New Storage Devices Utilizing Flash Memories and Hard Disk Drives

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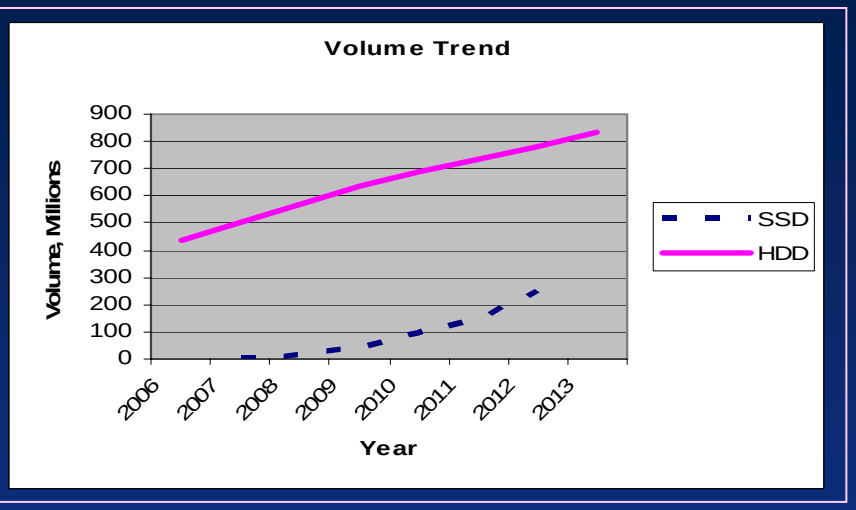
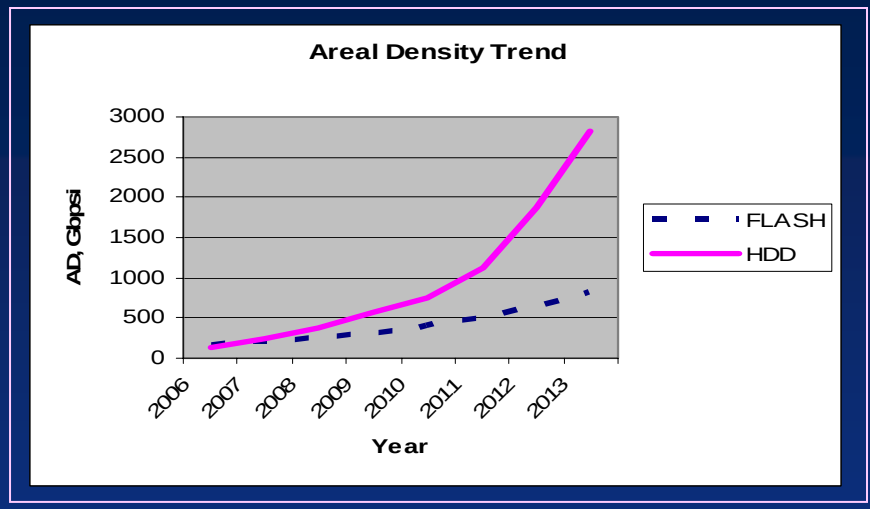
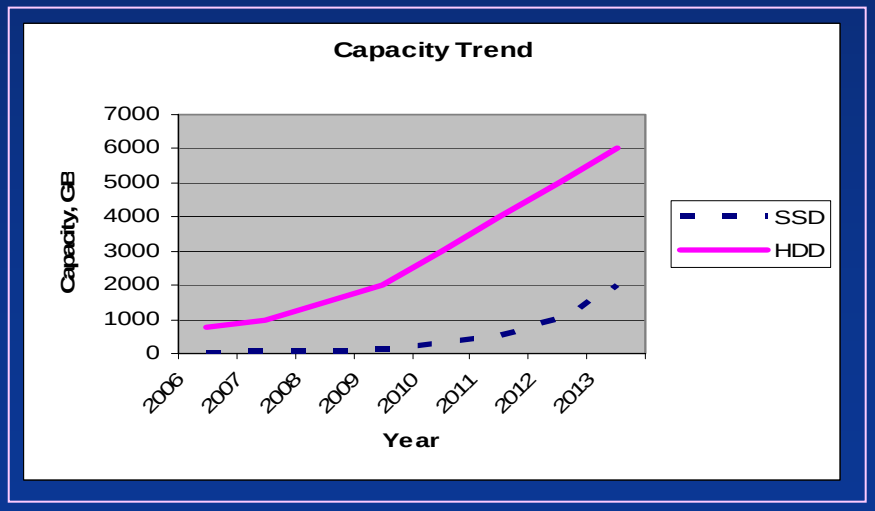
AGENDA

