



Ushering in the 3D Memory Era with V- NAND

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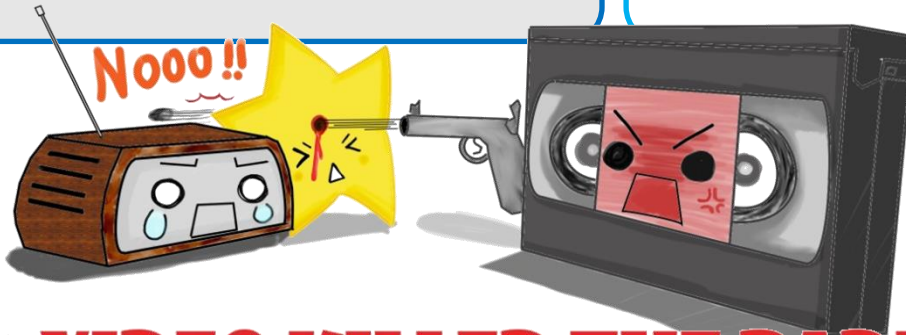
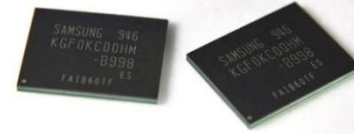
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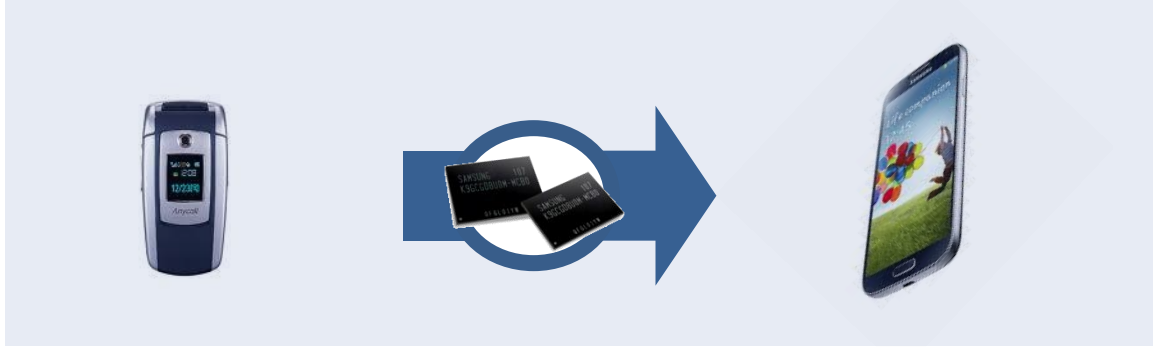


- **End User Paradigm Shift**
- **NAND Flash Ubiquity**
- **NAND Flash Scaling Limitation**
- **World's 1st 3D NAND Flash Technology: V-NAND**
- **Era of V-NAND Based Products**

It All Started Here...



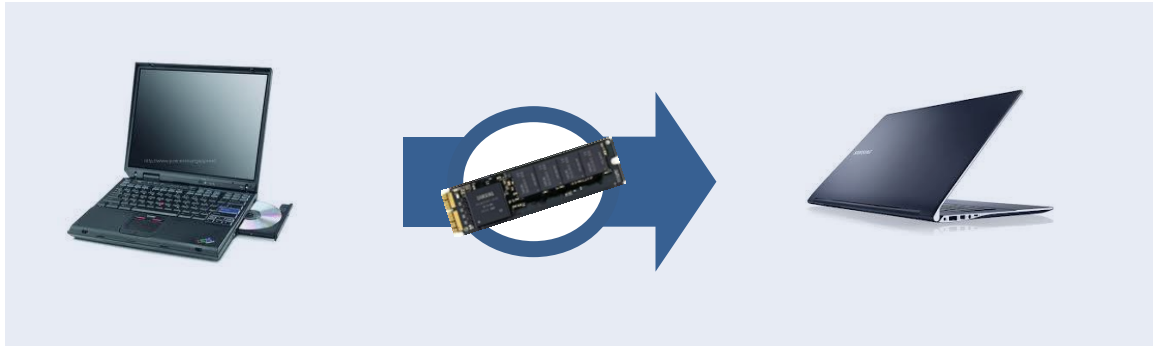
And Continues to Change the World



Personal Devices

Rich Multi-Media
Apps Apps Apps!

