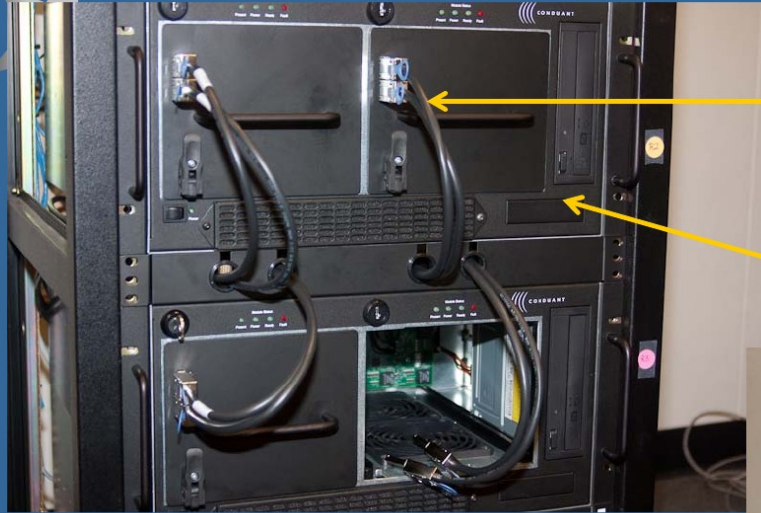


FB2HB2MB6

Ari Mujunen, Aalto University
Metsähovi Radio Observatory

FlexBuffTwoHarroBoxTooMarkBoxSix

Mark 6 hardware



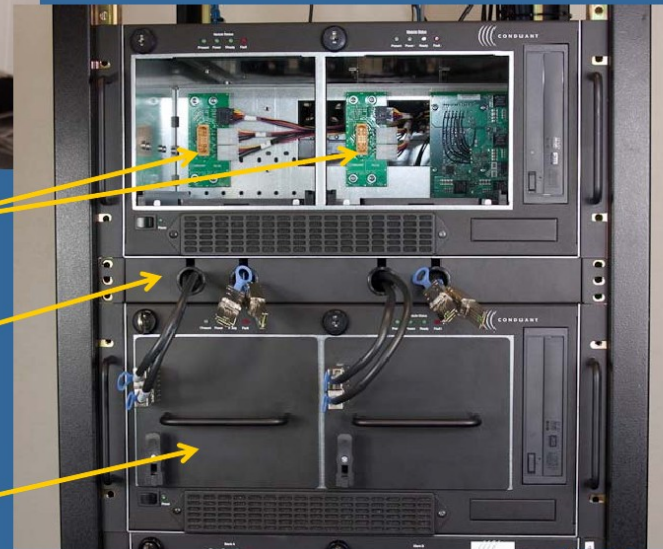
High-speed data connections to module front-panel via two standard SAS cables

Existing Mark 5 chassis is upgradeable to Mark 6

New chassis backplanes for disk power management

Cable-management panel (unused cables retract into panel)

Existing Mark 5 SATA disk modules are upgradeable to Mark 6 (new backplane and front panel)



Mark 5 SATA Drive Module Upgrade to Mark 6

USD 495 USD 300

Cost:
USD 62 per
each drive
+labor...

New Front
Panel

Connectors for two
eSATA cables

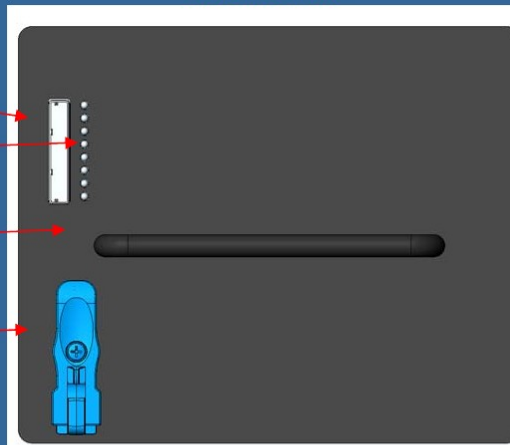
8x LED
(1 per drive)