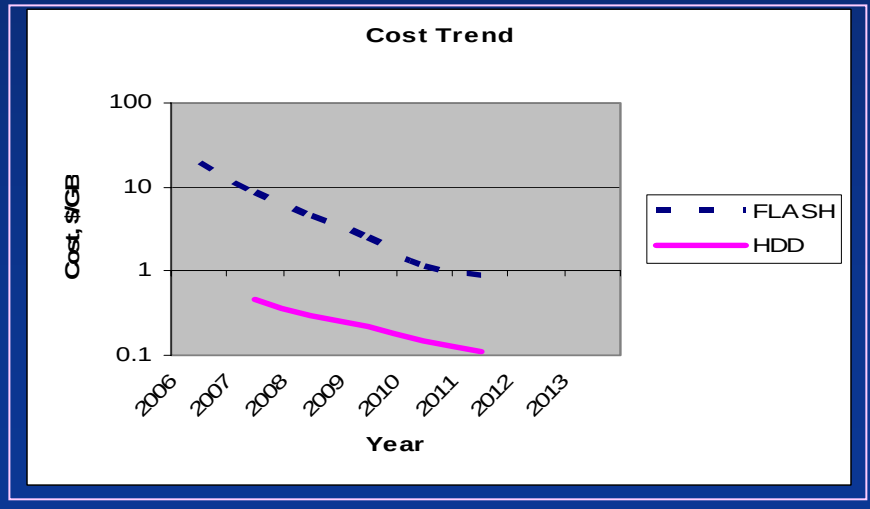
- Trends in HDD and SSD drives
- Strength and Weakness of
  - SSD
  - HDD
- Results from combining two technologies synergistically
- Concluding remarks

Trends in HDD and SSD Drives









From Web-Feet, i-Suppli, IDC, Trendfocus

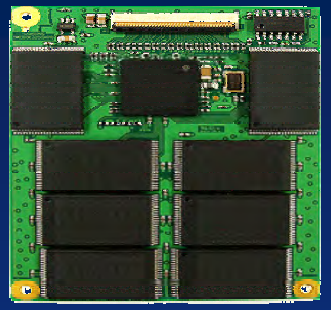
For next few years, HDD will continue to lead

Storage Solution → HDD or SSD?

- HDD

  - Low $/GB
  - High Sequential I/O
  - Low IOPS
  - High watts
  - High Capacity
  - Storage Incumbent

- SSD



  - High $/GB
  - High Random I/O
  - High IOPS
  - Low Watts
  - Light weight
  - Storage New comer