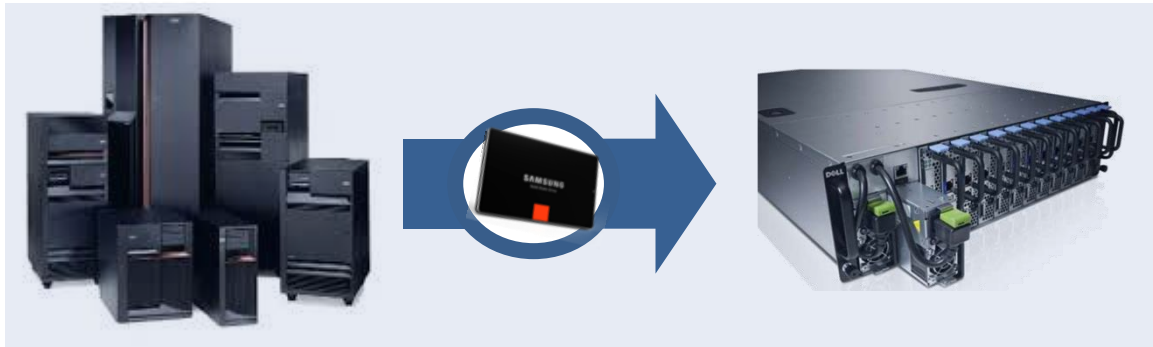
Samsung
SMART
eMMC
activated



Laptop Experience

Instant ON, Battery Life &
Sleek Design

Samsung
SSD
activated



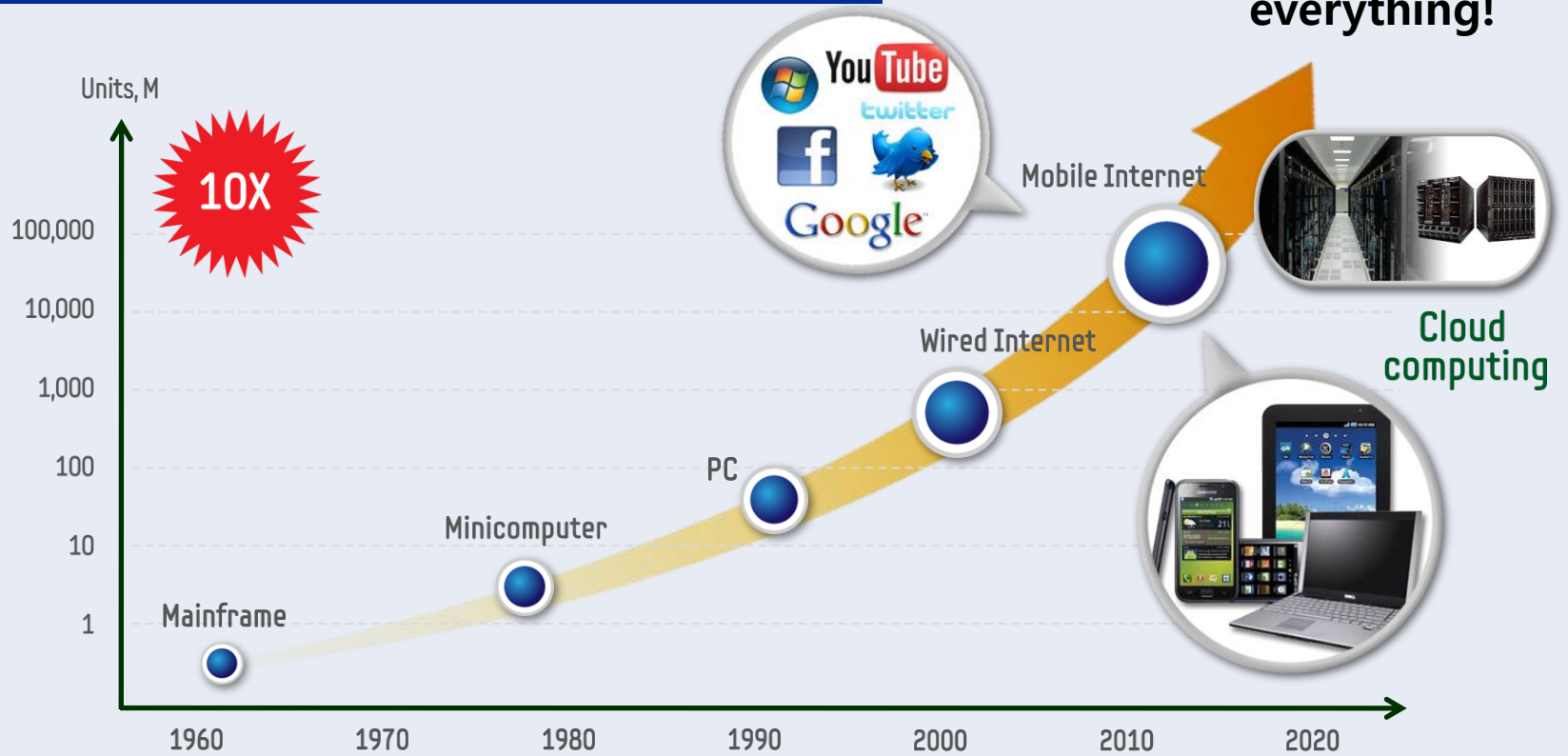
Server & Cloud

High Performance, Efficiency &
Robustness → TCO!

