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# Backblaze Hard Drive Stats for 2016

January 31st, 2017




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Of that number, there were 1,553 boot drives and 72,100 data drives. This post looks at the hard drive statistics of the data drives we monitor. We'll first look at the stats for Q4 2016, then present the data for all of 2016, and finish with the lifetime statistics for all of the drives Backblaze has used in our [cloud storage data centers](#) since we started keeping track. Along the way we'll share observations and insights on the data presented. As always you can download our [Hard Drive Test Data](#) to examine and use.

## Hard Drive Reliability Statistics for Q4 2016

At the end of Q4 2016 Backblaze was monitoring 72,100 data drives. For our evaluation we remove from consideration those drives which were used for testing purposes and those drive models for which we did not have at least 45 drives. This leaves us with 71,939 production hard drives. The table below is for the period of Q4 2016.

### Hard Drive Annualized Failure Rates for Q4 2016

Reporting period 10/1/2016 - 12/31/2016 inclusive

MFG	Model	Drive Size	Drive Count	Avg. Age (months)	Drive Days	Drive Failures	Failure Rate
HGST	HDS723030ALA640	3 TB	978	61.21	90,415	9	3.63%
HGST	HDS5C3030ALA630	3 TB	4,476	55.87	412,752	13	1.15%
HGST	HDS5C4040ALE630	4 TB	2,625	45.35	241,665	4	0.60%
Toshiba	DT01ACA300	3 TB	46	44.12	4,232	-	0.00%
Seagate	ST4000DX000	4 TB	184	38.54	17,354	7	14.72%
WDC	WD30EFRX	3 TB	1,105	30.39	100,259	9	3.28%
HGST	HMS5C4040ALE640	4 TB	7,014	29.48	648,393	9	0.51%
WDC	WD60EFRX	6 TB	446	24.14	41,304	5	4.42%
HGST	HUH728080ALE600	8 TB	45	22.99	4,140	-	0.00%
Toshiba	MD04ABA500V	5 TB	45	22.15	4,140	-	0.00%
Seagate	ST4000DM000	4 TB	34,738	21.73	3,196,552	234	2.67%
Seagate	ST6000DX000	6 TB	1,889	21.48	173,720	8	1.68%
Toshiba	MD04ABA400V	4 TB	146	20.61	13,432	-	0.00%

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## Notes:

1. The failure rate listed is for just Q4 2016. If a drive model has a failure rate of 0%, it means there were no drive failures of that model during that quarter.
2. 90 drives (2 storage pods) were used for testing purposes during the period. They contained Seagate 1.5TB and 1.0 TB WDC drives. These are not included in the results above.
3. The most common reason we have less than 45 drives of one model is that we needed to replace a failed drive, but that drive model is no longer available. We use 45 drives as the minimum number to report quarterly and yearly statistics.

## 8 TB Hard Drive Performance

In Q4 2016 we introduced a third 8 TB drive model, the Seagate ST8000NM0055. This is an enterprise class drive. One 60-drive Storage Pod was deployed mid-Q4 and the initial results look promising as there have been no failures to date. Given our past disdain for [overpaying for enterprise drives](#), it will be interesting to see how these drives perform.

We added 3,540 Seagate 8 TB drives, model ST8000DM002, giving us 8,660 of these drives. That's 69 petabytes of raw storage, before formatting and encoding, or about 22% of our current data storage capacity. The failure rate for the quarter of these 8 TB drives was a very respectable 1.65%. That's lower than the Q4 failure rate of 1.94% for all of the hard drives in the table above.




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models deliver the best value and we bet you are too. We'll let you know what we find.

## 2016 Hard Drive Performance Statistics

Looking back over 2016, we added 15,646 hard drives, and migrated 110 Storage Pods (4,950 drives) from 1-, 1.5-, and 2 TB drives to 4-, 6- and 8 TB drives. Below are the hard drive failure stats for 2016. As with the quarterly results, we have removed any non-production drives and any models that had less than 45 drives.

