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SAMSUNG MEMORY



Investor Presentation

2017

Contents

BUSINESS UPDATE

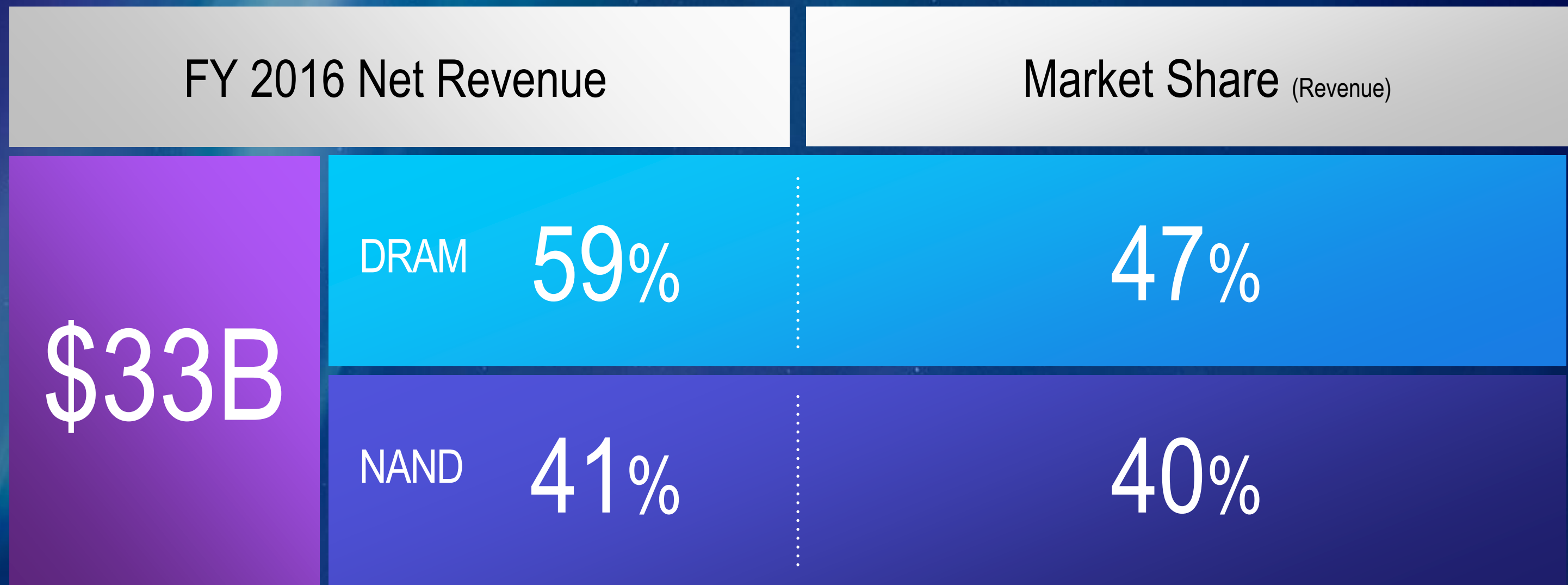
MEMORY MARKET OPPORTUNITIES

SAMSUNG STRATEGY

KEY TAKEAWAYS

SAMSUNG MEMORY OVERVIEW

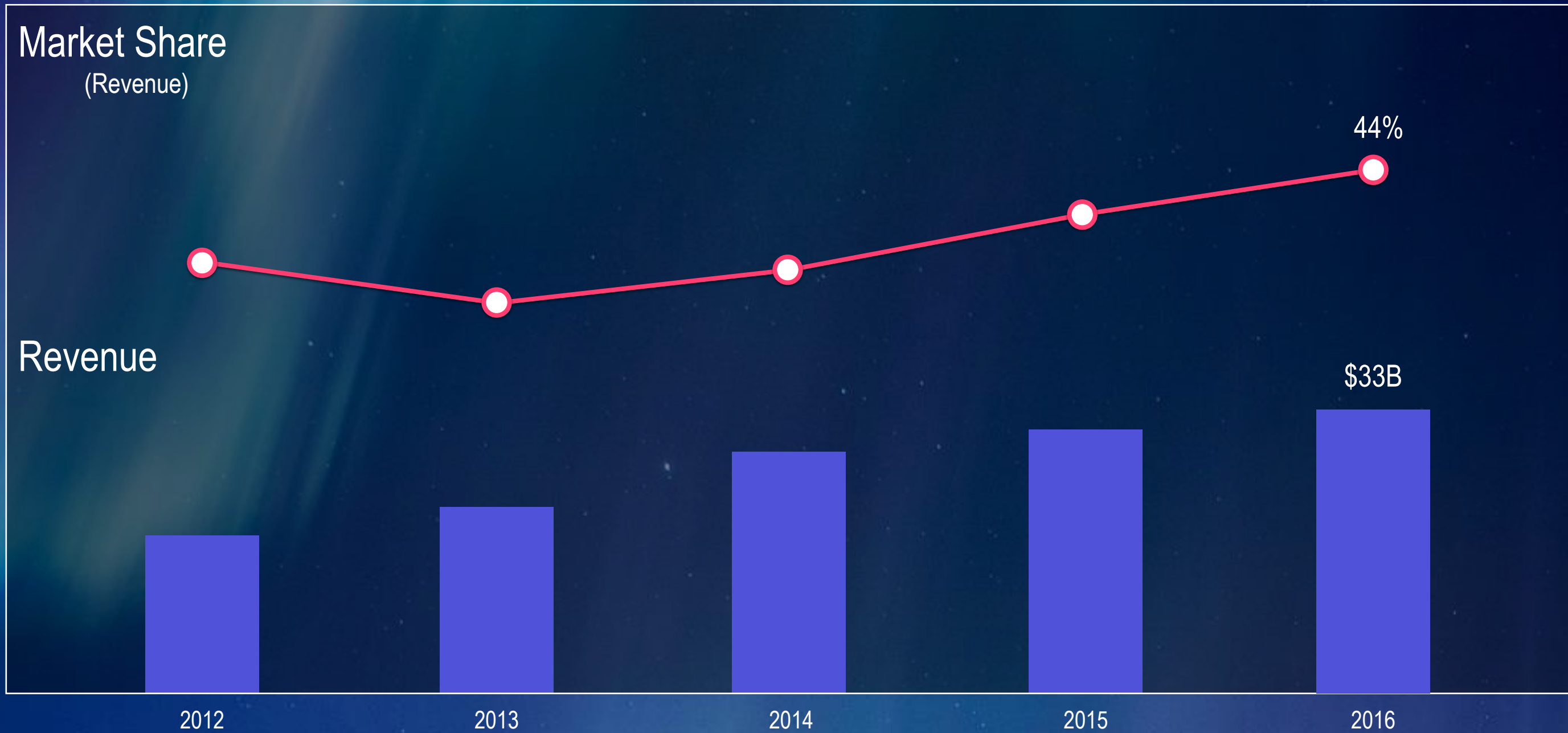
#1 in Memory Worldwide Since 1992



* FY2016 Market Share : Estimated

STRONG FINANCIAL PERFORMANCE

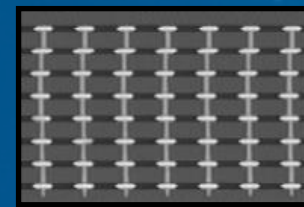
* FY2016 Market Share : Estimated



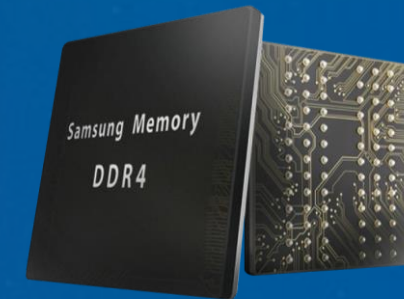
SAMSUNG'S TRACK RECORD OF INNOVATION