Samsung
SSD
activated

Change in User Environment: PC → Mobile + Cloud

Information growth drivers over time

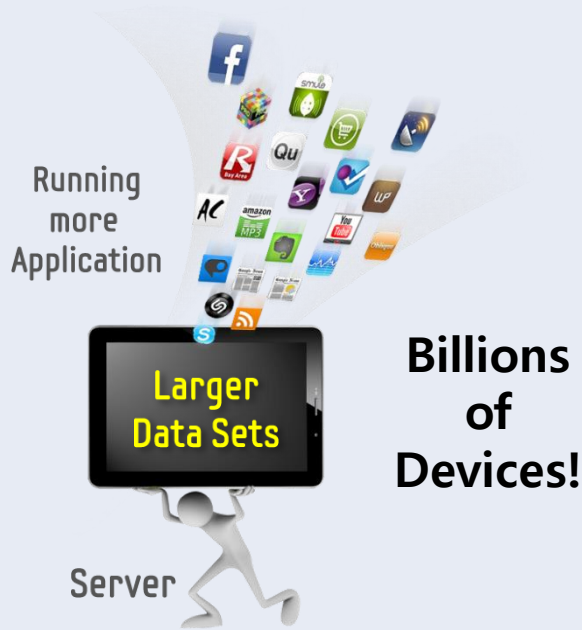


2012: Mobile connected devices exceeded the world's population

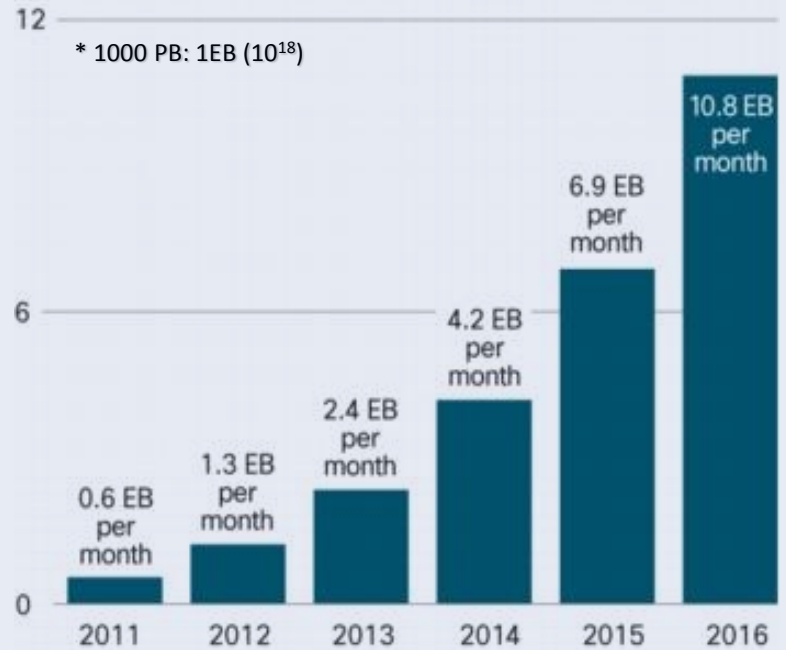
Impact on Datacenter Infrastructure



More applications for data



Data traffic: 78% CAGR



Source: Cisco Visual Networking Index

YouTube More video is uploaded to YouTube in one month than the 3 major US networks created in 60 years



What about Exabytes?

5 EB: Total data created between the dawn of civilization and 2003

NAND Flash Ubiquity



NAND is now an integral part of virtually every consumer device



By 2020 >50B things will be connected...

...And they will all need flash



NAND Demand Growth

■ NAND demand is expected to reach 36B(1GB Eq.) in 2013

- Mobile phones, SSDs and Tablets remain significant drivers for NAND demand



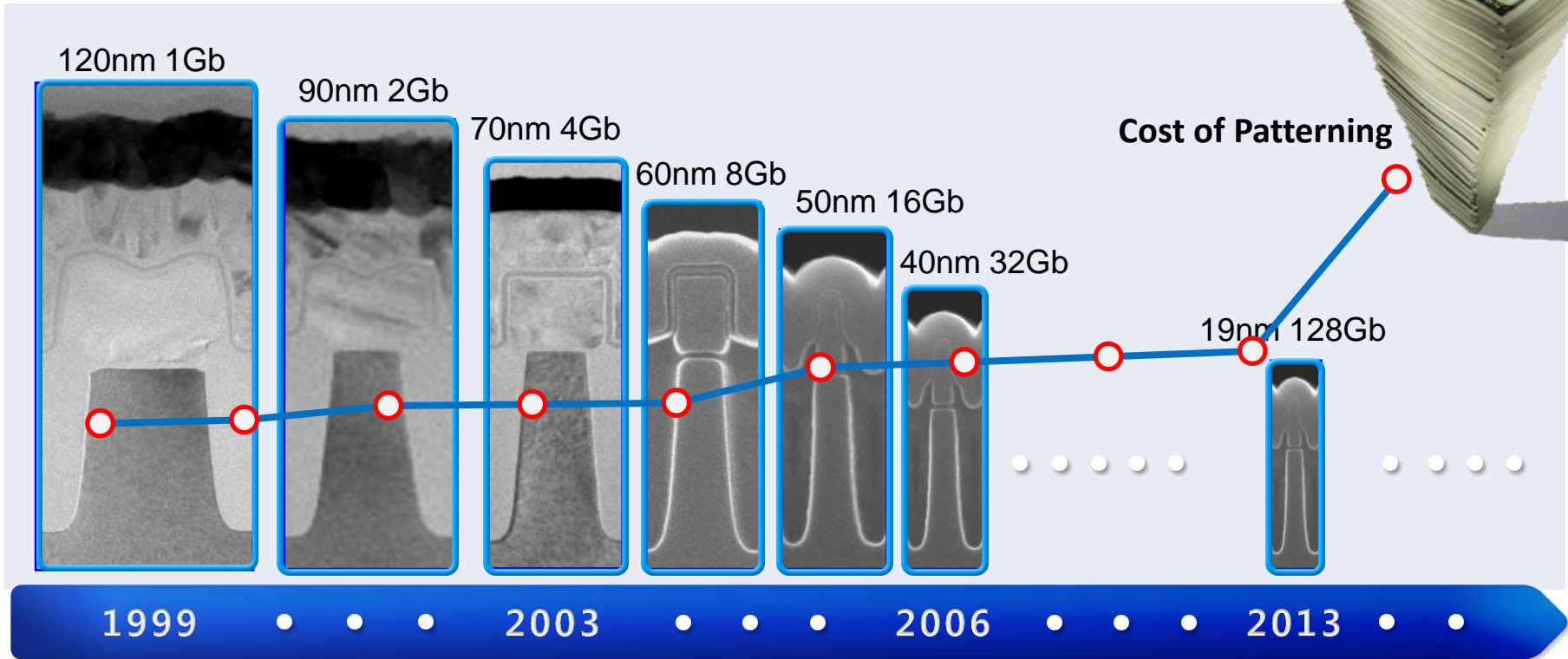
In 2015, there will be enough Flash to give every single person in the US a 256GB SSD



Has Moore's Law Come to an End for NAND?

■ Maintaining planar evolution so far... But, Scaling is getting difficult

- Sub-19nm hitting the limit of cell reliability → Enterprise ?
- Tremendous investment cost required to continue → Consumer ?



Future die shrinks:

Prohibitively expensive, reliability concerns, diminishing wafer productivity

How to power the Internet of Everything with NAND?