Re-use Handle from
old Module

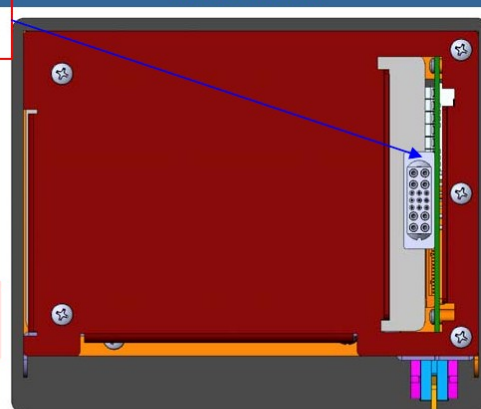
pre-installed

Cooling slots

Front Panel

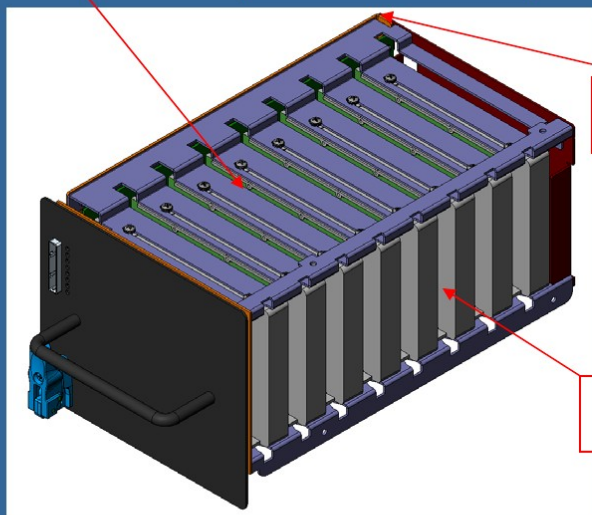


Rear Panel

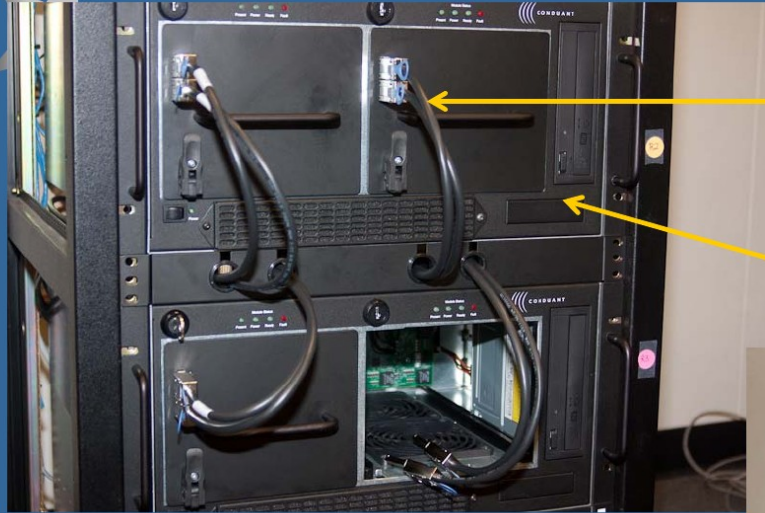


New PCB and
power connector

Easily
removable disks



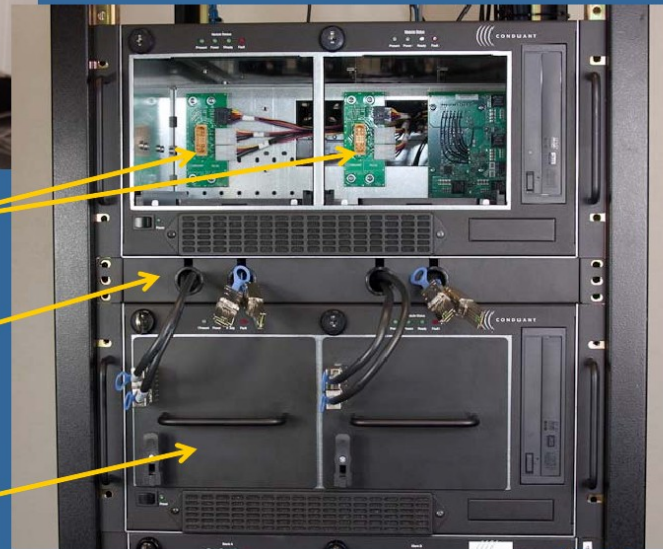
Mark 6 hardware



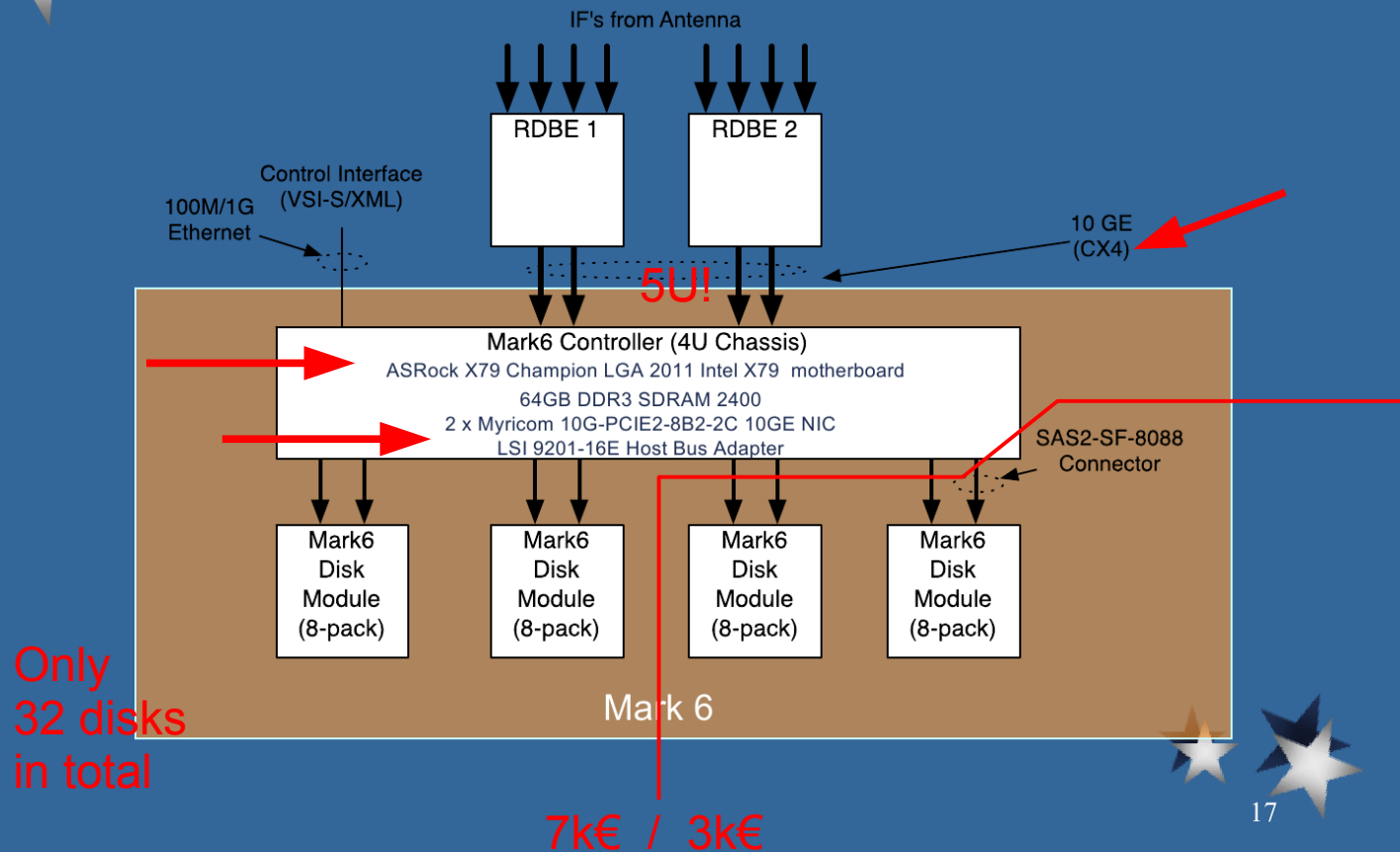
New chassis backplanes for
disk power management

