The Flash Revolution
By Jim O’Reilly

Prices are Diving and Capacities Exploding!

We are on the edge of a revolution in computer storage. With 3D NAND flash fast becoming a reality, MLC prices dropping fast and predictions of parity with bulk hard drives in the near future, makers of hard drives will have to adapt or fade into irrelevance.

In the debate about comparative pricing, one should bear in mind that some vendors and pundits compare flash and SSD prices with bulk storage drive pricing. That’s a bit like comparing a Ferrari and a bicycle. All-Flash Arrays already eclipse “enterprise” hard drives in price. A typical “enterprise” hard drive costs around $500 per terabyte OEM and much more installed in an array. This OEM number is around 8x the price of a bulk SATA hard drive. The lower price of flash solutions is already a major game-changer.

Before we even reach parity in price, however, the other benefits of solid-state memory in the All-Flash Array will present a very compelling case for banishing hard drives and their arrays to history. Lower power, higher reliability, low latency of access, and a reduced configuration complexity are all strong reasons to move on from traditional gear.

What we are talking about is the potential for All-Flash Arrays to vanquish hard drive secondary bulk storage. That obviously is a second major game changer, since the complexities of drive boxes just vanish. No more drive management and maintenance would be a blessing to any datacenter!

3D NAND holds out tremendous promise for capacity per die increases. The full potential of 3D will take a few years to realize, as vertical stacks are created and interconnect is minimized. Even so, we can expect a doubling of the capacity of a die this year, and we will see around 8x capacity per die in 2017.

The implications of this for the All-Flash array and SSD market segments are enormous. With IO performance already well beyond anything hard drive arrays can achieve, All-Flash Arrays will also deliver capacity. Just that 8x increase in per die capacity will yield around 10 PetaBytes of raw capacity in a rack of All-Flash units, and data reduction via compression and deduplication will scale the capacity much further, perhaps by a factor of 5 to 10x.

The number of hard drives required to match an All-Flash Array’s performance is between 3,000 and 6,000 of the fastest available drives. Packaging these requires 50 or more array boxes and takes up 5 to 10 racks of space – and that’s just to match the performance of a single All-Flash Array!

On the other hand, hard drive capacity of a configuration like the one above would be around 30 Petabytes using 10TB drives, much more than that All Flash Array, a point hard drive makers have jumped on (while perhaps forgetting that these are actually very slow drives). The advent of the denser flash makes that discussion nearly meaningless. One reason this is the case is that flash prices are expected to match bulk hard drives in $/terabyte in 2017.
The gains from 3D NAND are just starting and we can expect around a decade of capacity growth. Technical problems such as vertical alignment of the layers will be conquered and using a vertical NAND chain for example, should allow a much better floor plan than multi-layer 2D NAND approaches. This belief in continued capacity growth has already led to talk of 30TB SSD in 2018.

Because of the back-off on process nodes combined with improved error-correction techniques, TLC may be much more acceptable in mainstream solutions, and it and QLC (4 bits per cell) are talked of for the lowest cost archiving solutions. If this happens, capacity will take an even faster step up. This poses a serious challenge to tape storage too, for example.

We are very close to the turning point for storage. Breaking the cost barrier for flash is already rapidly moving the market away from “enterprise” hard drives, while further reductions will make flash the choice for all storage needs.

The hard drive vendors are against the wall. They are running out of technology options for boosting capacity, and we can expect only incremental gains for the near future. All the factors point to hard drives fading from the picture over the next few years and to a solid-state future.

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