### Hard Drive Annualized Failure Rates for 2016

Reporting period 1/1/2016 - 12/31/2016 inclusive

MFG	Model	Drive Size	Drive Count	Avg Age (months)	Drive Days	Drive Failures	Failure Rate
HGST	HUH728080ALE600	8 TB	45	22.99	16,155	-	0.00%
Seagate	ST8000DM002	8 TB	8,660	4.72	1,075,720	48	1.63%
Seagate	ST8000NM0055	8 TB	60	1.44	1,560	-	0.00%
Seagate	ST6000DX000	6 TB	1,889	21.48	684,840	16	0.85%
WDC	WD60EFRX	6 TB	446	24.14	166,152	25	5.49%
Toshiba	MD04ABA500V	5 TB	45	22.15	16,425	1	2.22%
HGST	HDS5C4040ALE630	4 TB	2,625	45.35	987,011	14	0.52%
HGST	HMS5C4040ALE640	4 TB	7,014	29.48	2,579,698	28	0.40%
HGST	HMS5C4040BLE640	4 TB	9,407	15.51	2,436,130	34	0.51%
Seagate	ST4000DM000	4 TB	34,738	21.73	12,359,750	938	2.77%
Seagate	ST4000DX000	4 TB	184	38.54	72,615	27	13.57%
Toshiba	MD04ABA400V	4 TB	146	20.61	52,983	-	0.00%
WDC	WD40EFRX	4 TB	75	17.16	16,790	1	2.17%
HGST	HDS5C3030ALA	3 TB	4,476	55.87	1,647,137	34	0.75%
HGST	HDS723030ALA	3 TB	978	61.21	361,937	22	2.22%
Toshiba	DT01ACA300	3 TB	46	44.12	16,900	2	4.32%
WDC	WD30EFRX	3 TB	1,105	30.39	390,379	35	3.27%
Totals			71,939		22,882,182	1,225	1.95%





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in 2016, three drives models endured the year with zero failures, and one with a small number of drives. Both the 4 TB Toshiba and the 8 TB HGST models went the entire year without a drive failure. The 8 TB Seagate (ST8000NM0055) drives, which were deployed in November 2016, also recorded no failures.

The total number of failed drives was 1,225 for the year. That's 3.36 drive failures per day or about 5 drives per workday, a very manageable workload. Of course, that's easy for me to say, since I am not the one swapping out drives.

The overall hard drive failure rate for 2016 was 1.95%. That's down from 2.47% in 2015 and well below the 6.39% failure rate for 2014.

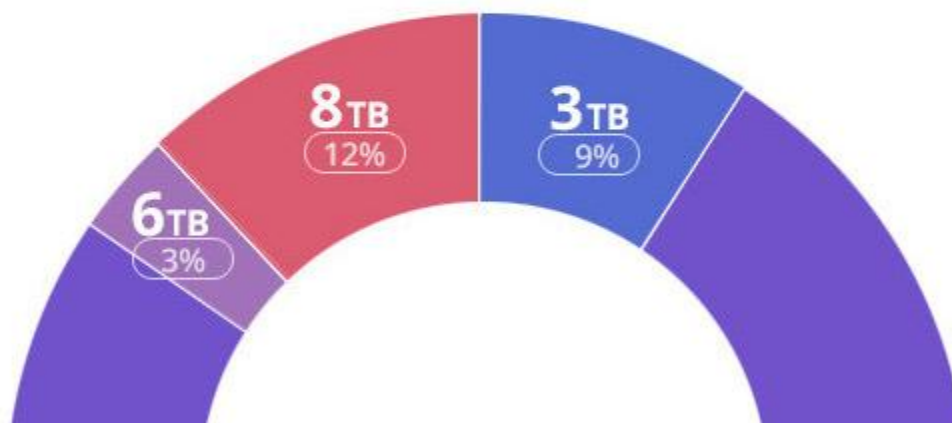
## Big Drives Rule

We increased storage density by moving to higher-capacity drives. That helped us end 2016 with 3 TB drives being the smallest density drives in our data centers. During 2017, we will begin migrating from the 3.0 TB drives to larger-sized drives. Here's the distribution of our hard drives in our data centers by size for 2016.

### 2016 Distribution of Hard Drives by Size

Backblaze data centers as of 12/31/2016.

Less than 1% are the 5 TB drives.



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Digging in a little further, below are the failure rates by drive size and vendor for 2016.

### Hard Drive Failure Rates by Drive Size

For 2016, as of 12/31/2016

Drive Size	Drive Count	Drive Days	Drive Failures	Failure Rate
3 TB	6,605	2,416,353	93	1.40%
4 TB	54,189	18,504,977	1,042	2.06%
5 TB	45	16,425	1	2.22%
6 TB	2,335	850,992	41	1.76%
8 TB	8,765	1,093,435	48	1.60%
<b>Totals</b>	<b>71,939</b>	<b>22,882,182</b>	<b>1,225</b>	<b>1.95%</b>



### Hard Drive Failure Rates by Manufacturer

For 2016, as of 12/31/2016

MFG	Drive Count	Drive Days	Drive Failures	Failure Rate
HGST	24.545	8.028.068	132	0.60%



## Computing the Failure Rate

Failure Rate, in the context we use it, is more accurately described as the Annualized Failure Rate. It is computed based on Drive Days and Drive Failures, not on the Drive Count. This may seem odd given we are looking at a one year period, 2016 in this case, so let's take a look.