Cable-management panel
(unused cables retract into panel)

Existing Mark 5 SATA disk modules
are upgradeable to Mark 6
(new backplane and front panel)



Mark 6 16Gbps demonstration system



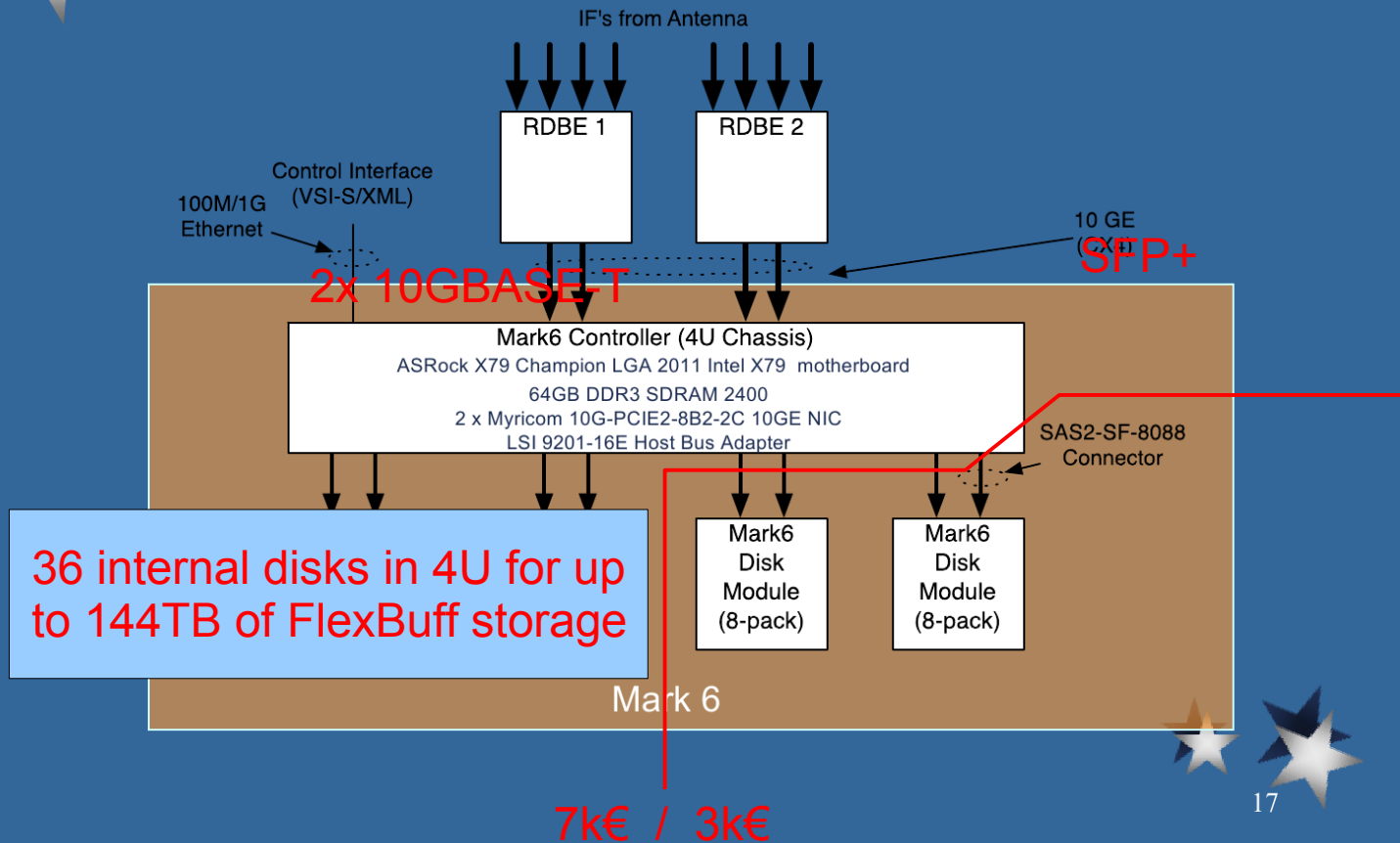
HW+SW Interchangeability

- Ran this --->
on FB HW
- jive5ab
with FB SW
should run
on Mark6 HW
just fine

Proof of Concept Experiment

- done with **prototype** software (v.0)
- June 2012
- Westford – GGAO
- technical details
 - VDIF format
 - 16 Gb/s onto 32 disks
 - 4 GHz bandwidth on the sky
 - dual polarization with 2 GHz IF's
 - processed as four 512 MHz channels

Mark6 16Gbps demonstration system



Motherboard


- 2x LGA2011 Xeon
- 7 slots PCIe x8

Supermicro | Products | Motherboards | Xeon® Boards | X9DRH-7TF - Mozilla Firefox

www.supermicro.nl/products/motherboard/xeon/c600/x9drh-7tf.cfm

X9DRH-7TF

Products > Motherboards > Xeon® Boards > [X9DRH-7TF]



Key Features

1. Dual socket R (LGA 2011) supports Intel® Xeon® processor E5-2600 and E5-2600 v2 family†
2. Intel® C602 chipset; QPI up to 8.0GT/s
3. Up to 1TB ECC DDR3, up to 1866MHz; 16x DIMM sockets
4. Expansion slots:
1 PCI-E 3.0 x16 and 6 PCI-E 3.0 x8
5. Intel® X540 Dual port 10GBase-T
6. 8x SATA2 and 2x SATA3 ports
7. 8x SAS2 ports from LSI 2208
8. Integrated IPMI 2.0 and KVM with Dedicated LAN
9. 7x USB 2.0 ports
(4 rear, 2 via header + 1 Type A)