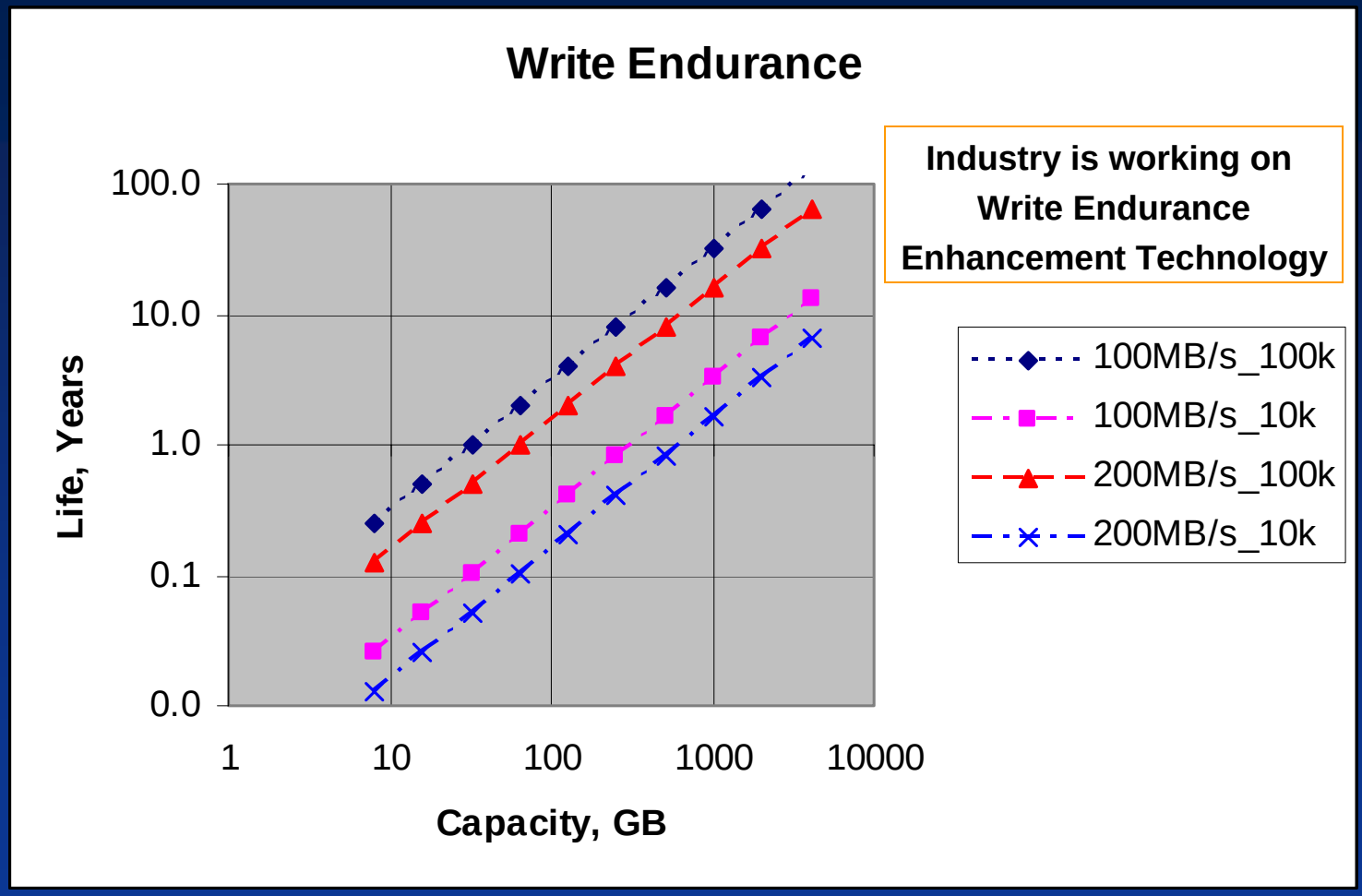
Samsung has both solutions

Strength and Weakness

	SSD	HDD
Strength	▪ High IOPS ▪ Rugged ▪ Light ▪ Low latency	▪ Large capacity ▪ Low cost ($/GB) ▪ Fast sequential I/O ▪ Storage incumbent
Weakness	▪ Write endurance ▪ Write speed ▪ High $/GB ▪ Expensive drive	▪ Mechanical Fragility ▪ Higher power ▪ Lower MTBF ▪ Low IOPS

Mainstream – HDD, Niche - SSD

Write Endurance of SSD



For higher MB/s, need larger capacity SSD

Will SSD be in mainstream PC?

- Current inhibitors of SSD
  - Too expensive : 128GB @ $500 ~ $600
  - Not enough capacity : ~64GB (HDD in NB now :~320GB)

Until the price is down and write endurance is up

HDD is preferred by customers

SSD is being deployed in laptop and enterprise

SSD? HDD? Or Both?

