Flash Memory Summit

OPEN Session 303G: Market Research

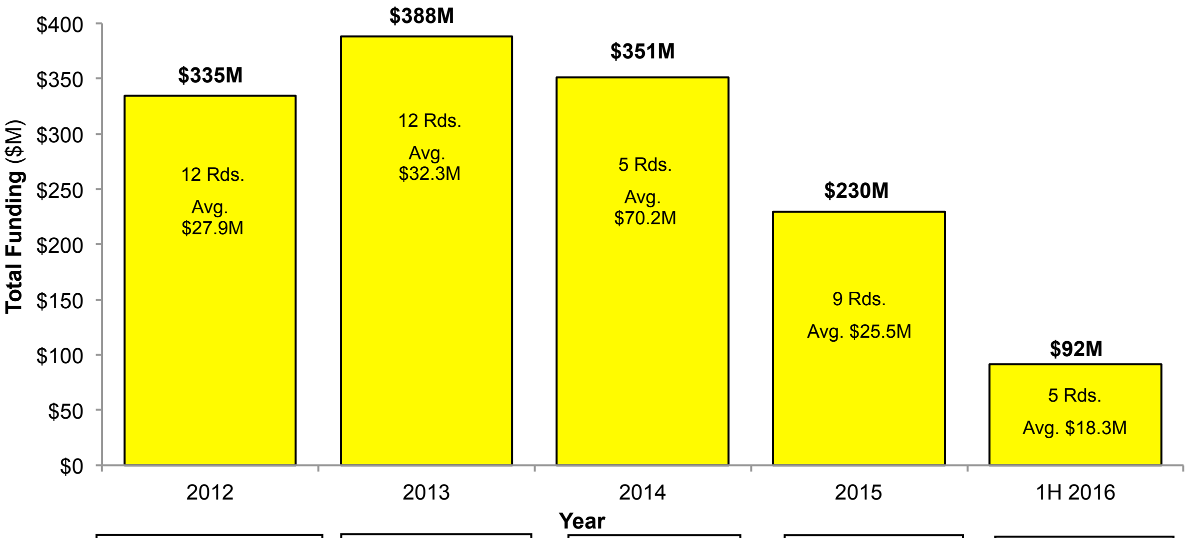
Flash Memory Venture Funding
&
M&A Insights

August 11, 2016

John Rotchford, Managing Director, SASI, LLC

Flash Memory Venture Funding

We are seeing a shift from larger, later stage rounds to smaller, earlier stage rounds.
This is the second wave of innovation and will ramp into 2017 and 2018….

