NAND Flash Viability for Enterprise SSD

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Enterprise SSD: Enabling Max Growth

- NAND applications evolved over time through enabling price points driven by litho, MLC & 3D
- NAND development historically has been driven by consumer applications => Commodity NAND
- Commodity NAND cost continuously decreases at the expense of key NAND parameters critical to enterprise
- Enterprise SSD have highest endurance, reliability and performance requirements that increase
- Need to bridge gap between Commodity NAND characteristics and Enterprise SSD requirements to enable lowest price points which will enable max. growth

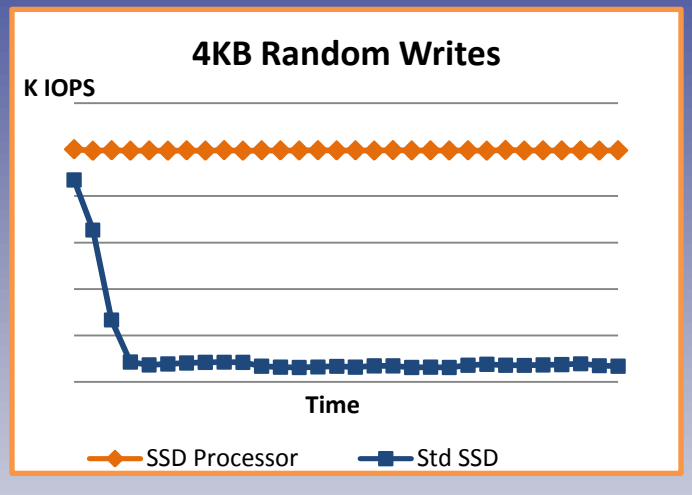
Enterprise SSDs Require New Solutions

- Enterprise SSDs require next generation NAND flash management to assure reliable high performance operation

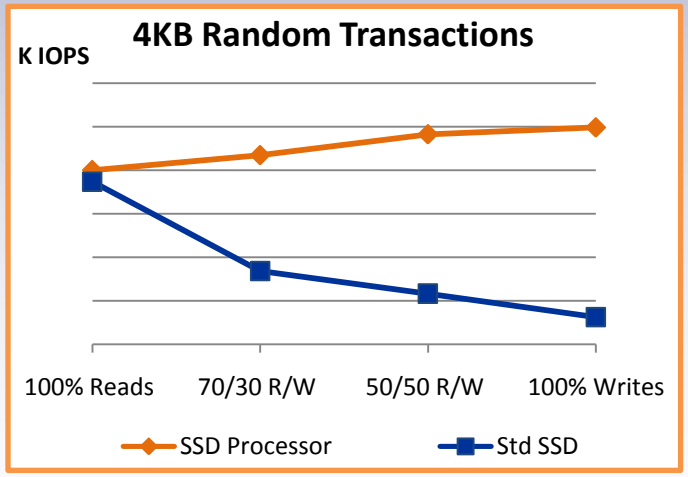
- New SSD Processors need to offer:
  - Balanced high performance read/write access
  - Endurance improvement of ~100x+
  - Reliability improvement of ~100x+

1. Balanced High Performance R/W

- Simple SSD Controllers cannot maintain high random write speeds
- They also slow significantly when performing mixed operations

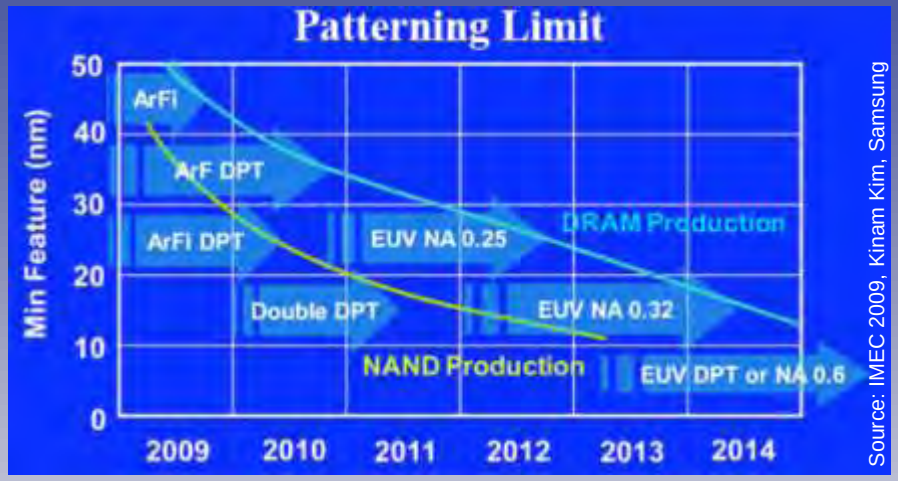


- New SSD Processors can manage high random write speeds
- They also perform very well in mixed workload operations



2. Significant Endurance Improvement

- NAND is expected to scale down to at least 1xnm yielding further cost reductions
- Key NAND parameters such as endurance degrade significantly with scaling
- Endurance needs to be improved by one order of magnitude every 18 months
- Increasingly more powerful processors will be required to enable use of Commodity NAND in Enterprise SSDs



NAND Process Geometry	NAND Flash Endurance	Endurance Improvement Required for Enterprise SSD
5X	10K	~100 x
3X	3K	~300 x
2X	1K	~1,000 x
1X	< 200	~10,000 x

3. Powerful Advanced Error Correction

Up to 16 parts/SSD

Up to 8 die/part

Each die has a greater than 1000 PPM failure rate

Std. Controller Failure Rate

1–(1–1/1000)^(128) = **12.0%**

- SSD Processors can reduce failures down to only **0.128%**
- This reduces rebuilds and enables more reliable single drive environments

SSD Processors can reduce failure rates (unrecoverable read errors) by up to 100x

Summary

- NAND flash has been optimized for consumer applications with a focus on cost
- Enabling price points are critical to enable maximum Enterprise SSD Market Growth
- Commodity NAND offers the lowest cost but by itself is not suitable for Enterprise SSD

High-Performance SSD processors will enable cost effective reliable Enterprise SSD through the use of commodity NAND