First to market memory products

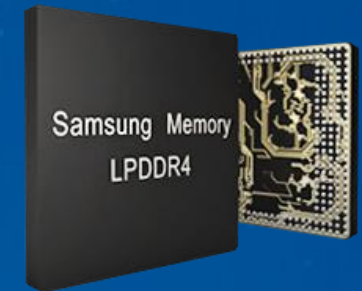
DRAM



8GB HBM2^{*}



1xnm 8Gb DDR4

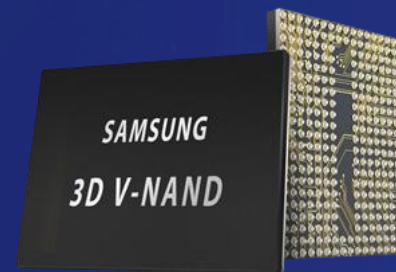


16Gb LPDDR4

^{*} HBM: High Bandwidth Memory

2015 ◀ ▶ 2016

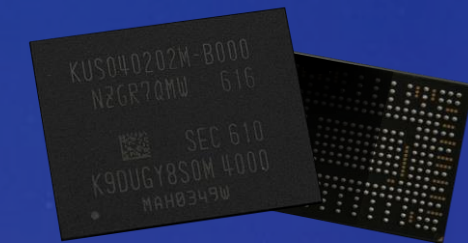
NAND



48Layer V-NAND



16TB SAS SSD for Server



512GB smallest BGA^{*} SSD

^{*} BGA: Ball Grid Array

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BUSINESS UPDATE

MEMORY MARKET OPPORTUNITIES

SAMSUNG STRATEGY

KEY TAKEAWAYS

CONNECTIVITY IS DRIVING GROWTH IN BIG DATA



Each Minute...

