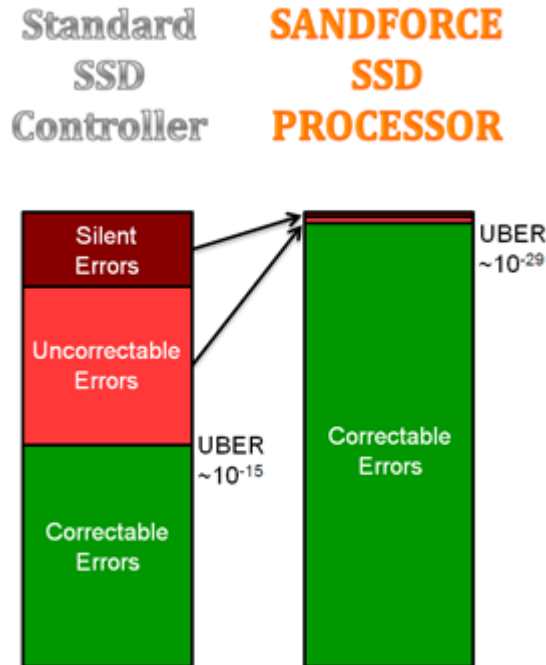


# RAISE

## Automatic Encryption RAISE SATA 6Gb/s Interface

RAISE™ improves total SSD reliability

While the new generations of NAND flash memory is developed with shrinking silicon geometries to reach higher densities, its endurance is significantly dropping. The importance of advanced data protection techniques to prevent data errors is increasing. SandForce SSD Processors not only feature higher-level ECC to protect against correctable errors, but provide a protection against uncorrectable errors in the form of the innovative SandForce RAISE technology. The combination of higher level ECC protection and RAISE provides an Uncorrectable Bit Error Rate (UBER) of  $\sim 10^{-29}$  with nearly one quadrillion times fewer uncorrectable errors than other controllers.

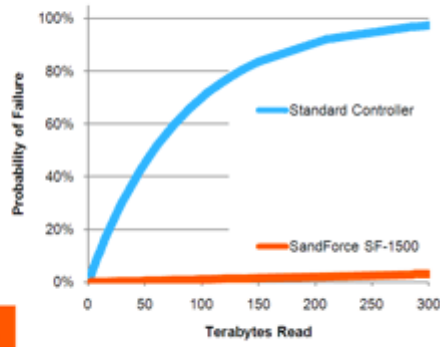
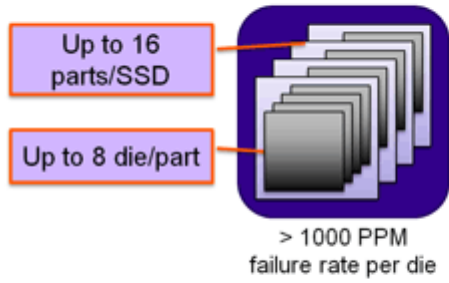


**RAISE - Redundant Array of Independent Silicon Elements** - writes data across multiple flash die to enable recovery from a failure in a sector, page or entire block, just like the concept of multi-drive RAID used in disk-based storage, but RAISE only requires a single drive.

SSDs are built using flash die that are assembled up to 8 die per package. For optimum capacity the SSD can be assembled with up to 16 packages. That puts 128 individual die in one SSD. If the failure rate (unrecoverable read error) of one MLC die is conservatively 1,000 PPM (a failure probability of 0.1%) then using the probability formula for 128 devices the failure rate increases to 12.0% over the life of the SSD.

Using RAISE technology in a SandForce Driven SSD reduces the probability of a single unrecoverable read error by 100 times to 0.001%. Applying that same formula, the failure rate of the SSD drops from 12.0% to a mere 0.13%, nearly 100 times lower.

- RAISE™: Redundant Array of Independent Silicon Elements
  - Data protection beyond ECC
  - Benefit of RAID without additional write overhead



	Standard UBER= $1 \times 10^{-15}$	Advanced UBER= $1 \times 10^{-16}$	SandForce UBER= $1 \times 10^{-17}$
5 year Cumulative Failure Rate	99.60%	45.82%	0.00%

**Assumptions**

- JEDEC Enterprise App Class 1 (proposed)
- 200GB capacity, 4GB MLC die