Disruptive technology is required to continue to satisfy capacity, cost and reliability requirements





ES Jung, Ph.D

*EVP & GM,
Semiconductor R&D Center*



Human Desire for NAND



High Speed

High Density

Low Power

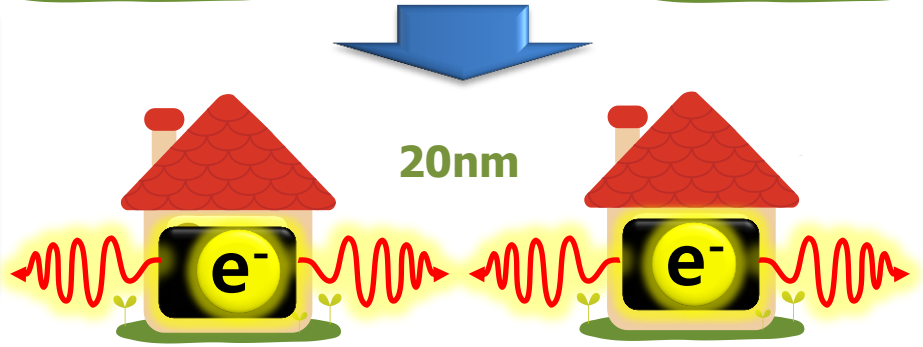
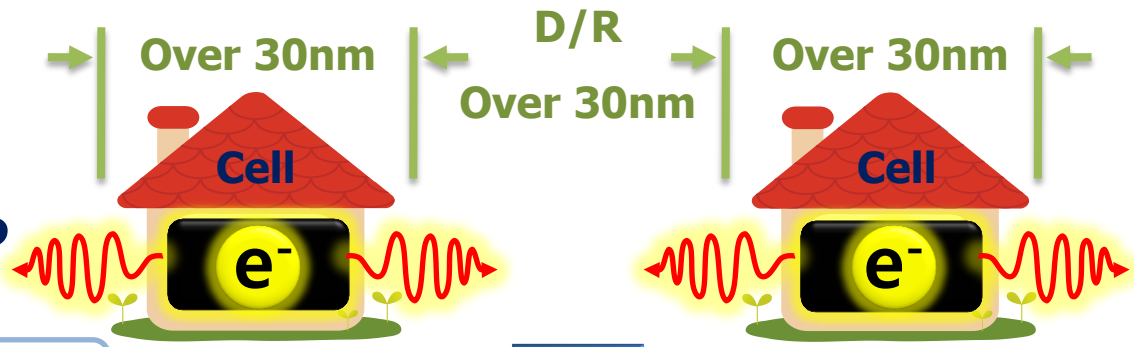
High Reliability

2 Questions



Q1. Why so difficult ?

- 1** Cell to Cell Interference
- 2** Patterning



Q2. 3D V-NAND Can Solve ?

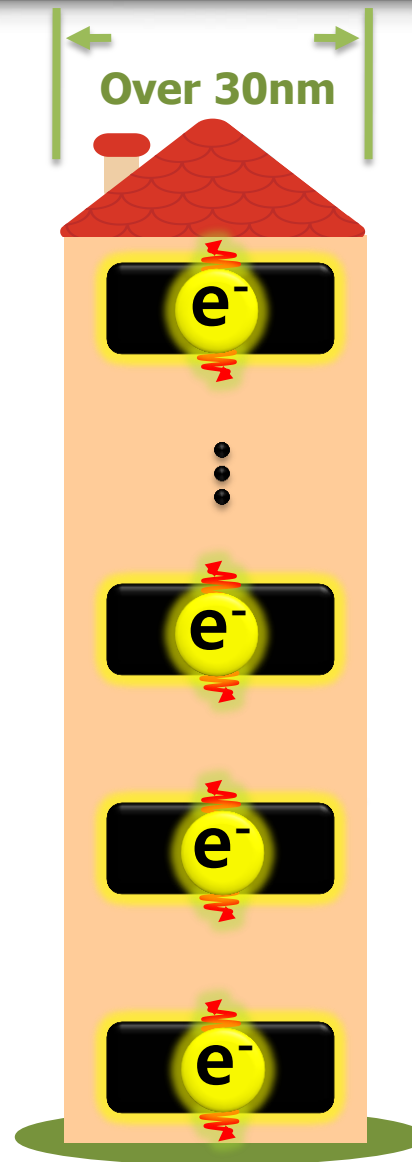
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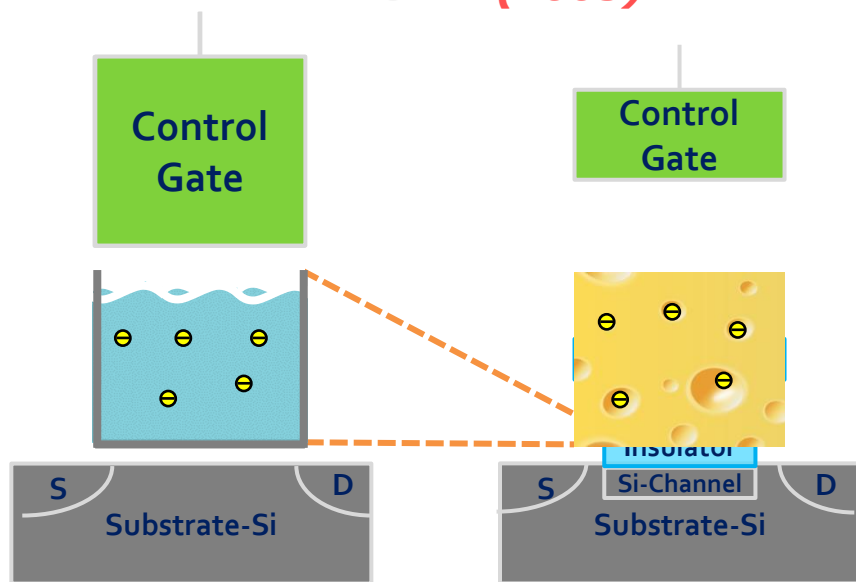
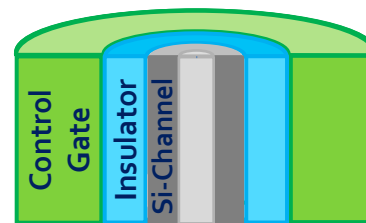
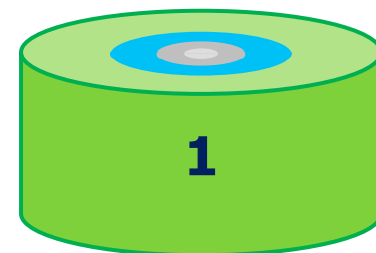
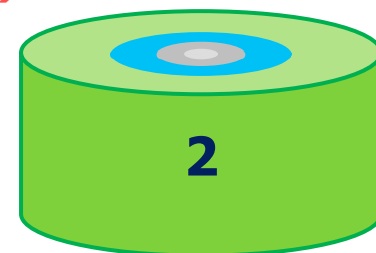
3 Disruptive Innovations