Links & Resources

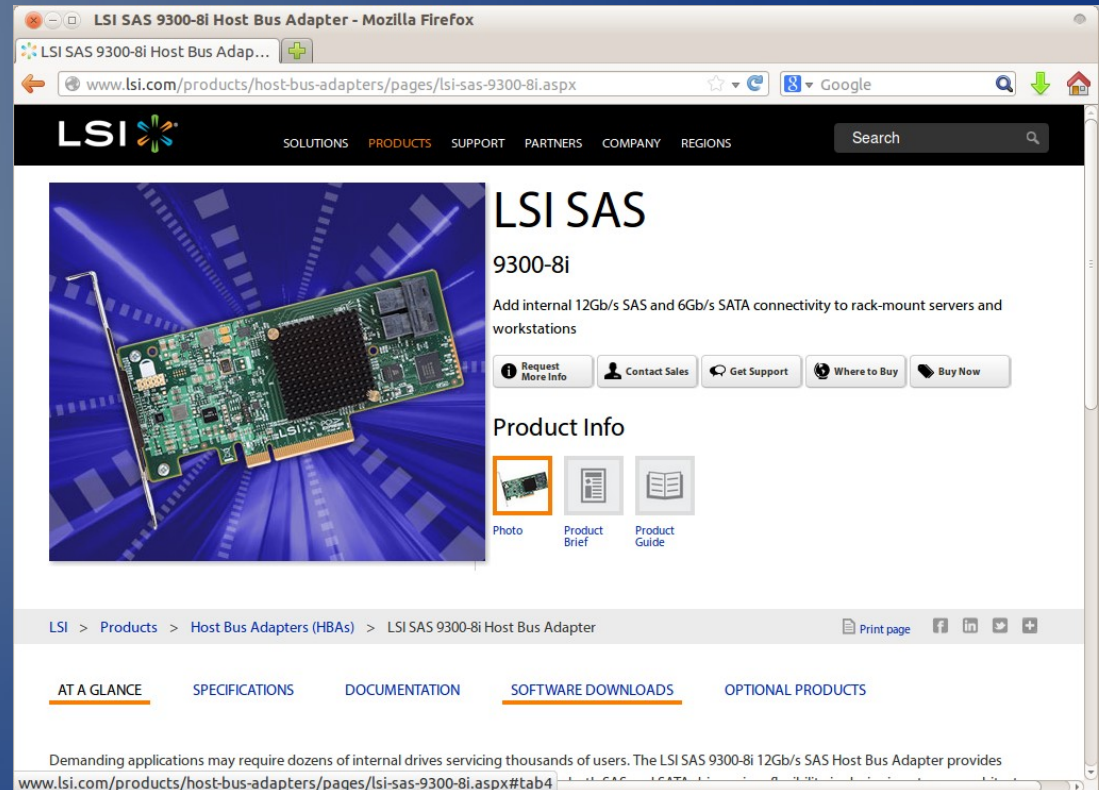
- ▶ [Tested Memory List](#)
- ▶ [Tested HDD / SSD List](#)
- ▶ [Motherboard Manual](#)
- ▶ [Update Your BIOS](#)
- ▶ [IPMI Firmware](#)
- ▶ [Download the Latest Drivers and Utilities](#)
- ▶ [Heat Sink Compatibility](#)
- ▶ [OS Compatibility](#)

Specifications

Product SKUs	Chassis (Optimized for X9DRH-7TF)
MBD-X9DRH-7TF	CSE-825TO-R740LPB CSE-826BA-R1K28LPB