150,000,000



2,800,000



500,000



300,000



Number of Connected Devices

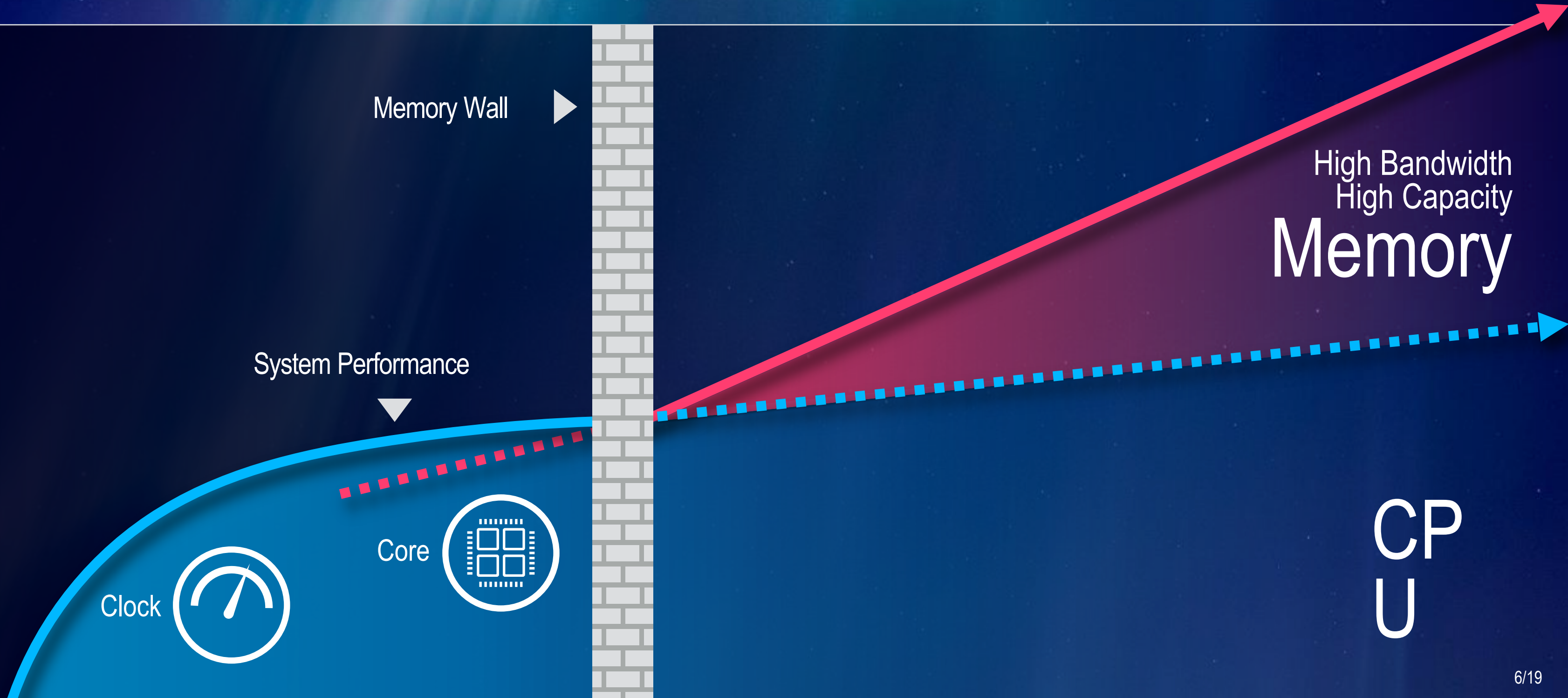
15B
in 2016



50B
in 2020

MEMORY IS AT THE CORE OF BIG DATA

Improvements to system performance will be driven by memory



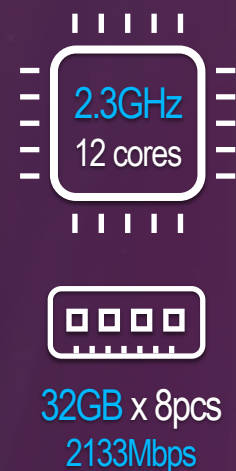
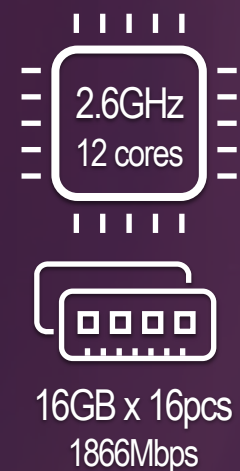
BENEFITS OF HIGH PERFORMANCE DRAM

Cost comparison for 10,000 Datacenter Servers*

Higher Freq. CPU
Lower Freq. DRAM

Higher Freq. DRAM
Lower Freq. CPU

H/W
Config.



13% ▼

Build-up
Cost

System
Power



19% ▼

Energy

\$92M

TCO 14%*

\$79M

H/W
Cost

Operating
Cost

2.6GHz

2.3GHz

* Datacenter: built on 20U Rack
* H/W Configuration at same system performance
* TCO: Total Cost of Ownership for four years

BENEFITS OF SSD ADOPTION

HDD and SSD comparison for 100PB Datacenter *

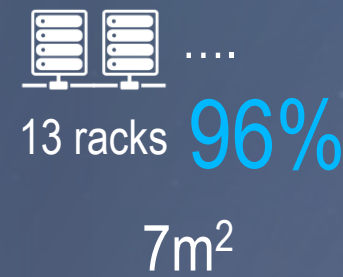
15Krpm 600GB HDD
x 166K



16TB SSD
x 6K

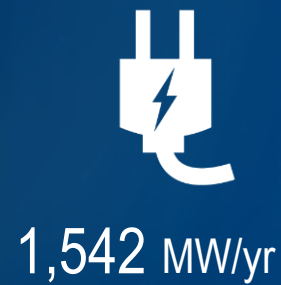


Footprint



Enclosures

Power



Energy

AFR^{*}



Maintenance

\$63M



HDD

TCO 40%

\$41M



SSD

Operating Cost

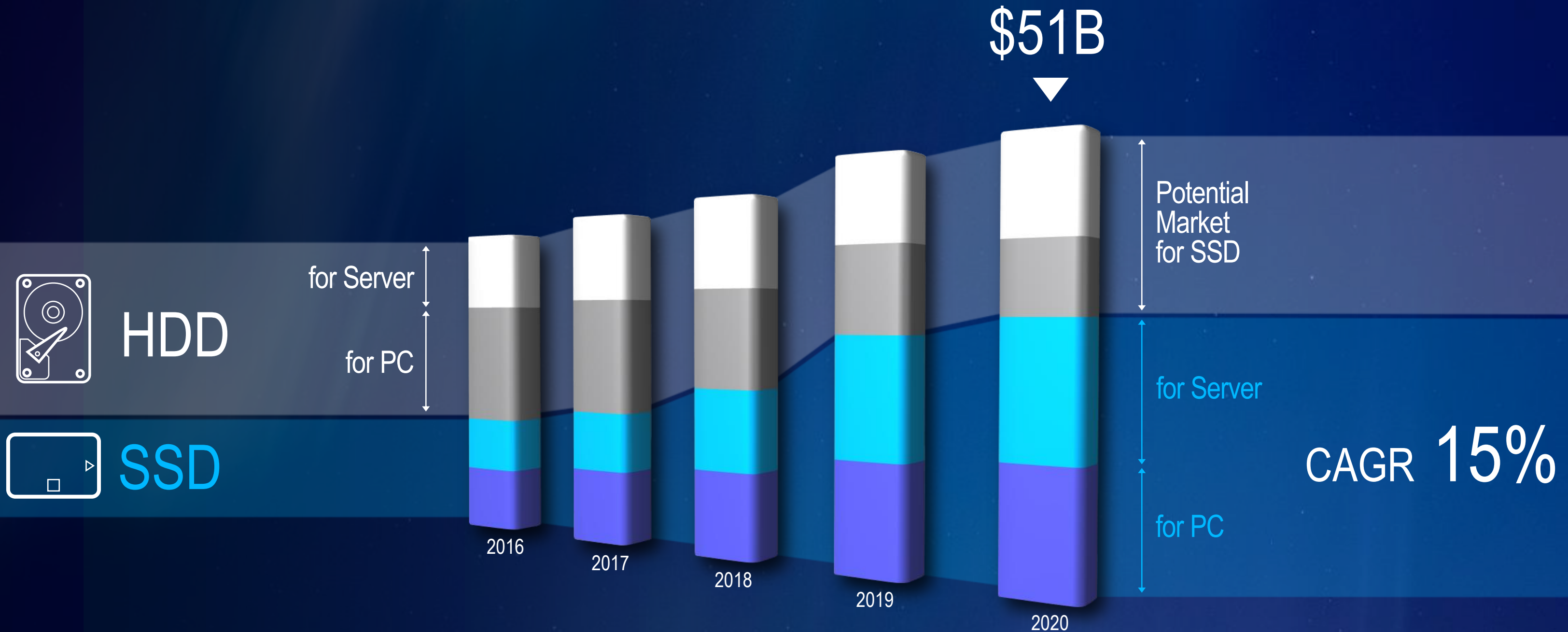
H/W Cost

* Datacenter: built on 40U Rack
* TCO: Total Cost of Ownership for four years
* AFR: Annual Failure Rate