- Both satisfy Notebook needs in a different way

SSD	Best For
+ Performance (Random Read) + Low Power + Rugged	● Storing frequently used data ● Performance from – Fast Boot, Application launching

HDD	Best For
+ Capacity + Low cost / GB + Sequential Write	● Storing less frequently used large amounts of sequential data ● Performance contributes – Fast sequential file transfer

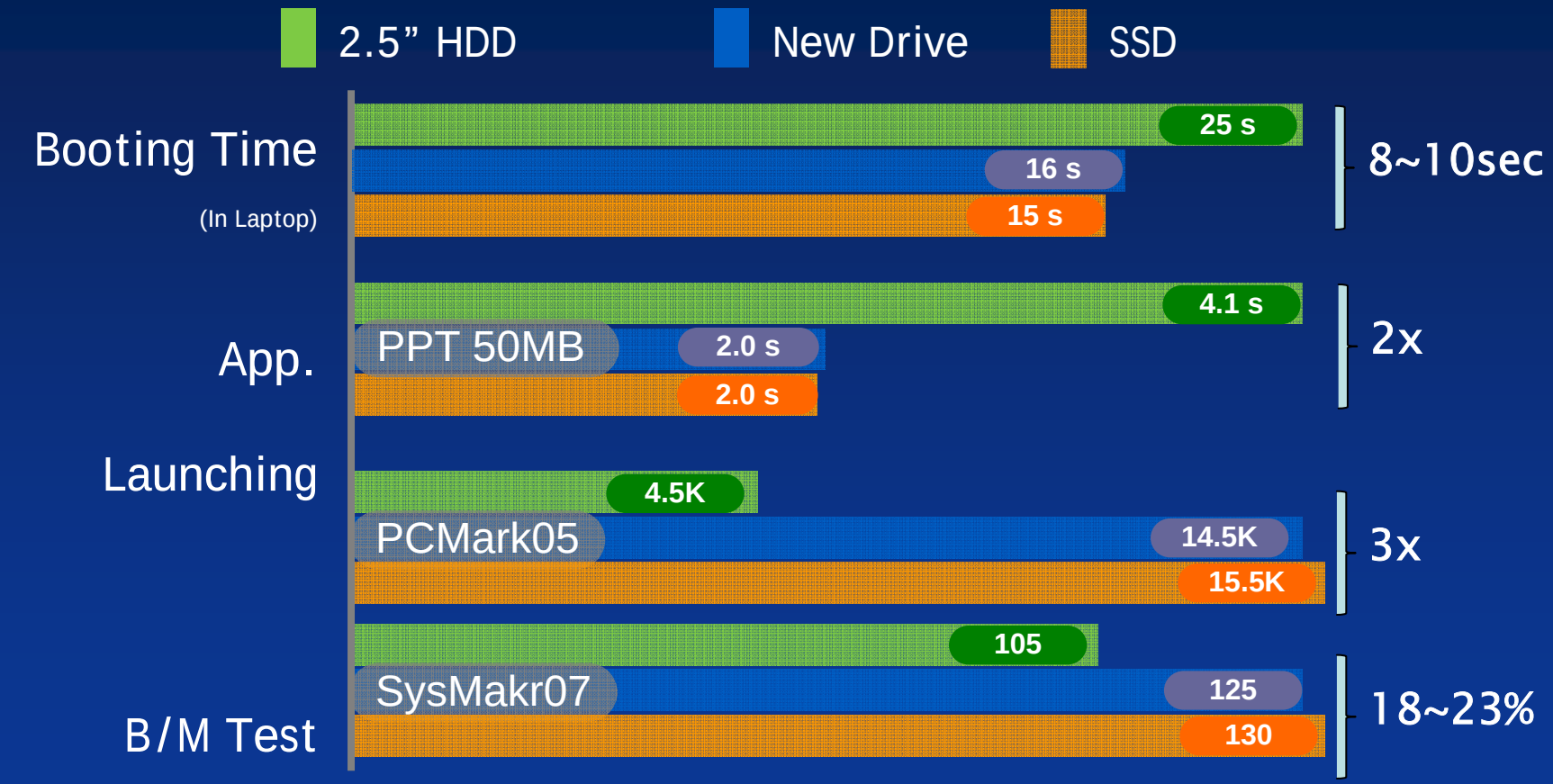
We want to enjoy benefits of both SDD and HDD