We start by dividing the Drive Failures by the Drive Count. For example if we use the statistics for 4 TB files, we get a "failure rate" of 1.92%, but the annualized failure rate shown on the chart for 4 TB drives is 2.06%. The trouble with just dividing Drive Failures by Drive Count is that the Drive Count constantly changes over the course of the year. By using Drive Count from a given day, you assume that each drive contributed the same amount of time over the year, but that's not the case. Drives enter and leave the system all the time. By counting the number of days each drive is active as Drive Days, we can account for all the ins and outs over a given period of time.

## Hard Drive Benchmark Statistics

As we noted earlier, we've been collecting and storing drive stats data since April 2013. In that time we have used 55 different hard drive models in our data center for data storage. We've omitted models from the table below that we didn't have enough of to populate an entire storage pod (45 or fewer). That excludes 25 of those 55 models.

### Annualized Hard Drive Failures Rates





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HGST	HUH728080ALE600	8.0TB	45	30,958	2	2.36%	
Seagate	ST8000DM002	8.0TB	8,660	1,075,720	48	1.63%	
Seagate	ST8000NM0055	8.0TB	60	1,560	0	0.00%	
Seagate	ST6000DX000	6.0TB	1,889	1,201,586	47	1.43%	
WDC	WD60EFRX	6.0TB	458	340,821	53	5.68%	
Toshiba	MD04ABA500V	5.0TB	45	30,015	2	2.43%	
HGST	HDS5C4040ALE	4.0TB	2,639	3,354,643	81	0.88%	
HGST	HDS5C4040ALE630	4.0TB	75	38,914	3	2.81%	
HGST	HMS5C4040ALE640	4.0TB	7,085	6,069,981	108	0.65%	
HGST	HMS5C4040BLE640	4.0TB	9,362	4,264,374	56	0.48%	
Toshiba	MD04ABA400V	4.0TB	146	88,972	3	1.23%	
Seagate	ST4000DM000	4.0TB	34,737	22,933,912	1,810	2.88%	
Seagate	ST4000DX000	4.0TB	212	238,415	37	5.66%	
WDC	WD40EFRX	4.0TB	46	46,684	3	2.35%	
Toshiba	DT01ACA300	3.0TB	58	64,470	7	3.96%	
HGST	HDS5C3030ALA	3.0TB	4,595	5,934,094	134	0.82%	
HGST	HDS723030ALA	3.0TB	1,027	1,313,124	69	1.92%	
Seagate	ST3000DM001	3.0TB	4,247	2,205,148	1,614	26.72%	
Seagate	ST33000651AS	3.0TB	293	222,147	26	4.27%	
WDC	WD30EFRX	3.0TB	1,102	1,029,747	162	5.74%	
WDC	WD30EZRX	3.0TB	388	123,577	25	7.38%	
HGST	HDS722020ALA	2.0TB	4,716	5,294,695	229	1.58%	
Seagate	ST32000542AS	2.0TB	288	119,309	32	9.79%	
Seagate	ST320LT007	2.0TB	85	67,332	88	47.70%	
WDC	WD20EFRX	2.0TB	132	66,485	9	4.94%	
Seagate	ST1500DL003	1.5TB	51	30,913	77	90.92%	
Seagate	ST31500341AS	1.5TB	539	330,431	216	23.86%	
Seagate	ST31500541AS	1.5TB	1,929	1,427,627	397	10.15%	
WDC	WD10EACS	1.0TB	84	60,690	5	3.01%	
WDC	WD10EADS	1.0TB	474	369,302	37	3.66%	
Totals			85,467	58,375,646	5,380	3.36%	