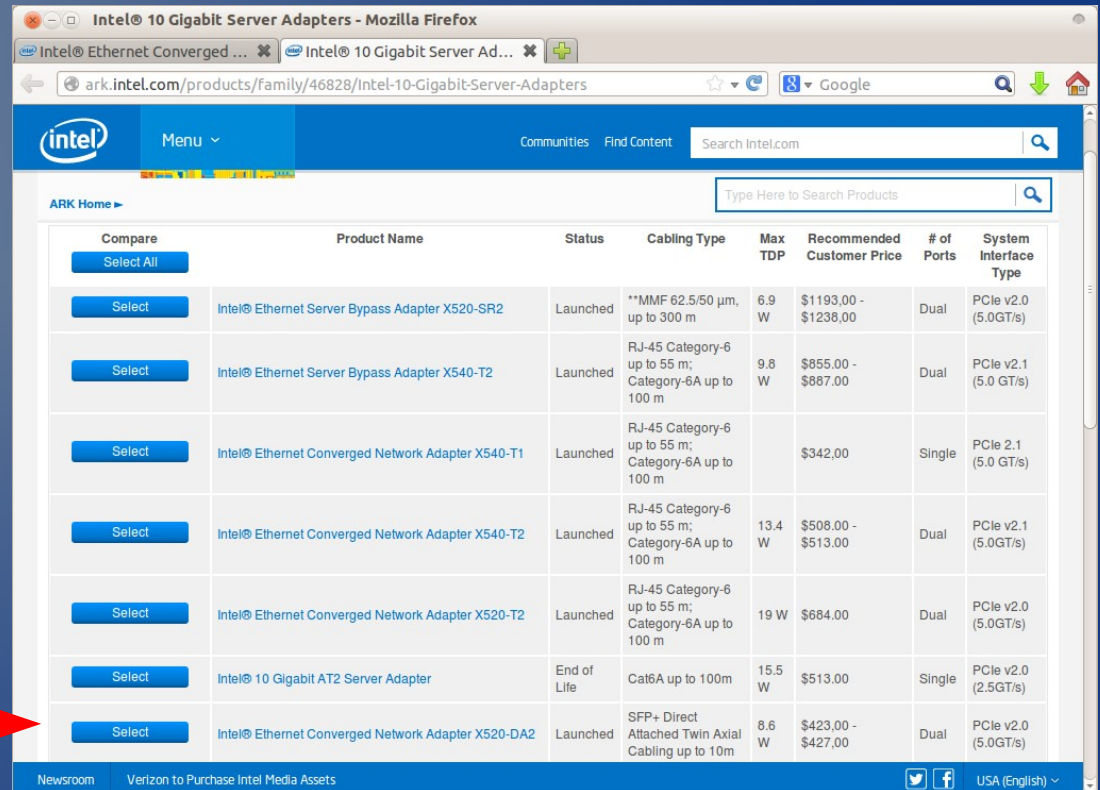
Disk Controllers

- SATA III 6Gbps Generation
- LSI3008 chips
- One controller per 8 disks



10GE Adapters

- Dual SFP+



Intel® 10 Gigabit Server Adapters - Mozilla Firefox

ark.intel.com/products/family/46828/Intel-10-Gigabit-Server-Adapters

Search Intel.com

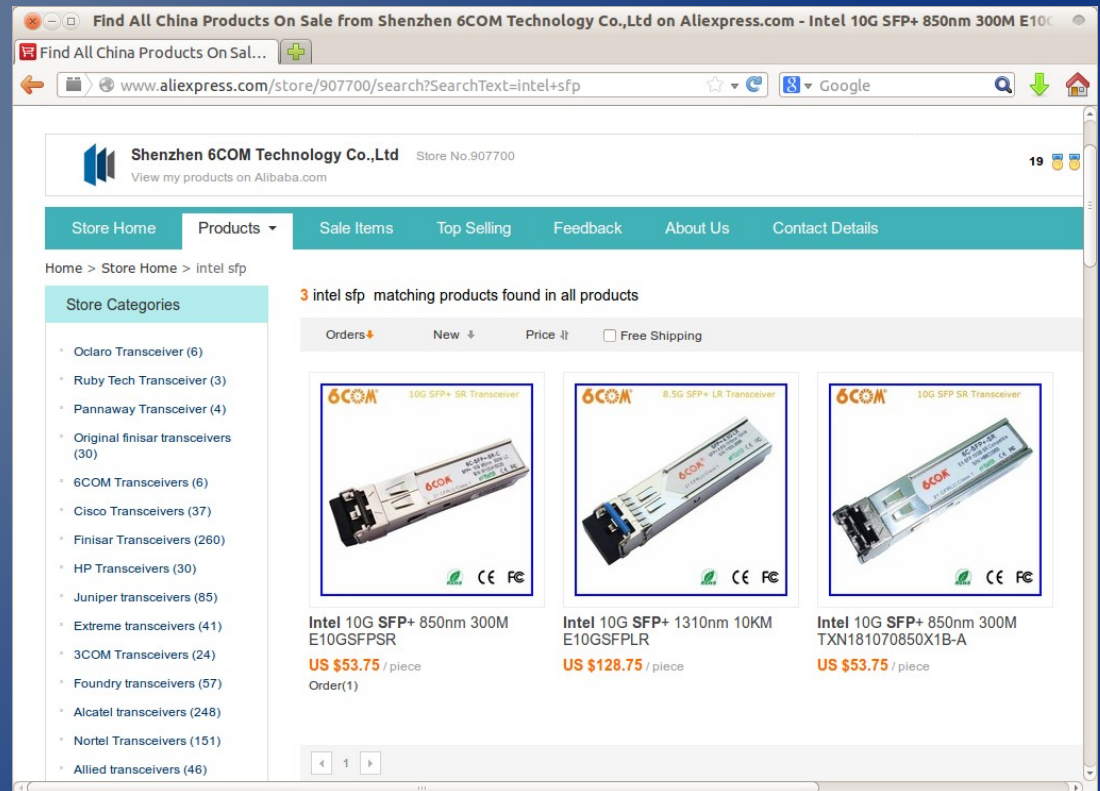
ARK Home ▶

Compare	Product Name	Status	Cabling Type	Max TDP	Recommended Customer Price	# of Ports	System Interface Type
Select All							
Select	Intel® Ethernet Server Bypass Adapter X520-SR2	Launched	**MMF 62.5/50 µm, up to 300 m	6.9 W	\$1193.00 - \$1238.00	Dual	PCIe v2.0 (5.0GT/s)
Select	Intel® Ethernet Server Bypass Adapter X540-T2	Launched	RJ-45 Category-6 up to 55 m; Category-6A up to 100 m	9.8 W	\$855.00 - \$887.00	Dual	PCIe v2.1 (5.0 GT/s)
Select	Intel® Ethernet Converged Network Adapter X540-T1	Launched	RJ-45 Category-6 up to 55 m; Category-6A up to 100 m		\$342.00	Single	PCIe 2.1 (5.0 GT/s)
Select	Intel® Ethernet Converged Network Adapter X540-T2	Launched	RJ-45 Category-6 up to 55 m; Category-6A up to 100 m	13.4 W	\$508.00 - \$513.00	Dual	PCIe v2.1 (5.0GT/s)
Select	Intel® Ethernet Converged Network Adapter X520-T2	Launched	RJ-45 Category-6 up to 55 m; Category-6A up to 100 m	19 W	\$684.00	Dual	PCIe v2.0 (5.0GT/s)
Select	Intel® 10 Gigabit AT2 Server Adapter	End of Life	Cat6A up to 100m	15.5 W	\$513.00	Single	PCIe v2.0 (2.5GT/s)
Select	Intel® Ethernet Converged Network Adapter X520-DA2	Launched	SFP+ Direct Attached Twin Axial Cabling up to 10m	8.6 W	\$423.00 - \$427.00	Dual	PCIe v2.0 (5.0GT/s)

Newsroom | Verizon to Purchase Intel Media Assets | USA (English) ▼

10G Optical Modules

- Reasonable cost
- Takes ~1 month
 - Just like branded modules...