Samsung Magic
Synergistic Integration of Two Drives

HDD + Proprietary ingredients • Intelligent data management • Hardware integration = SSD + New Drive

HDD	SSD	New Drive
• Capacity • $/GB	• I/O Performance • Power	• I/O Performance • Reliability • Capacity • Cost

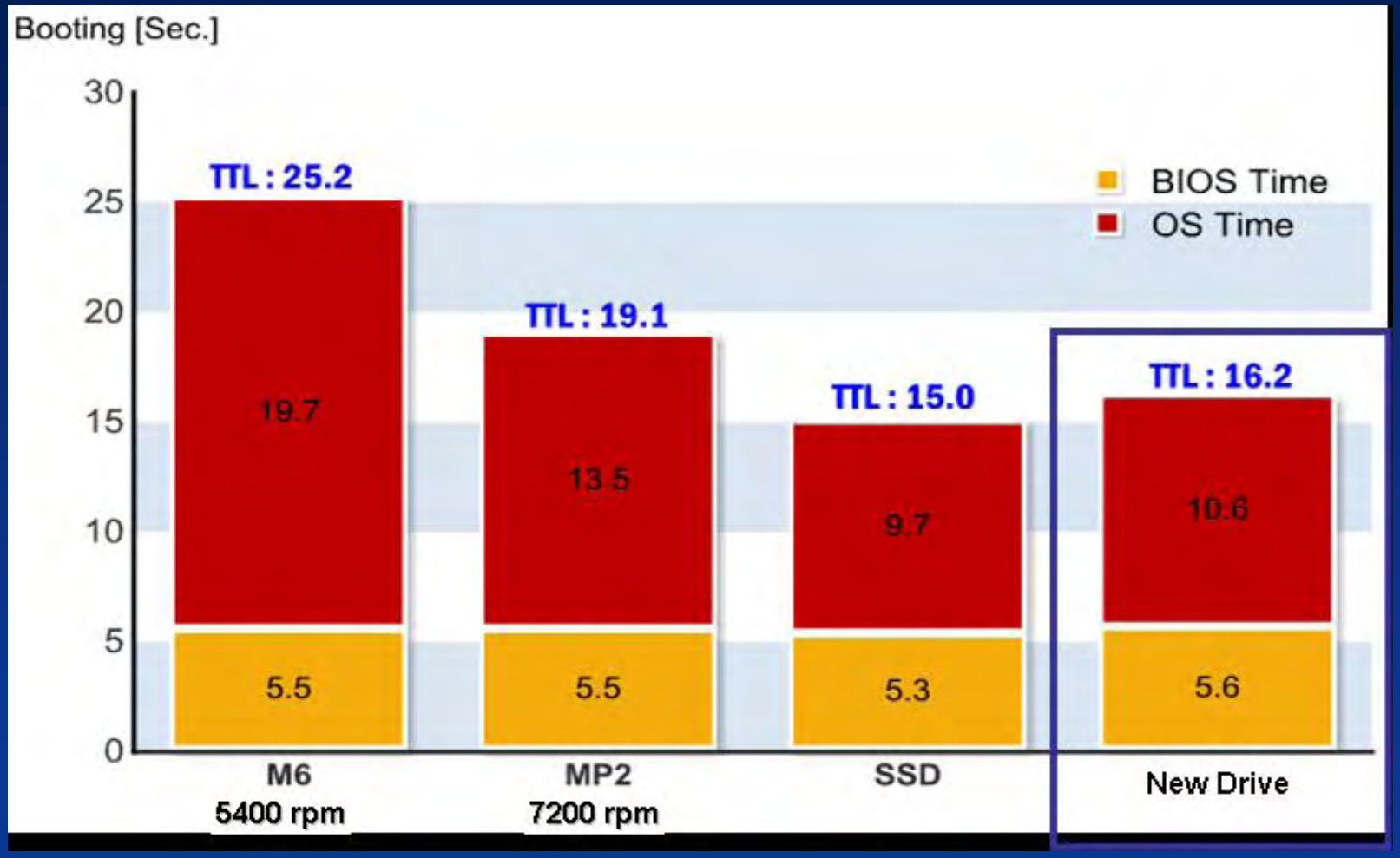
Results From New Drive



[Test system : Dell Inspiron 1720]