2 *Structure Innovation*
(2008)

1 *Material Innovation*
(2003)

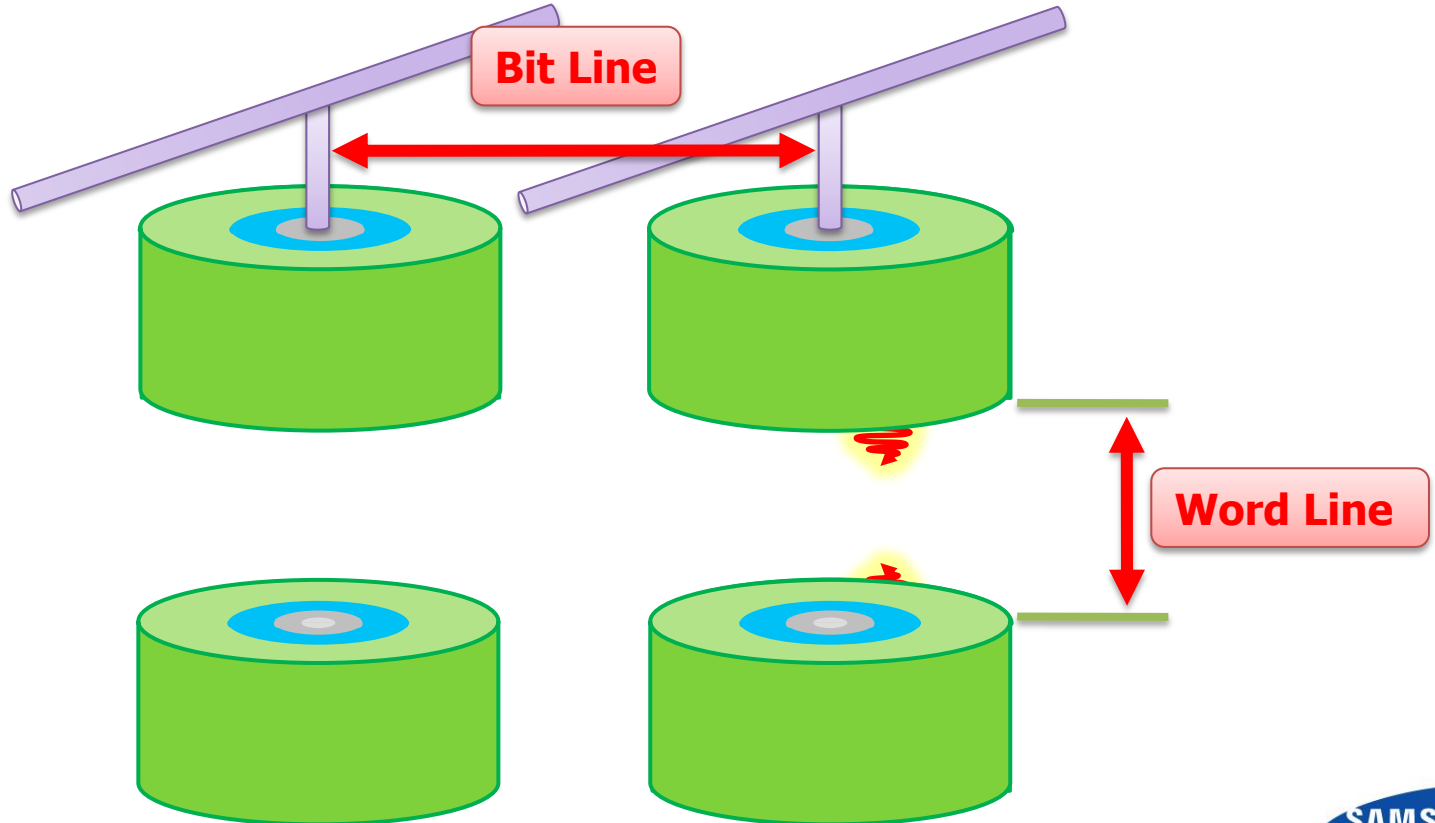
3 *Integration Innovation*
(2008)