* Enclosure: Server cost excluding storage

SSD REPLACEMENT OF HDD

Increasing adoption driven by lower TCO & higher capacity*



HDD



SSD

for Server

for PC

Potential Market for SSD

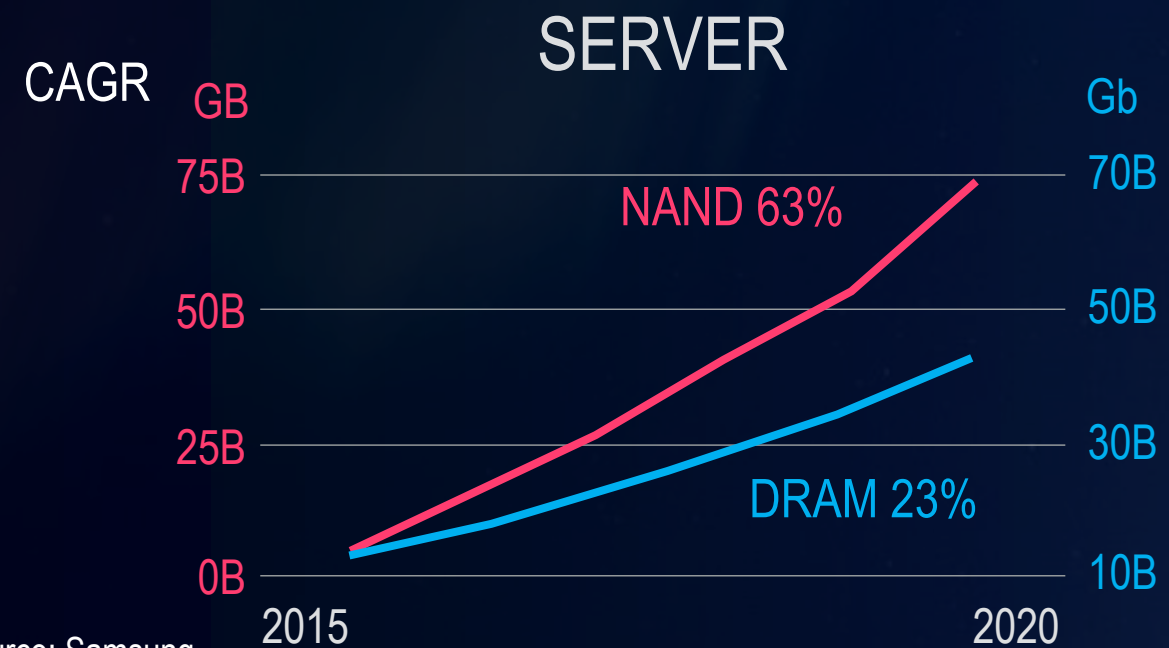
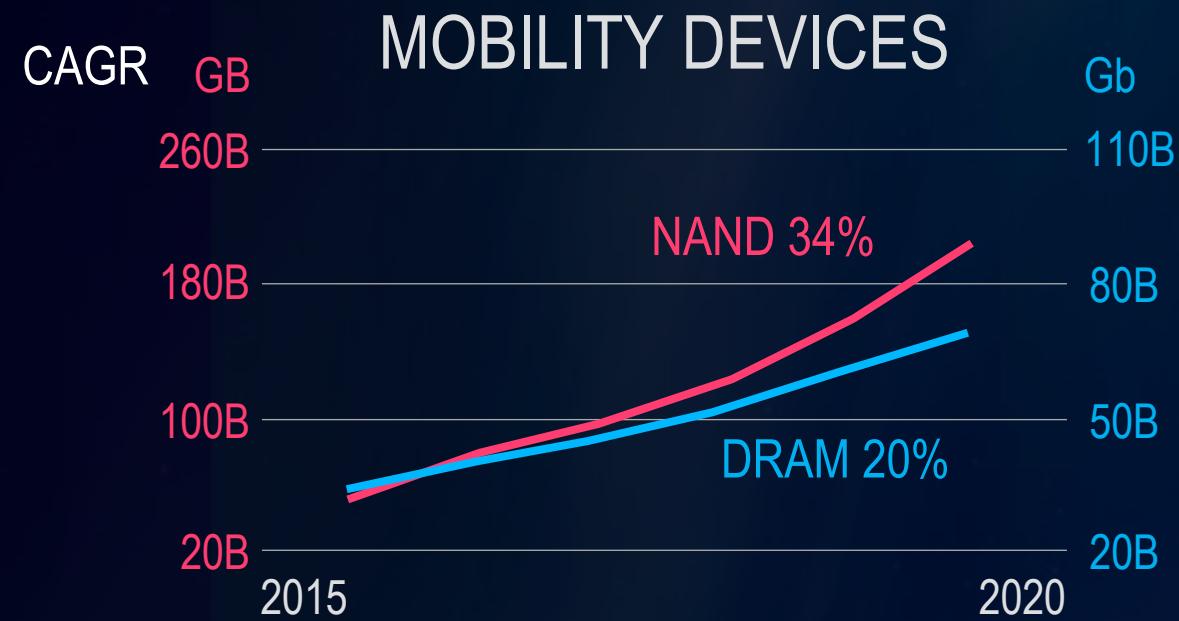
for Server

