing power into the same environment without raising your energy use or your energy costs.

However energy and cost savings are measured, when you acquire equipment that uses the smaller 2.5" form factor Fujitsu SAS hard disk drives, there will be about a one-third savings in direct energy usage and the costs that go with it. Other costs and energy use due to air conditioning will also go down. Space requirements will continue to decrease in the future when systems designers redesign their equipment chassis to accommodate the smaller format equipment without wasted space. Ultimately that will mean more computing power for a given amount of space, with lower energy consumption and costs.

The current generation of Fujitsu's 2.5" SFF SAS hard disk drives have capacities ranging from 36GB to 147GB, offered in either 10K or 15K RPM speeds (MBB Series & MBC Series). The 3Gb/sec SAS interface of the Fujitsu hard disk drives allows customers to take advantage of the increased performance associated with Serial Attached SCSI, while at the same time providing lower heat dissipation, lower acoustics, and lower power.

As a leader in storage technology globally, Fujitsu has been a leader in development of the SAS standard and is a member of the SCSI Trade Association.