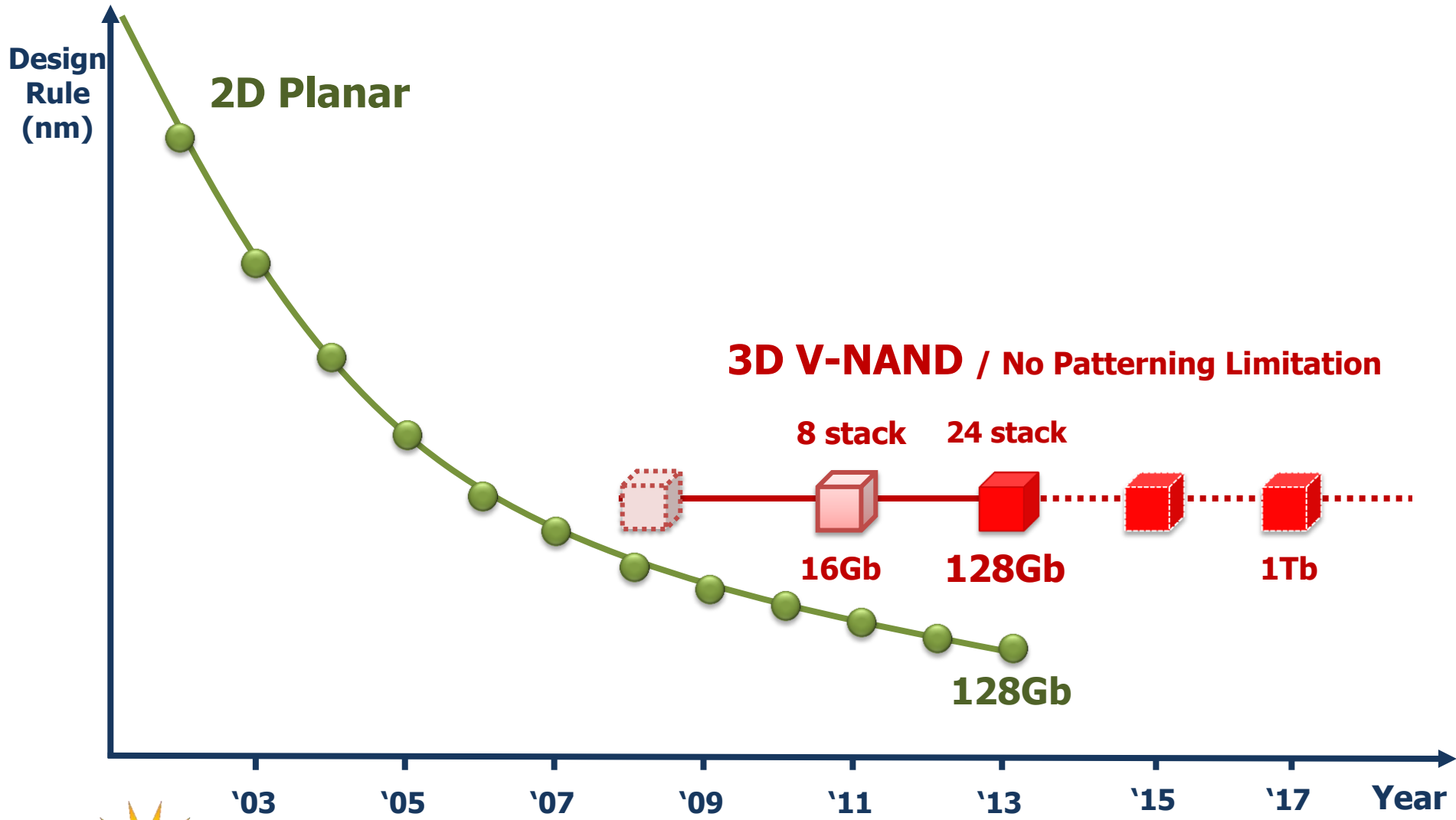
Innovation Result: V-NAND Cell



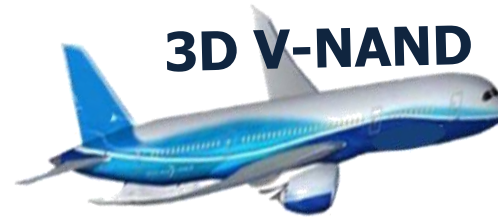
- 1 Cell to Cell Interference** → **B/L Interference Free**
→ **W/L Interference Almost Free**
- 2 Patterning** → **Patterning Issue Free**



V-NAND Era for the Future



Paradigm Shift from Drive to Fly



3D V-NAND

Innovative Technology

Material

Structure

Integration

2D Planar





3D Memory Era Begins Today !



Samsung V-NAND

World's 1st V-NAND Based SSD



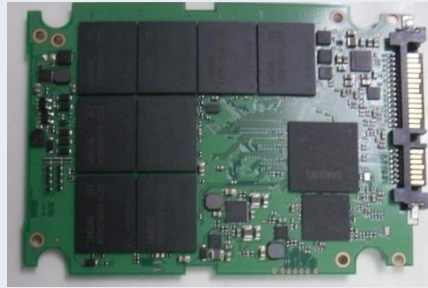
- SATA 6Gbps
- 2.5" Form Factor
- 480/960GB
- Power-Loss Data Protection



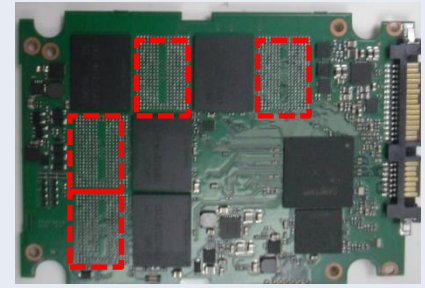
Benefits of V-NAND Based SSD



Less
Real Estate



Planar NAND SSD
(8Ch, 8dies/Ch)



V-NAND SSD
(8CH, 4dies/Ch)

Higher
Performance

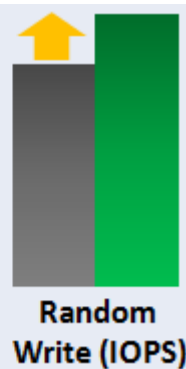
Low Power
Consumption

Normalized (a.u)

Performance

22%
Faster

20%
Faster



Power

27%
Lower

45%
Lower



* Note: Performance and power result is based on measured maximum improvement.



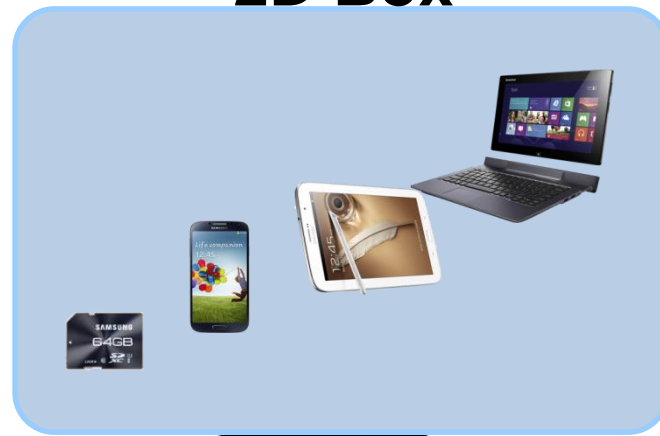
- ✓ Smaller & Faster
- ✓ Lower Power
- ✓ Higher Capacities

You can have your cake
and eat it too!

