Ushering in the 3D Memory Era with V-NAND

Aug. 2013

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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
And Continues to Change the World

Personal Devices
Rich Multi-Media
Apps Apps Apps!

Laptop Experience
Instant ON, Battery Life & Sleek Design

Server & Cloud
High Performance, Efficiency & Robustness → TCO!
2012: Mobile connected devices exceeded the world's population
Impact on Datacenter Infrastructure

More applications for data

Billions of Devices!

Data traffic: 78% CAGR

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

**NAND Bit Shipment Trend**

- CAGR: 60.3%

Source: Samsung & IHS, 2Q 2013

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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-1ynm 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?
Q1. Why so difficult?

1. Cell to Cell Interference
2. Patterning

Q2. 3D V-NAND Can Solve?
3 Disruptive Innovations

1 Material Innovation (2003)

- Control Gate
- Substrate-Si
- Si-Channel
- Insulator
- S
- D

2 Structure Innovation (2008)

- Control Gate
- 2D CTF
- 3D CTF
- 3D V-NAND

3 Integration Innovation (2008)

- Control Gate
- Insulator
- Si-Channel
- Substrate-Si
- S
- D

Flash Memory Summit
Samsung
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

2D Planar

Design Rule (nm)

Year

2003 2005 2007 2009 2011 2013 2015 2017

3D V-NAND / No Patterning Limitation

8 stack 24 stack

16Gb 128Gb 128Gb 1Tb
Paradigm Shift from Drive to Fly

3D V-NAND

Innovative Technology

Material

Structure

Integration
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
- Higher Performance
- Low Power Consumption

**Performance**
- 22% Faster
- 20% Faster

**Power**
- 27% Lower
- 45% Lower

*Note: Performance and power result is based on measured maximum improvement.*
Benefits of V-NAND Based SSD

- Smaller & Faster
- Lower Power
- Higher Capacities

You can have your cake and eat it too!
Benefits of V-NAND Based SSD
Benefits of V-NAND Based SSD

Greater V-NAND cell reliability $\rightarrow$ expanded NAND universe

- **CE**: lower cost continuum. **Enterprise**: endurance enabling rapid adoption rate
- Lightning fast internet of the future!
SSD market growth has always been constrained

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

[Samsung Projection based on 2013 2Q iSuppli market forecast ]
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..)

K Units

SSD Industrial

SSD

HDD

K Units

Enterprise

Client

HDD

Cache SSD

SSD

Hybrid HDD

HDD/Nontraditional CE

[Samsung Projection based on 2013 2Q iSuppli market forecast]
SSD Market Forecast with V-NAND Impact

“SSD for Everyone!”

K Units

Enterprise

K Units

Client

[Samsung Projection based on 2013 2Q iSuppli market forecast]
The V-NAND Vision: 20/20 to 2020

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