for PC

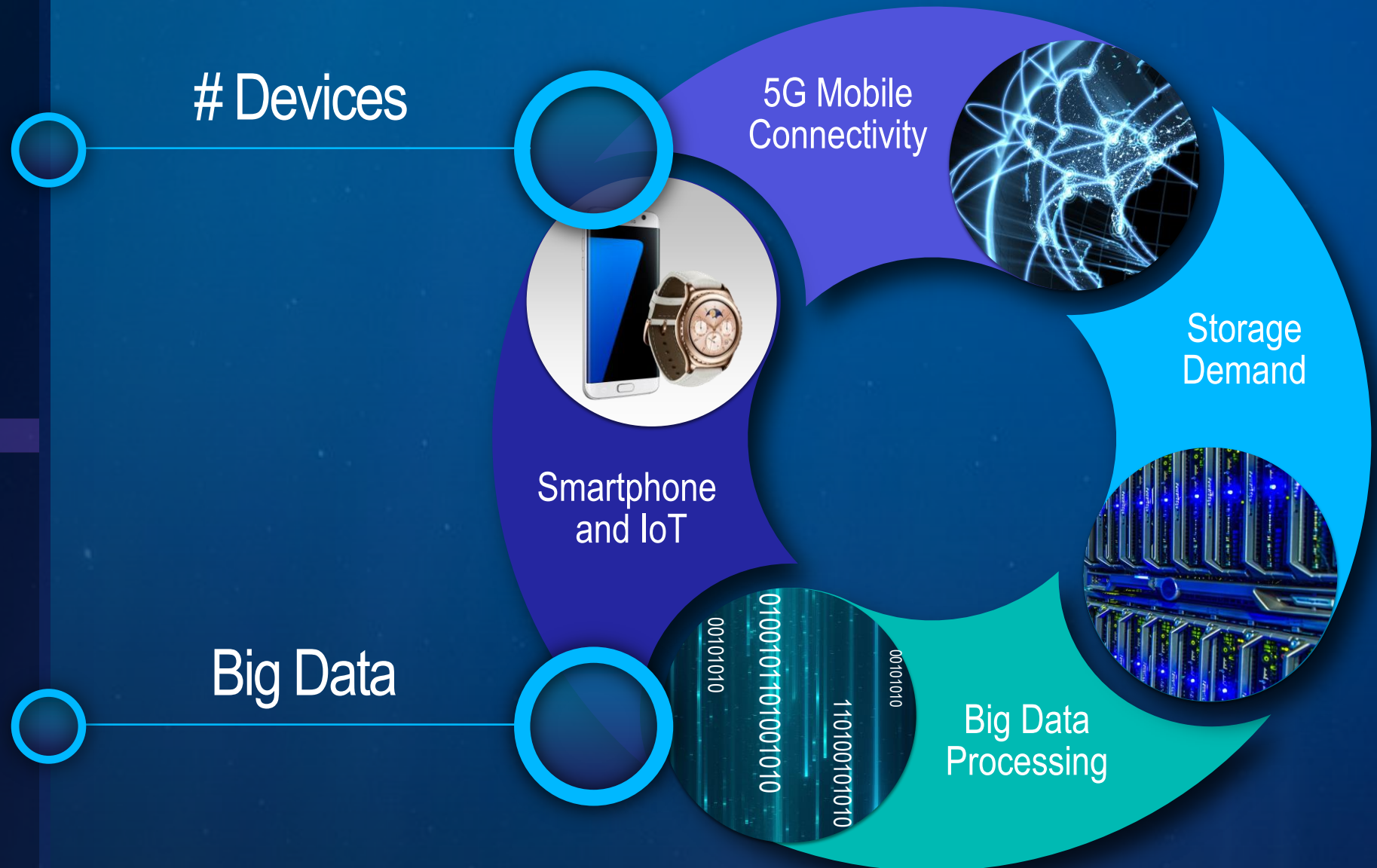
CAGR 15%

* TCO: Total Cost of Ownership

MEMORY-CENTRIC COMPUTING EVOLUTION



Source: Samsung



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BUSINESS UPDATE

MEMORY MARKET OPPORTUNITIES

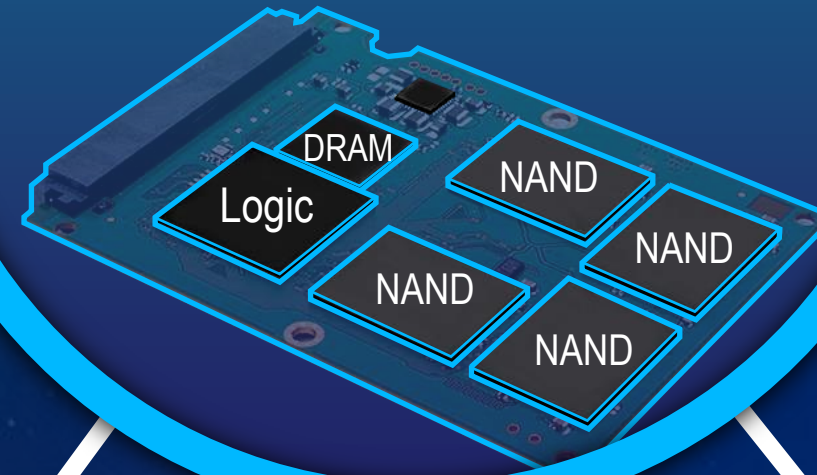
SAMSUNG STRATEGY

KEY TAKEAWAYS

SAMSUNG'S STRATEGY

Solutions

Total Solutions/Portfolio