Benefits of V-NAND Based SSD



2D Box



Benefits of V-NAND Based SSD

■ Greater V-NAND cell reliability → expanded NAND universe

- CE: lower cost continuum. Enterprise: endurance enabling rapid adoption rate
- Lightning fast internet of the future!



SSD Market Forecast



■ SSD market growth has always been constrained

- Doubts about keeping up \$/Gb improvements
- Concerns about degrading NAND Flash parameters (Endurance, Performance, Retention..)

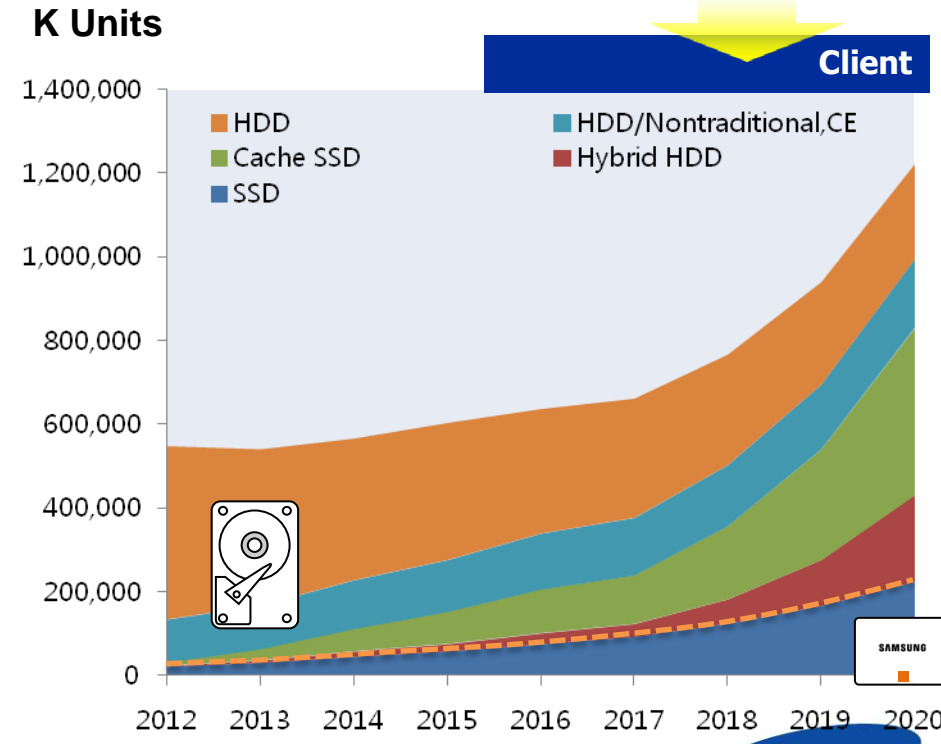
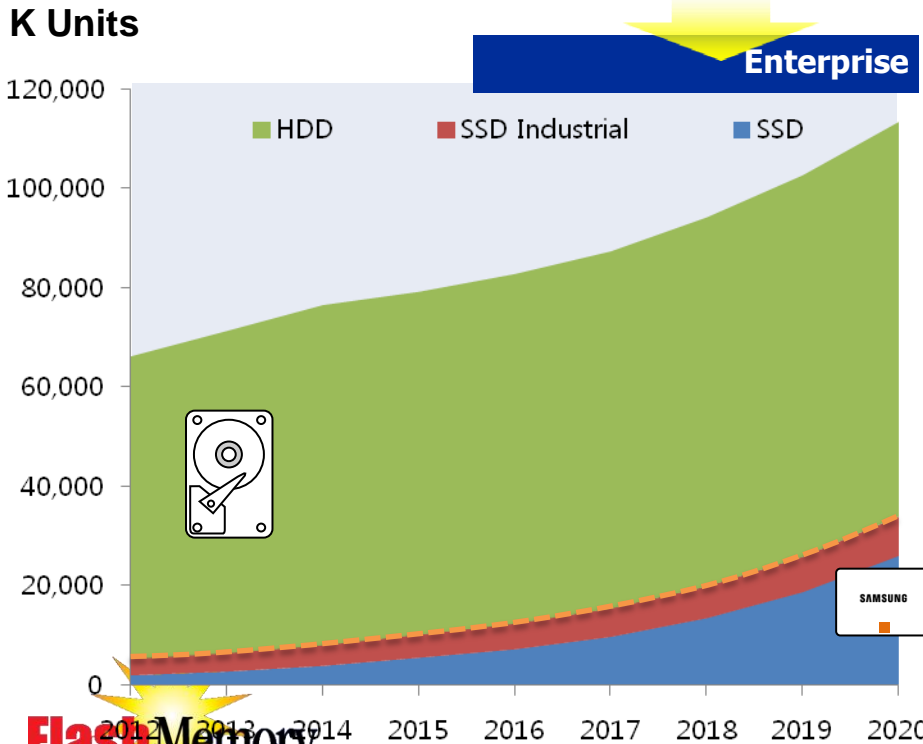
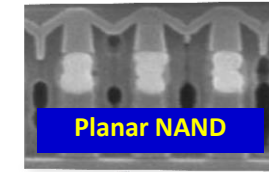