Parts List

- 6304e
 - From www.damicon.fi published no-VAT prices
 - 4U 36-disk, 2x6-core Xeon, 64GB RAM, 4x10GE (2x-T, 2xSFP+), 2xMark6
- | | | |
|---|------|---|
| 1 | 1565 | SUP-CSE-847AR1400LPB |
| | | 4U ATX Supermicro SC847A-R1400LPB 36xSAS/SATA multilane 2x1400W |
| 1 | 756 | SUP-X9DRH-7TF |
| | | Supermicro X9DRH-7TF EATX 2*Xeon E5 C602 16DDR3 1x16/6x8 PCIe |
| | | 6SATA 8SAS 2*10G |
| 2 | 335 | I-X-E5-2620V2 |
| | | Intel Xeon E5-2620v2 6-core IB-EP 2100 MHz 15 MB HT LGA2011 80 W |
| 2 | 36 | SUP-SNK-P0048P |
| | | Supermicro LGA2011 X9 DP 2U passive heat sink |
| 8 | 83 | 8GB-1600D3-ECC |
| | | 8GB 72-bit ECC DDR3 SDRAM DIMM 1600 MHz PC3-12800E CL11 |
| 4 | 294 | SAS9300-8I |
| | | LSI Logic SAS 9300-8i HBA 12Gb SAS 6Gb SATA 2xSFF8643 PCIe3x8 LP |
| 8 | 27 | CAB-8643-8087 |
| | | SAS cable SFF8643-SFF8087 internal 1m |
| 1 | 25 | CAB-SFF8087 |
| | | SAS cable iPass SFF8087-SFF8087 internal 50 cm |
| 2 | 350? | SAS9300-8E |
| | | LSI Logic SAS 9300-8e HBA 12Gb SAS 6Gb SATA 2xSFF8644 PCIe3x8 LP |
| 1 | 366 | I-E10G42BTDA |
| | | Intel E10G42BTDA 10 Gigabit X520-DA2 (SFP+) (82599EB) 1p PCI-e x8 2.0 |
| 1 | 80 | AS80 |
| | | Installation and testing |
| 1 | 230 | TAKUU3SERV |
| | | Warranty extension to 3yr |

Disks

- 5TB and 6TB disks starting to appear
 - Hitachi He-filled 6TB, Seagate Ent Cap 5TB
- 4TB around 150—300e each; 6—14k€ 144TB

```
40x disks ("two cartons" :-)
155  ST4000DM000
    4TB Seagate Barracuda 7200.14 ST4000DM000 SATA/6Gbit 64 MB NCQ
170  ST4000VN000
    4TB Seagate NAS ST4000VN000 5900 rpm SATA/6Gbit 64 MB NCQ
234  ST4000NC000
    4TB Seagate Terascale ST4000NC000 5900 rpm SATA/6Gbit 64 MB NCQ ISE
292  ST4000NM0033
    4TB Seagate Constellation ES.3 ST4000NM0033 7200 rpm SATA/6Gbit 128 MB NCQ
342  ST4000NM0023
    4TB Seagate Constellation ES.3 ST4000NM0023 7200 rpm SAS/6Gbit 128 MB
4TB disks (144TB FlexBuff capacity) 6200--13680e

3TB disks 114--283e --> 4560--11320e (108TB FlexBuff capacity),
not worth the savings
```


Enterprise Drives...?

- From BackBlaze (commercial backup service provider)



Enterprise Failure Rates

- Annualized failure rate
 - 4.6% Enterprise
 - 4.2% Consumer
- Makes one suspect they are identical disks...

Backblaze Blog » Enterprise Drives: Fact or Fiction? - Mozilla Firefox

Backblaze Blog » Enterprise Dr...

blog.backblaze.com/2013/12/04/enterprise-drive-reliability/

they have logged:

368 drive-years on the enterprise-grade drives.
17 drives that failed and were replaced.

Enterprise vs. Consumer Drives

At first glance, it seems the enterprise drives don't have that many failures. While true, the *failure rate of enterprise drives is actually higher than that of the consumer drives!*

	Enterprise Drives	Consumer Drives
Drive-Years of Service	368	14719
Number of Failures	17	613
Annual Failure Rate	4.6%	4.2%

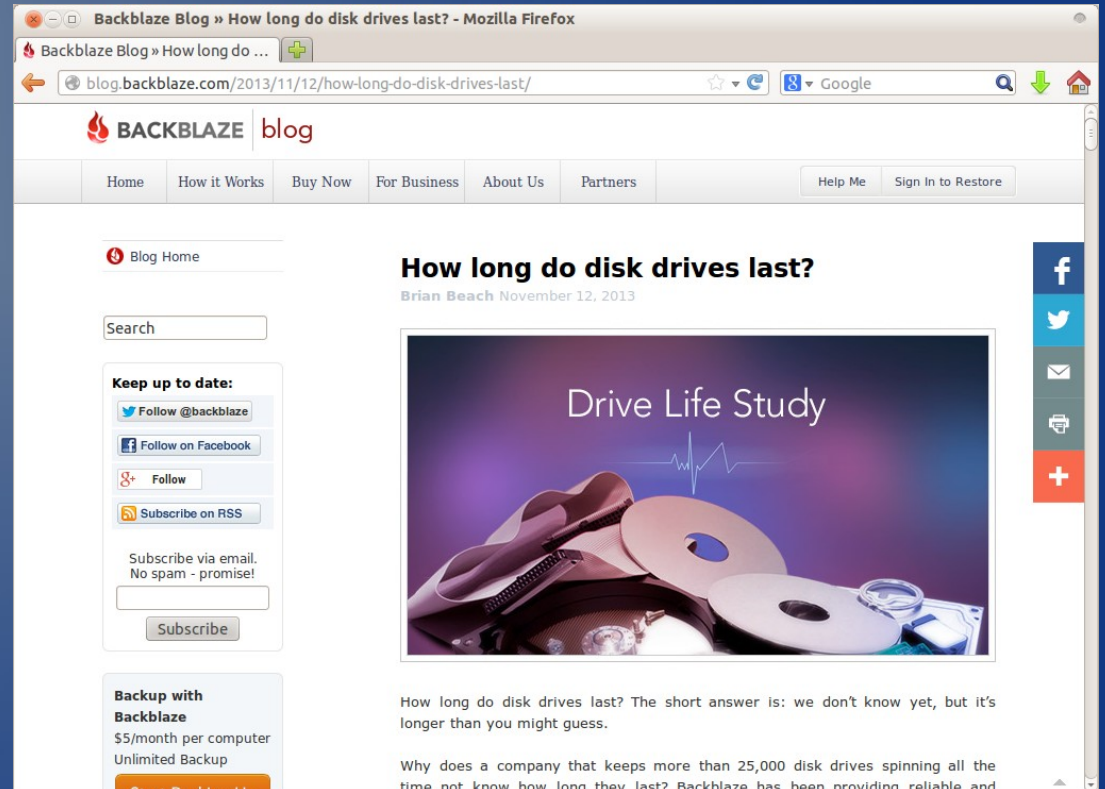
It turns out that the consumer drive failure rate does go up after three years, but all three of the first three years are pretty good. We have no data on enterprise drives older than two years, so we don't know if they will also have an increase in failure rate. It could be that the vaunted reliability of enterprise drives kicks in after two years, but because we haven't seen any of that reliability in the first two years, I'm skeptical.