Diversify
Product Portfolio

Fulfill
Customer Needs

Technology

Advanced Technology Scaling



Strengthen
Cost Leadership

Operations

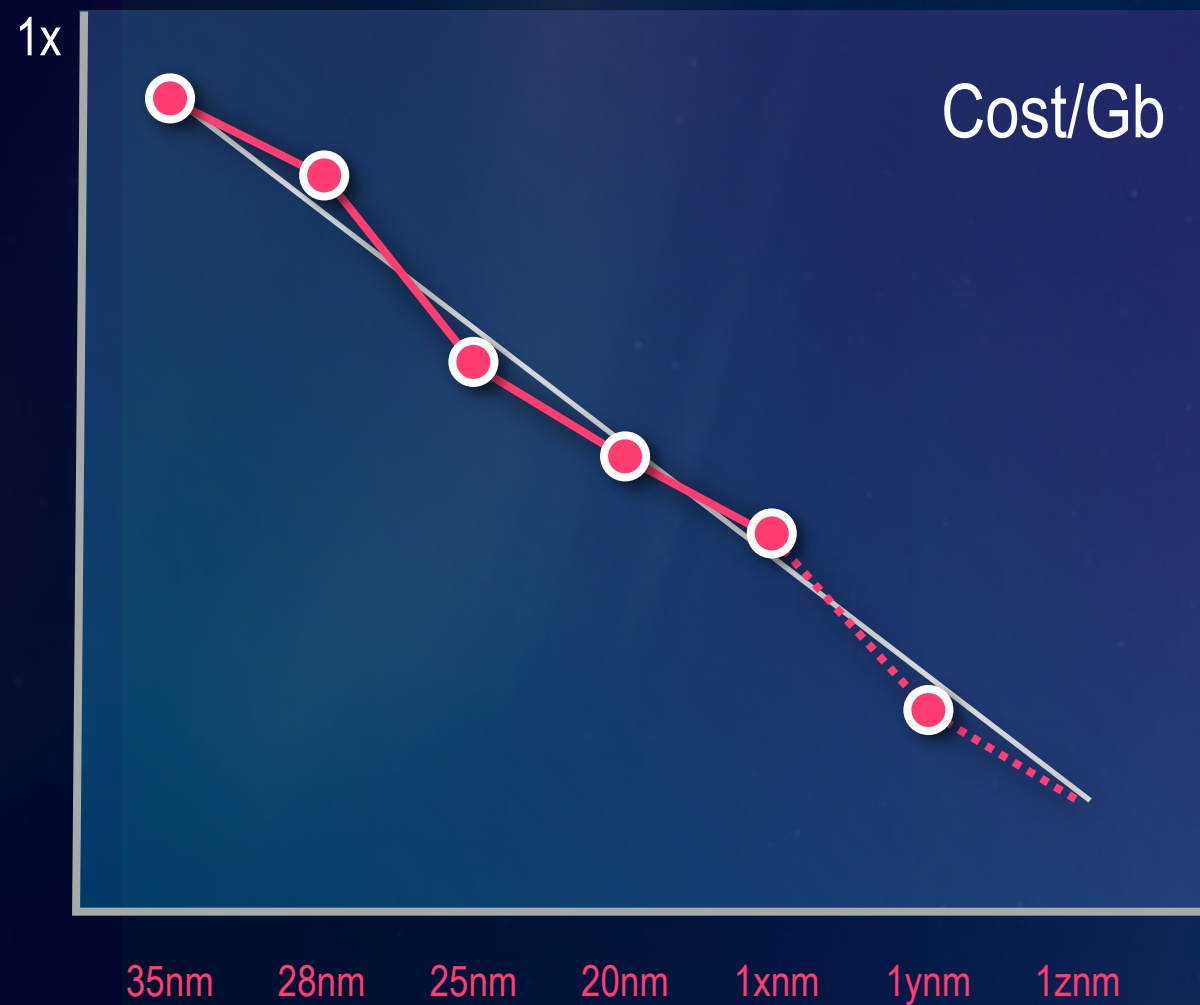
Operational Excellence



CONTINUOUS TECHNOLOGY SCALING

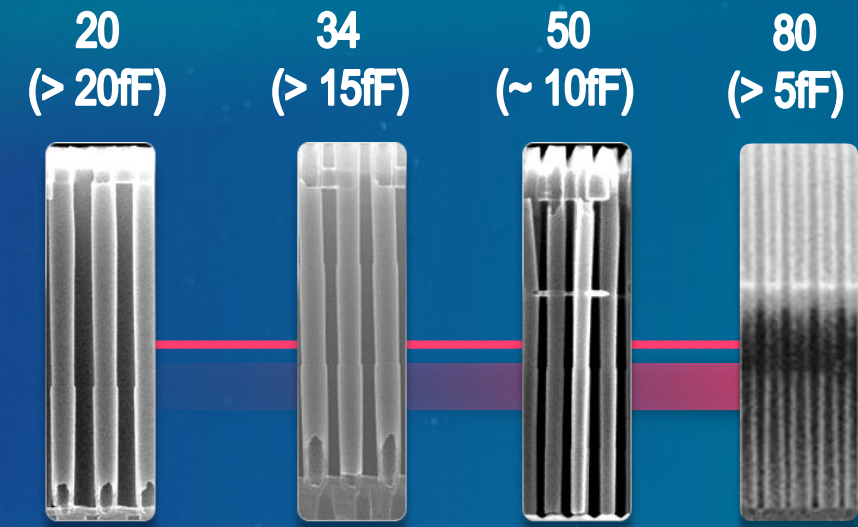
Pushing limits without EUV*

DRAM



Higher

Aspect Ratio
(Capacitor)



Process node (nm)