New drive shows significant advantage

Results From New Drive



[Test system : Dell Inspiron 1720]

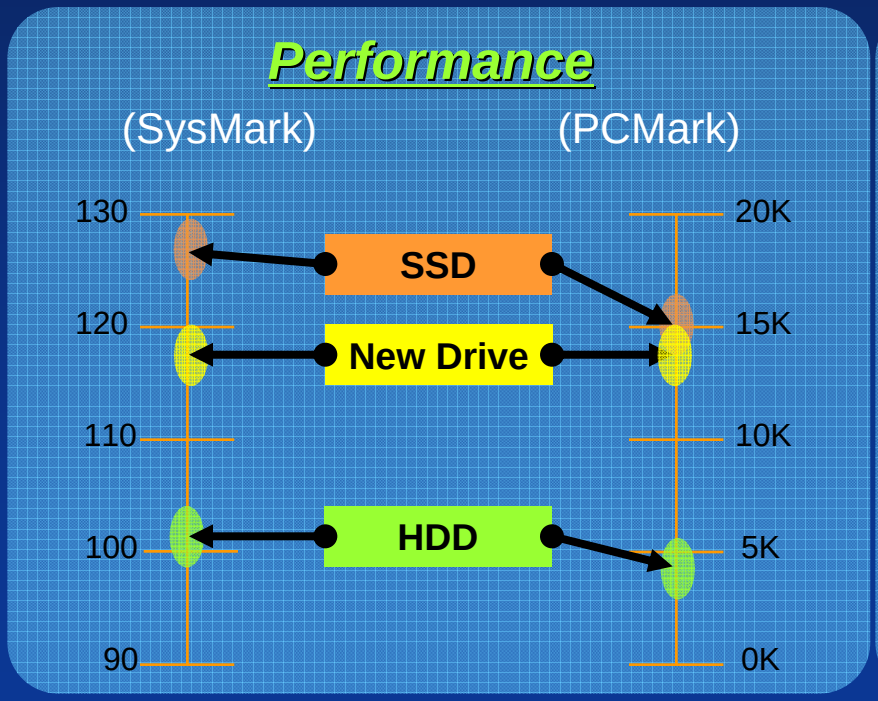
Significant improvement in boot time with new drive