You might object to these numbers because the usage of the drives is different. The enterprise drives are used heavily. The consumer drives are in continual use storing users' updated files and they are up and running all the time, but the usage is lighter. On the other hand, the enterprise drives we have are coddled in well-ventilated low-vibration enclosures, while the consumer drives are in Backblaze Storage Pods, which do have a fair amount of vibration. In fact, the [most recent design change to the pod](#) was to reduce vibration.

Overall, I argue that the enterprise drives we have are treated as well as the consumer drives. And the enterprise drives are failing more.

Disk Life

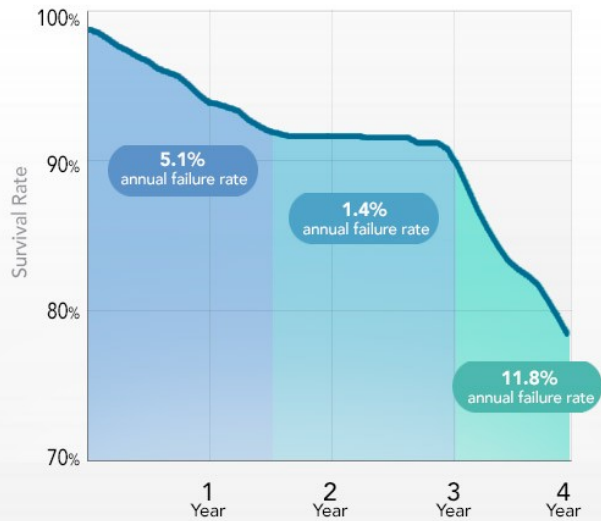
- Disks last maybe longer than generally expected
- Bathtub curve applies well