60
1z

40

20

1x

1y

Lower

Leakage Current
Innovation

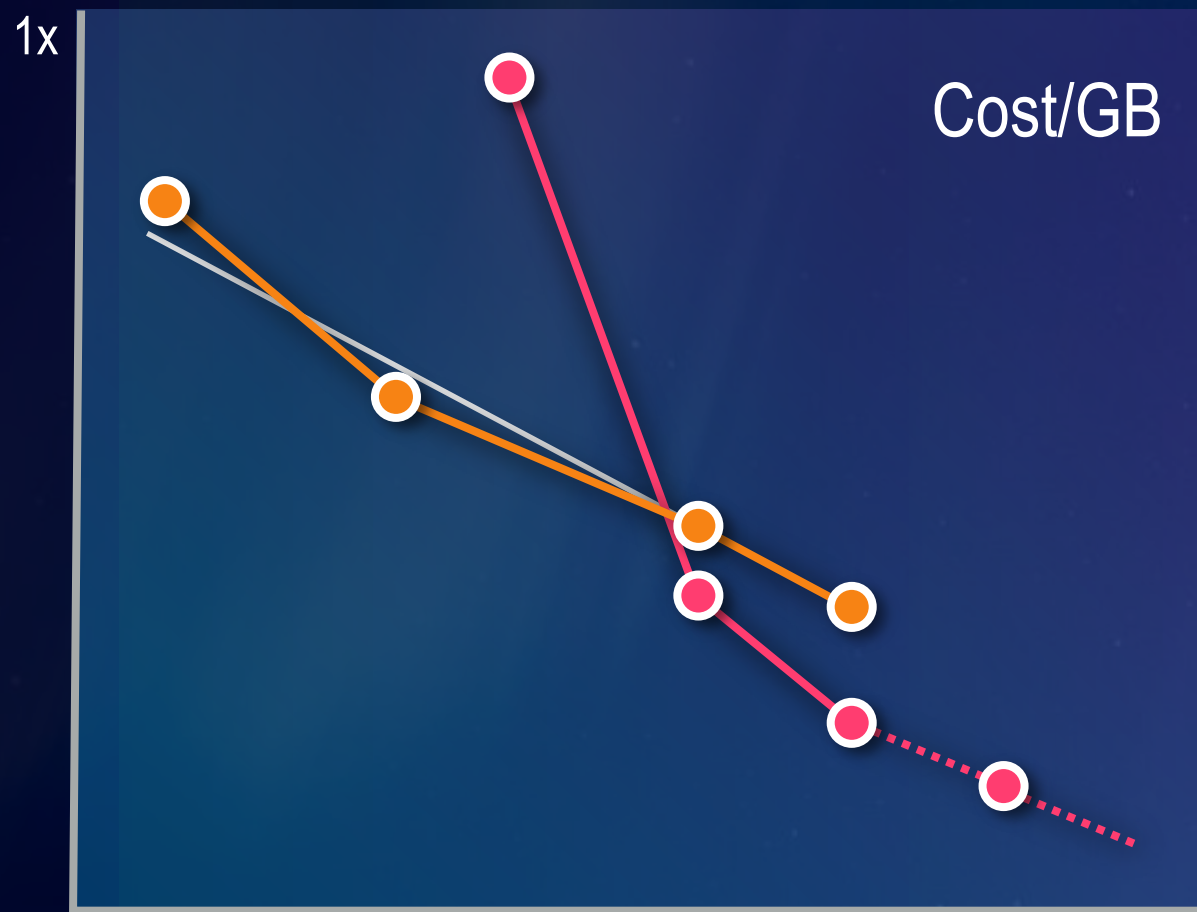


TECHNOLOGY BREAKTHROUGH WITH V-NAND

Paradigm shift in NAND scaling

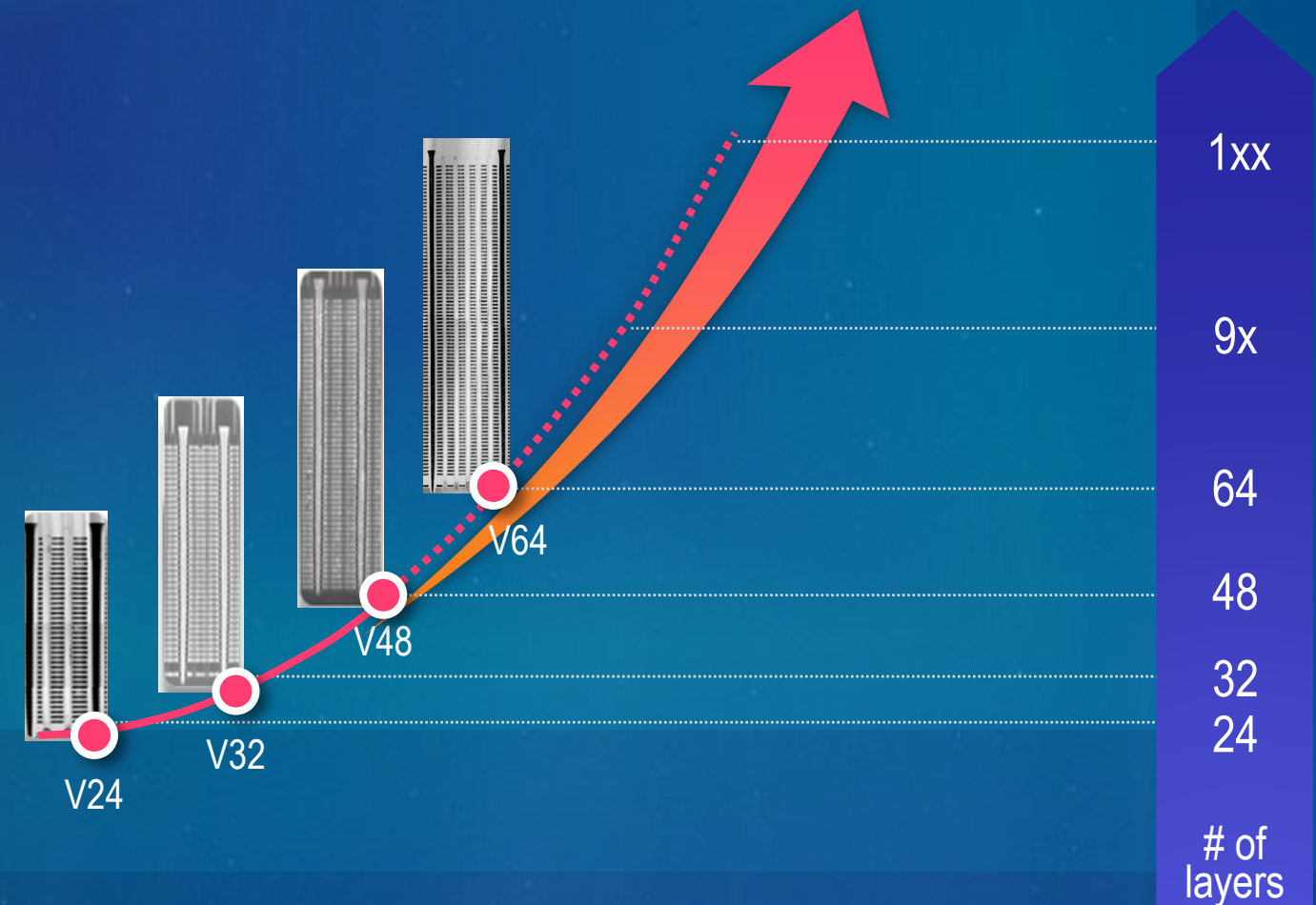


NAND

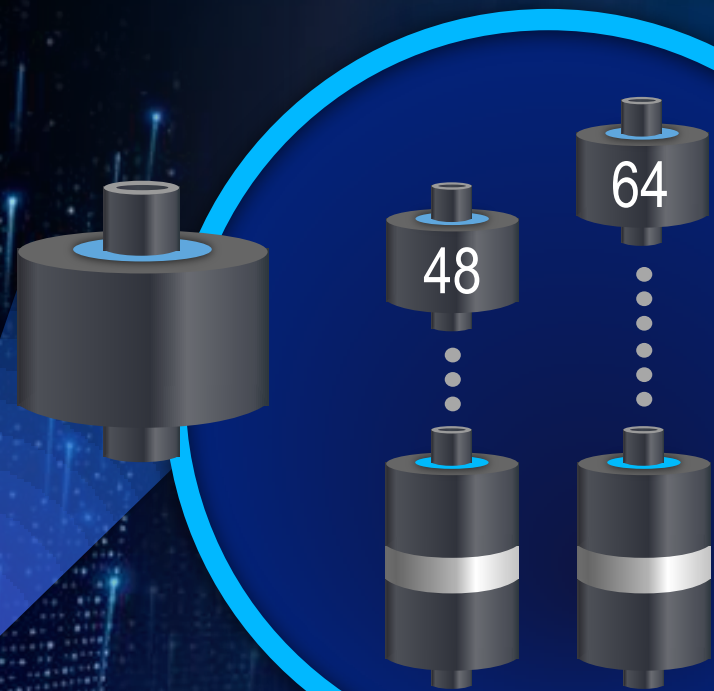


Planar 21nm 19nm 16nm 14nm
 V-NAND V24 V32 V48 V64 V9x

Roadmap beyond 100 layers



ADVANTAGES OF V-NAND OVER PLANAR NAND



Capacity **4x**

Speed **2x**

Endurance **10x**

Power Efficiency **2x**

Wafer Cost / Investment



UNIQUE CAPABILITIES FOR MEMORY SOLUTIONS

Integrating key components to deliver value-added solutions

INTEGRATED SOLUTION



SOFTWARE / LOGIC (CONTROLLER)

ADVANCED PACKAGING TECHNOLOGY



STACKING / TSV*

* TSV: Through Silicon Via

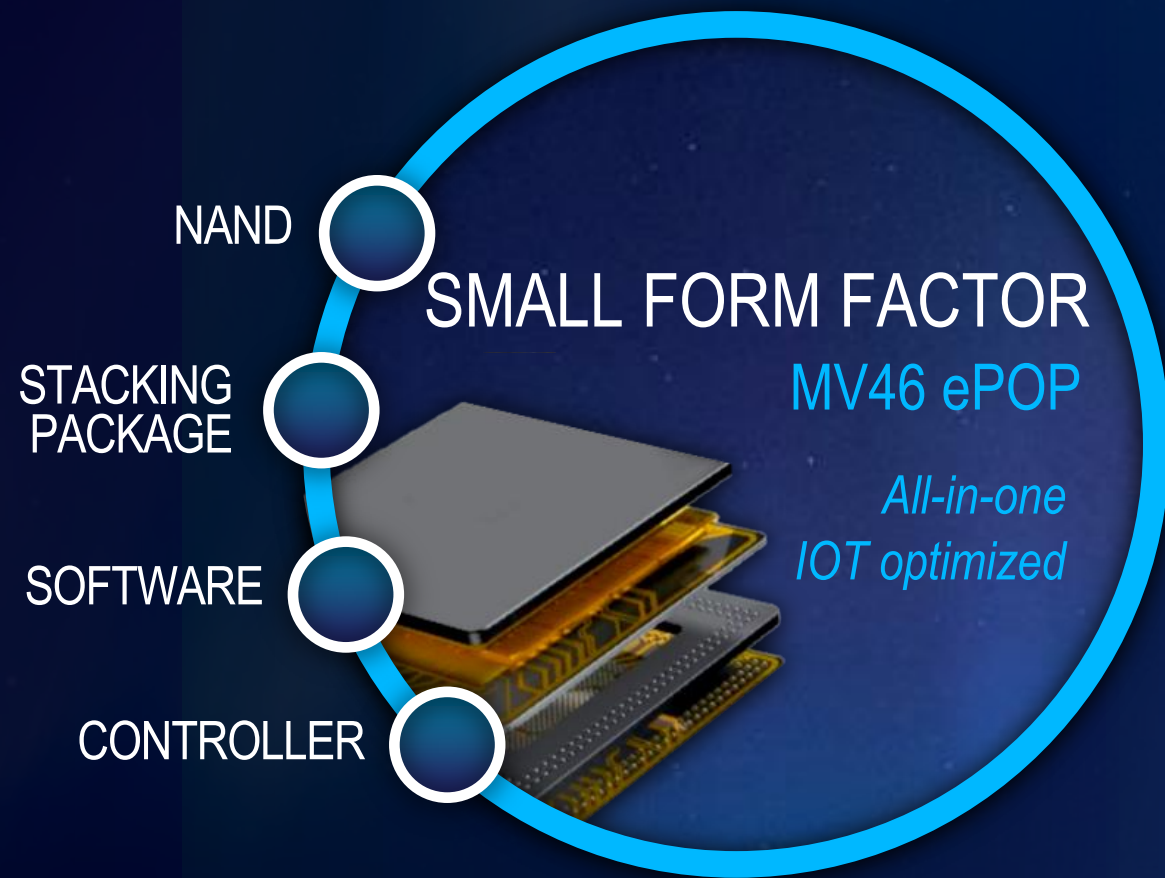
ADVANCED PROCESS TECHNOLOGY



COMPONENT

FUTURE DRAM SOLUTIONS

Prioritizing for Premium and Full Customization



HIGH TEMPERATURE TOLERANCE

EMI TOLERANCE*

BUFFER LOGIC CHIP

PERFORMANCE PACKAGE

LOW-COST SUBSTRATE

* EMI: Electro Magnetic Interference

* HBM: High Bandwidth Memory

FUTURE NAND SOLUTIONS

2-Track Strategy of HDD replacement and Value creation

TRACK 1

HDD REPLACEMENT



TRACK 2

VALUE CREATION



* BGA: Ball Grid Array

The next creation starts here

“Placing memory at the forefront of future innovation and creative IT life”



Technology
Leading technological breakthroughs



Customers
Supporting customers' future innovation



Employees
Fostering employees' creativity



Society
Enriching a new way of digital life

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BUSINESS UPDATE

MEMORY MARKET OPPORTUNITIES

SAMSUNG STRATEGY

KEY TAKEAWAYS

KEY TAKEAWAYS

- ✓ Strengthen leadership in market share and profitability with advanced technology
- ✓ Take advantage of new opportunities from memory-centric computing
- ✓ Lead the market by maximizing synergy with components, package and solution products
- ✓ Continue to deliver customer satisfaction and pursue sustainable growth