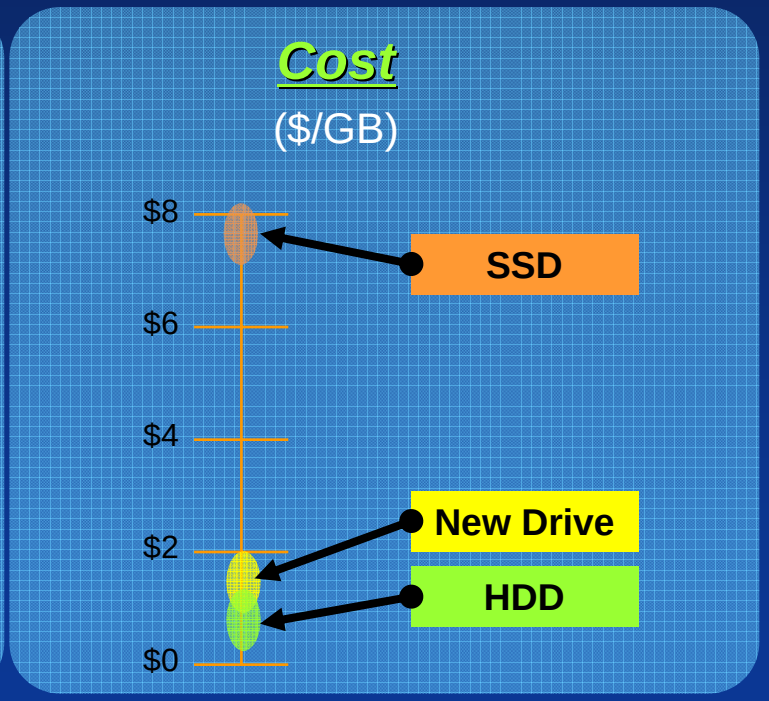
Results From New Drive

- **Performance : New Drive ~ SSD**

  Cost : SSD >> New Drive > HDD

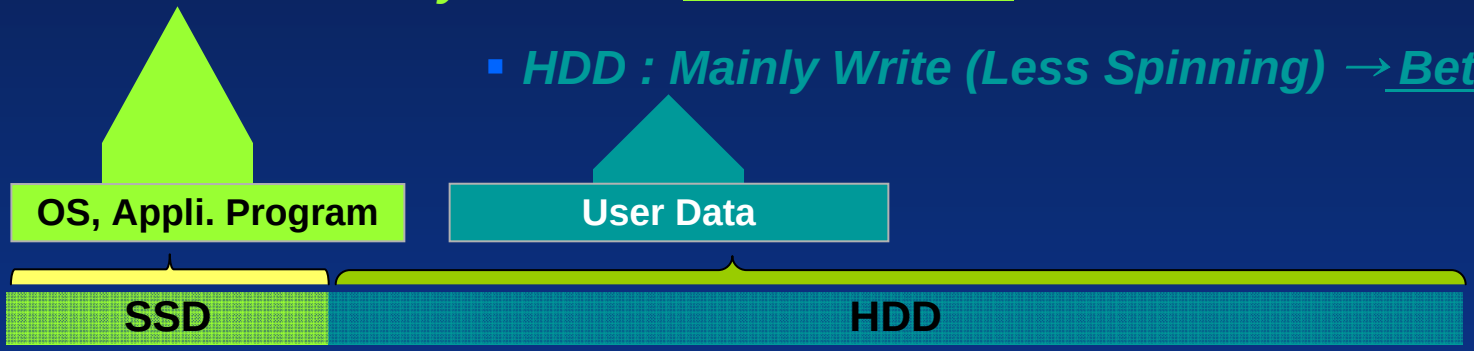
+ High Capacity

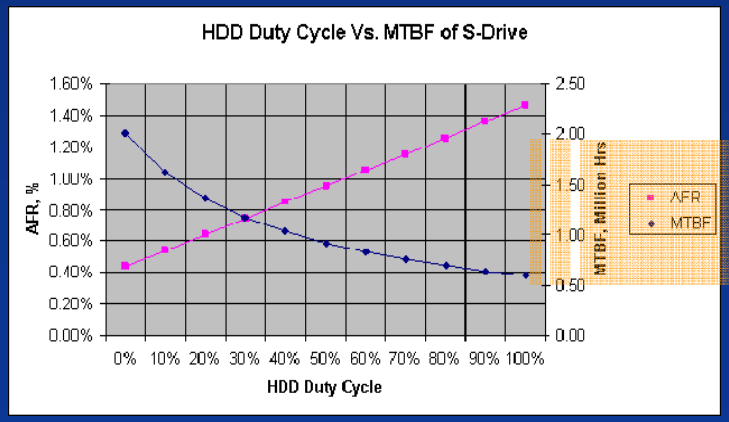




Reliability From New Drive

- **Distributed Operation of SSD & HDD**
  - ***SSD : Mainly Read → Less Wear-out***
  - ***HDD : Mainly Write (Less Spinning) → Better MTBF***





Duty Cycle		Aggregated
SSD	HDD	MTBF
0%	100%	600K
50%	50%	1.0M
70%	30%	1.2M
90%	10%	1.6M

*** Estimated by Samsung**

Concluding Remarks

- At Samsung, we have developed a new class of drives that integrated hard disk drives and flash based solid state drives synergistically to obtain best of both worlds
  - I/O performance similar to SSD
  - Capacity similar to HDD
  - Enhanced reliability
  - OS independent
  - Affordable storage with great user experience
- Development of such unique product was enabled by
  - Proprietary hardware integration
  - Intelligent data management
- New drives are being evaluated by customers
  - Need industry acceptance

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Thank You