Disk Life

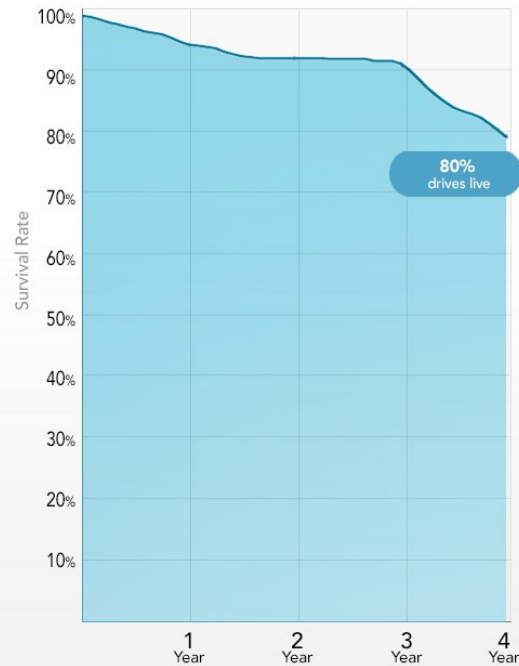
Drives Have 3 Distinct Failure Rates

Hard Drive Survival Rates - Chart 1



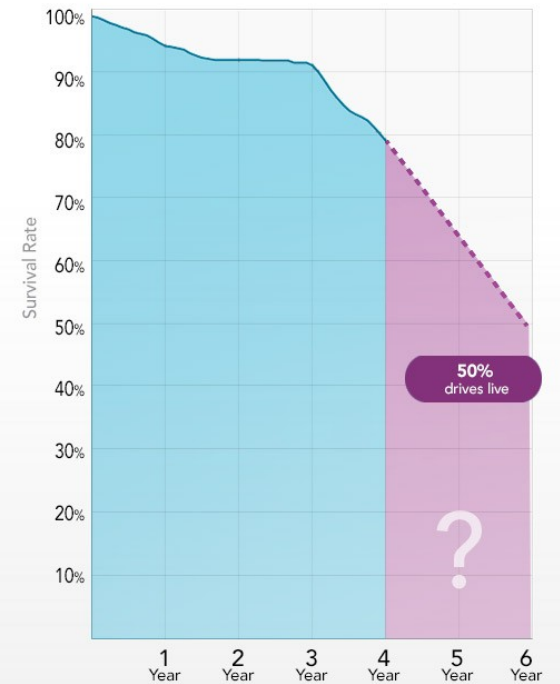
80% of Drives Last Four Years

Hard Drive Survival Rates - Chart 2



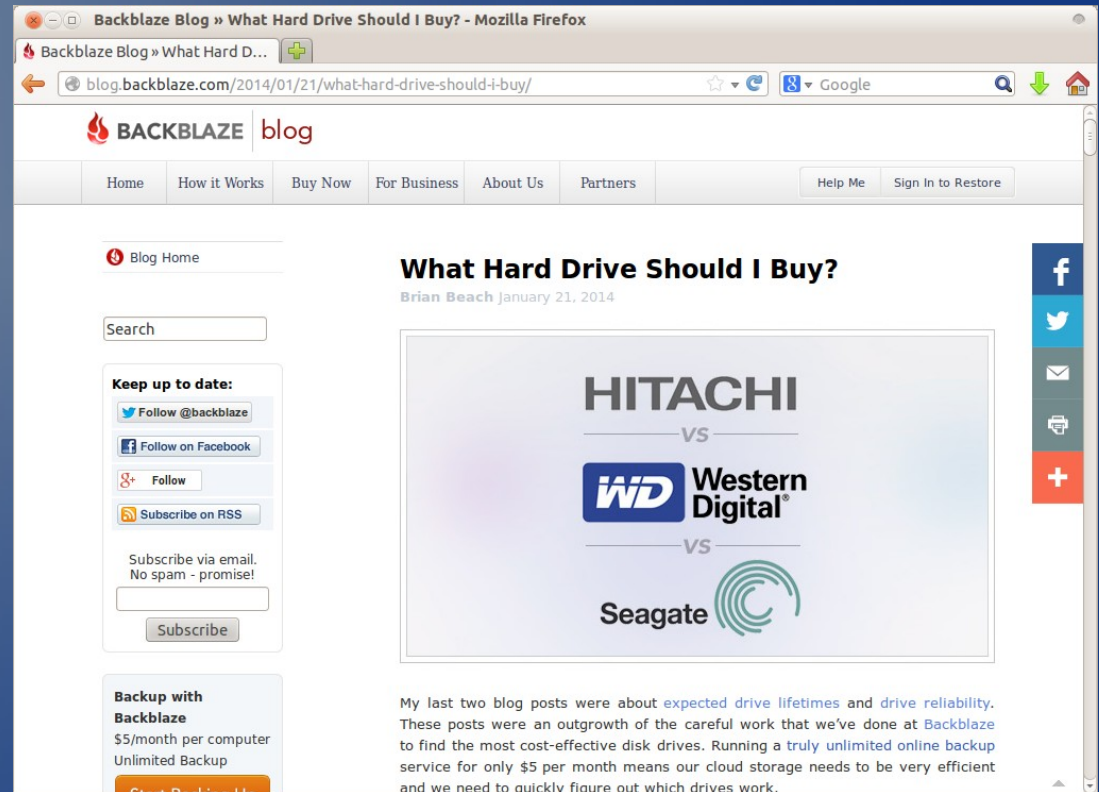
6 Year Expected Median Drive Life

Hard Drive Survival Rates - Chart 3



Disk Brand Names..?

- On Tue 21-Jan-2014 BackBlaze published `_their_ stats`
- Be careful since “per-model” & “per-batch” numbers vary a lot...



Backblaze Blog » What Hard Drive Should I Buy? - Mozilla Firefox

Backblaze Blog » What Hard D...

blog.backblaze.com/2014/01/21/what-hard-drive-should-i-buy/

Tags

- Backblaze for Business
- Backblaze Fun
- Backblaze Mobile
- Backblaze Tips & Tricks
- Backup Awareness Month
- Backup Devices
- Backup Needs
- Backup News
- Behind Backblaze
- Cloud Storage
- Customer Stories
- Data Loss
- Events
- Growth Hacking
- Jobs
- Kudos
- Locate My Computer
- Mac Love
- Offers
- Partners
- Release
- Restories

ones are good enough that we would buy them again. In this post, I'll answer those questions.

Drive Population

At the end of 2013, we had 27,134 consumer-grade drives spinning in [Backblaze Storage Pods](#). The breakdown by brand looks like this:

Brand	Number of Drives	Terabytes	Average Age in Years
Seagate	12,765	39,576	1.4
Hitachi	12,956	36,078	2.0
Western Digital	2,838	2,581	2.5
Toshiba	58	174	0.7
Samsung	18	18	3.7

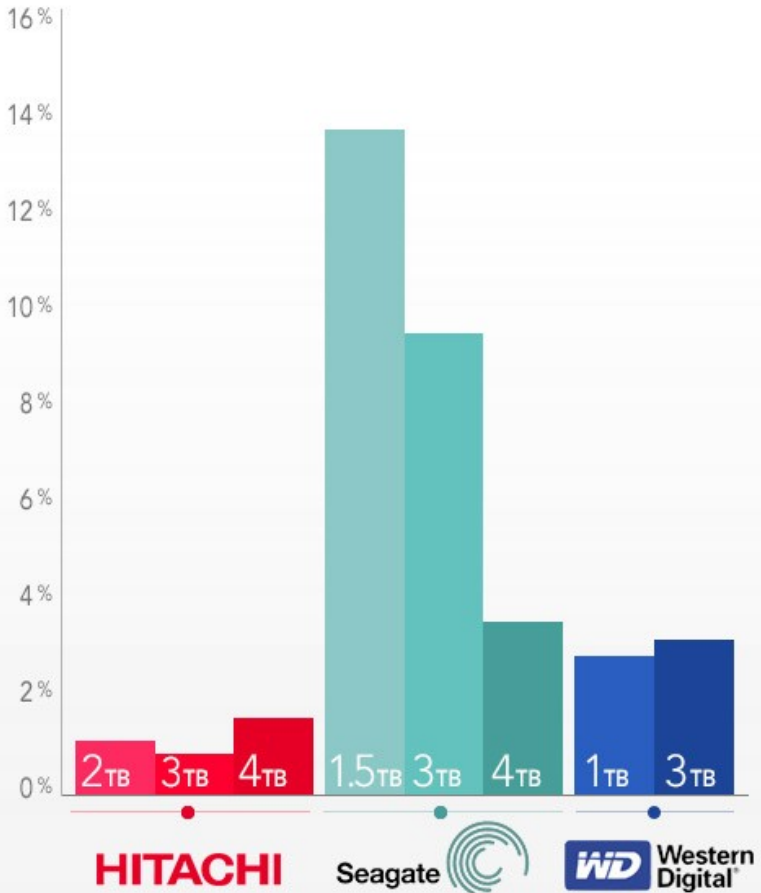
Hard Drives by Manufacturer Used by Backblaze

As you can see, they are mostly Seagate and Hitachi drives, with a good number of Western Digital thrown in. We don't have enough Toshiba or Samsung drives for good statistical results.

Why do we have the drives we have? Basically, we buy the least expensive drives that will work. When a new drive comes on the market that looks like it would work, and the price is good, we [test a pod full](#) and see how they perform. The new drives go through initial setup tests, a stress test, and then a couple weeks in production. (A couple of weeks is enough to fill the pod with data.) If things still look good, that drive goes on the buy list. When the price is right, we buy it.

We are willing to spend a little bit more on drives that are reliable, because it costs money to replace a drive. We are not willing to spend a lot more, though.

Annual Failure Rate



- BackBlaze buying now: Seagate Desktop HDD.15 (ST4000DM000)...!