SSD Market Forecast



SSD market growth has always been constrained

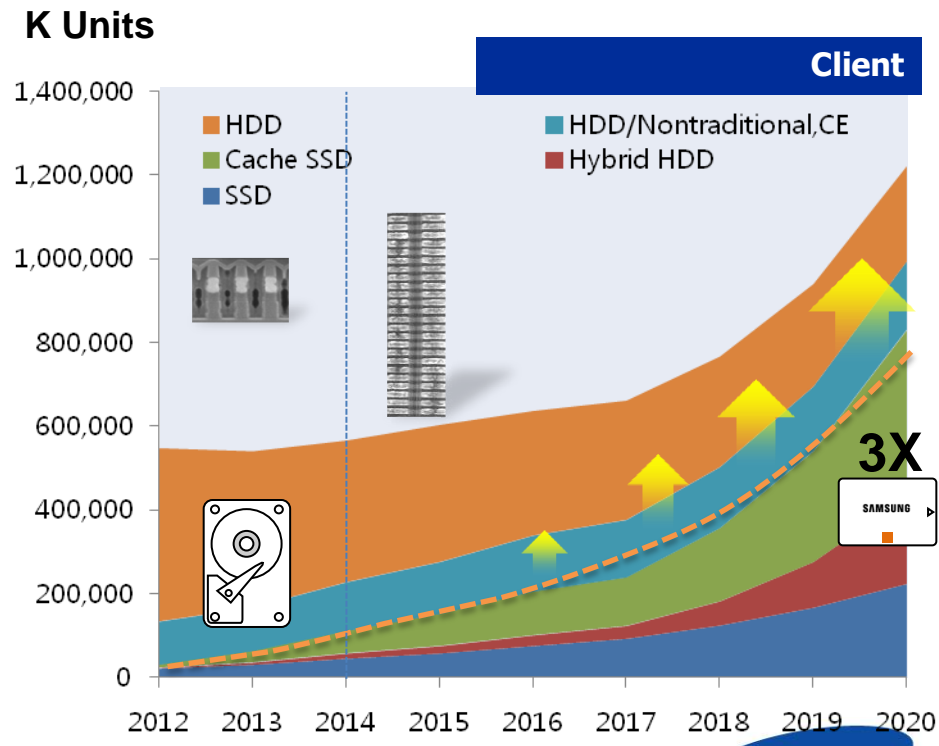
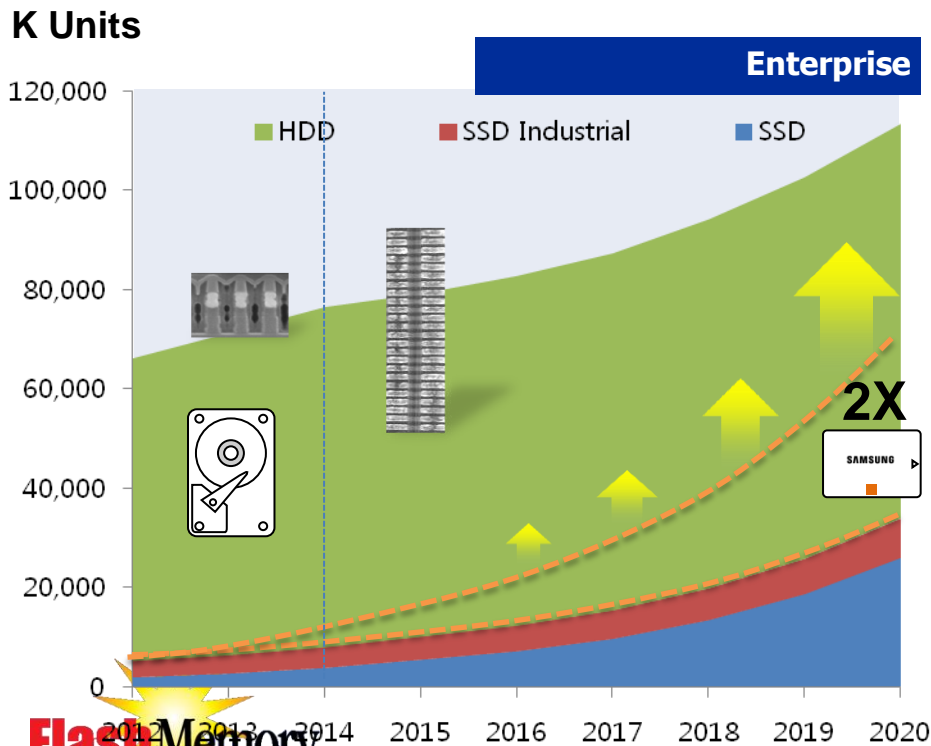
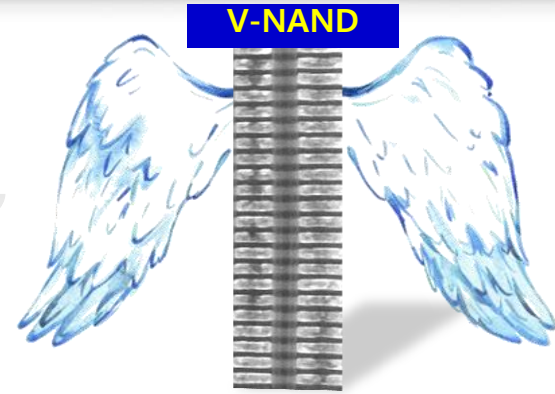
- Doubts about keeping up \$/Gb improvements
- Concerns about degrading NAND Flash parameters (Endurance, Performance, Retention..)



SSD Market Forecast with V-NAND Impact



“SSD for Everyone!”



The V-NAND Vision: 20/20 to 2020



**V-
N A N D:
F U T U R E
O F F L A S H
M E M O R Y
I S T O D A Y**



Drive

New Applications

Lead

Green IT Market

Create

Next-Generation Business



**Samsung's innovation doesn't stop here...
We will continue to push the best technology solutions**





DON'T BLAME YOURSELF.

It's time for the IT Industry to evolve.





Thank You