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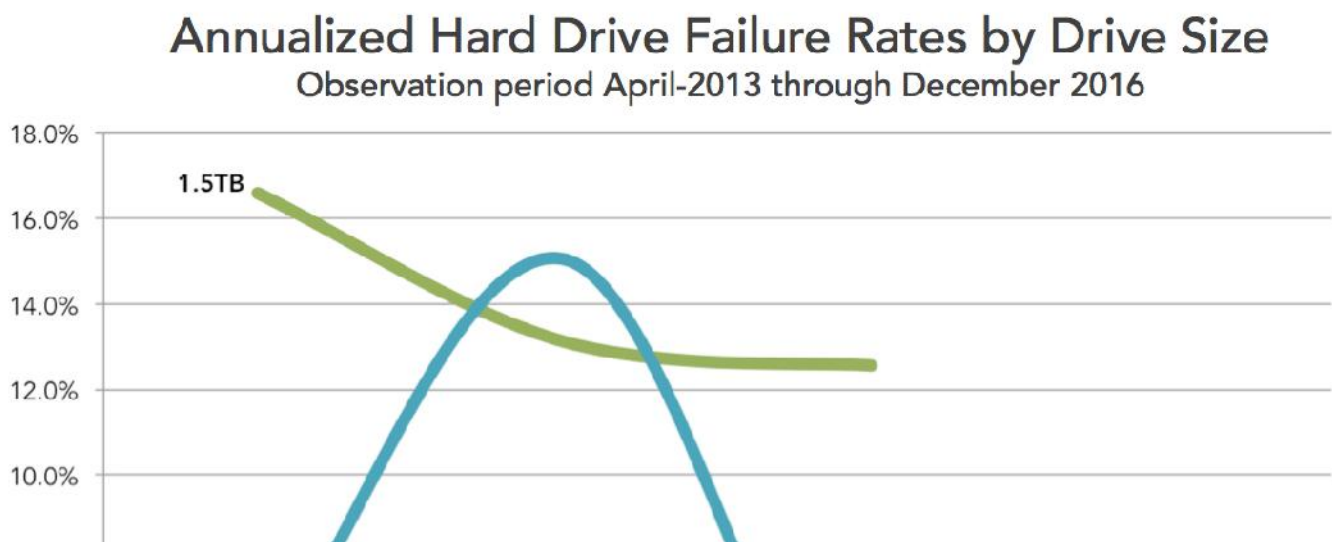
Since April 2013, there have been 5,837 hard drive failures, that works out to about 5 per day or about 7 per workday (200 workdays per year). As a point of reference, Backblaze only had 4,500 total hard drives in June 2010 when we [racked our 100th Storage Pod](#) to support our [cloud backup service](#).

The 58,375,646 Drive Days translates to a little over 1.4 Billion Drive Hours. Going the other way we are measuring a mere 159,933 years of spinning hard drives.

You'll also notice that we have used a total of 85,467 hard drives. But at the end of 2016 we had 71,939 hard drives. Are we missing 13,528 hard drives? Not really. While some drives failed, the remaining drives were removed from service due primarily to migrations from smaller to larger drives. The stats from the "migrated" drives, like Drive Hours, still count in establishing a failure rate, but they did not fail, they just stopped reporting data.

## Failure Rates Over Time

The chart below shows the annualized failure rates of hard drives by drive size over time. The data points are the rates as of the end of each year shown. The "stars" mark the average annualized failure rate for all of the hard drives for each year.



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## Notes:

1. The "8.0TB" failure rate of 4.9% for 2015 is comprised of 45 drives of which there were 2 failures during that year. In 2016 the number of 8 TB drives rose to 8,765 with 48 failures and an annualized failure rate of 1.6%.
2. The "1.0TB" drives were 5+ years old on average when they were retired.
3. There are only 45 of the "5.0TB" drives in operation.

## Can't Get Enough Hard Drive Stats?

We'll be presenting the webinar "Backblaze Hard Drive Stats for 2016" on Thursday February 2, 2017 at 10:00 Pacific time. The webinar will be recorded so you can watch it over and over again. The webinar will dig deeper into the quarterly, yearly, and lifetime hard drive stats and include the annual and lifetime stats by drive size and manufacturer. You will need to subscribe to the Backblaze BrightTALK channel to view the webinar. [Sign up for the webinar today.](#)

As a reminder, the complete data set used to create the information used in this review is available on our [Hard Drive Test Data](#) page. You can download and use this data for free for your own purpose, all we ask is three things 1) you cite Backblaze as the source if you use the data, 2) you accept that you are solely responsible for how

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[download the ZIP file](#) containing the MS Excel spreadsheet.

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### Andy Klein

Andy has 20+ years experience in technology marketing. He has shared his expertise in computer security and data backup at the Federal Trade Commission, Rootstech, RSA and over 100 other events. His current passion is to get everyone to back up their data before it's too late.

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