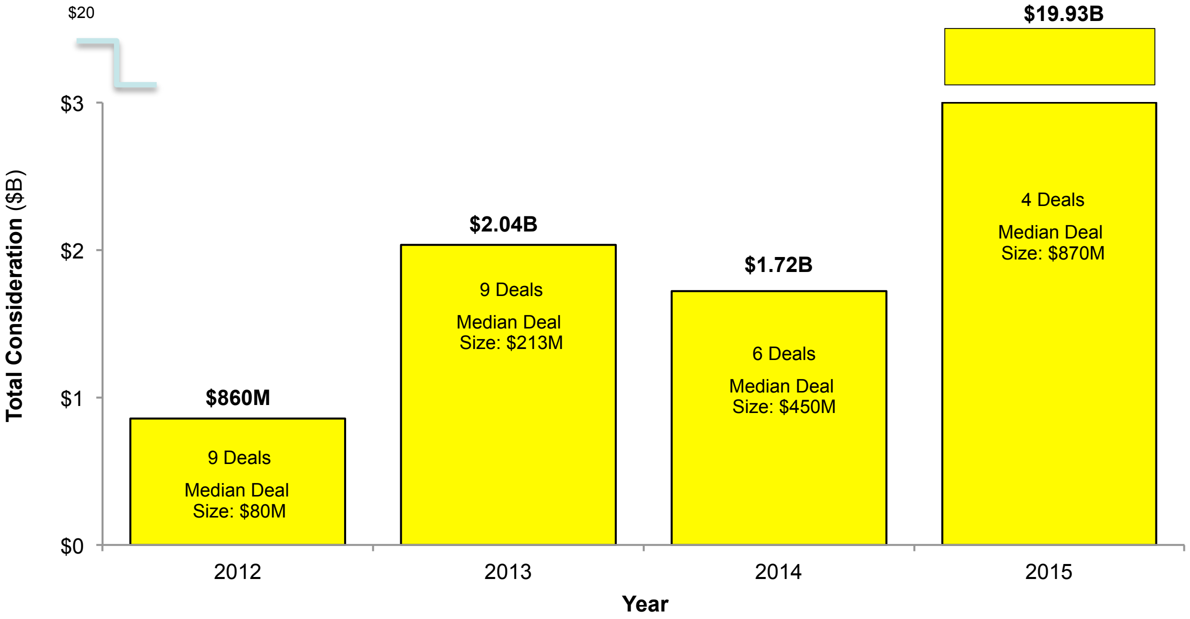


Top Five Rounds

2012	2013	2014	2015	1H 2016
Violin Memory, $50M 6th Nimble Storage, $40.7M 5th Pure Storage, $40M 4th STT, $36M 1st Avalanche Technology, $30M 3rd	Pure Storage, $150M 5th Skyera, $52M 2nd Crocus Technology, $45M Later Tegile, $35M 3rd SolidFire, $31M 4th	Tintri, $75M 5th Pure Storage, $225M 6th PernixData, $35M 3rd Reduxio, $15M 2nd NVMDurance, $1M 1st	Tegile, $70M 4th Crossbar, $35M 4th Nantero, $31.5M 5th Everspin Tech., $29M 2nd Crocus, $21M 5th	Elastifile, $35M 2nd Avalanche Tech, 23M 6th Diablo Tech, $19M 3rd E8 Storage, $12M 2nd NVM Durance, $2.5M 1st

Flash Memory M&A Transactions

2016 is off to a slow start with one trade but we see M&A picking up in 2nd half of 2016, into 2017….



Top Deals

2012	2013	2014	2015
EMC/XtremIO, $430M IBM/Texas Memory Systems $250M NetApp/CacheIQ, $90M SanDisk/FlashSoft, $70M	WD/Virident Systems, $645M Cisco/WhipTail, $415M WD/STEC, $340M SanDisk/SMART Storage Systems, $307M Fusion-io/NextGen, $119M	SanDisk/Fusion-io, $1.1B Seagate/LSI, $450M EMC/DSSD, $150M	WD/SanDisk, $19.0B NetApp/SolidFire, $870M Silicon Motion/Shannon Sys, $57.5M Micron/Tidal Systems, ND

Flash Market Consolidation

We expect market leaders to fuel further consolidation in 2017…

Buyer	Software	Systems	Sub-Systems	Hybrid	SSDs/ Controllers
Cisco	Whiptail (2013)				
EMC	DSSD (2014)	XtremIO (2012)			
IBM		Texas Memory (2012)			
Intel	Nevex (2012)				
NetApp		SolidFire (2015) CacheIO (2012)			
Toshiba		OCZ (2013)			OCZ (2013)
Samsung	Proximal Data (2014) NVELO (2012)				
Seagate			LSI (2014)		LSI/ (2014)
Violin Memory		GridIron (2013)			
Western Digital	SanDisk (2015) Velobit (2013)	Skyera (2014)	SanDisk (2015) Virident (2013)	SanDisk (2015)	SanDisk (2015) STEC (2013)
Micron					Tidal Systems (2015)

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Flash Memory Venture Market Map

Our market map has expanded across all segments…..

Systems

- kaminario.
- PURESTORAGE
- NIMBUS DATA
- LIQID (PCIe)
- E8 storage Rack-Scale Flash. No Compromise. (NVMe)
- Mangstor (NVMe)

Memory/Controllers

- adesto TECHNOLOGIES (CBRAM)
- CNEXLABS (NVMe
- avalanche technology Spin Programmable Storage Solutions (NMV)
- EVERSPIN TECHNOLOGIES (MRAM)
- CROCUS Technology Blossoming future (MRAM)
- Crossbar (RRAM)
- NxGnData
- Spin Transfer Technologies An Allied Minds Company (MRAM)
- NANTERO (NRAM)

Software

- primaryio
- nvm durance
- NUTANIX/ pernixdata
- Radian MEMORY SYSTEMS
- Elastifile

Sub-Systems

- diablo technologies
- Xitore

Hybrid

- tegile
- nimblestorage
- Tintri
- reduxio

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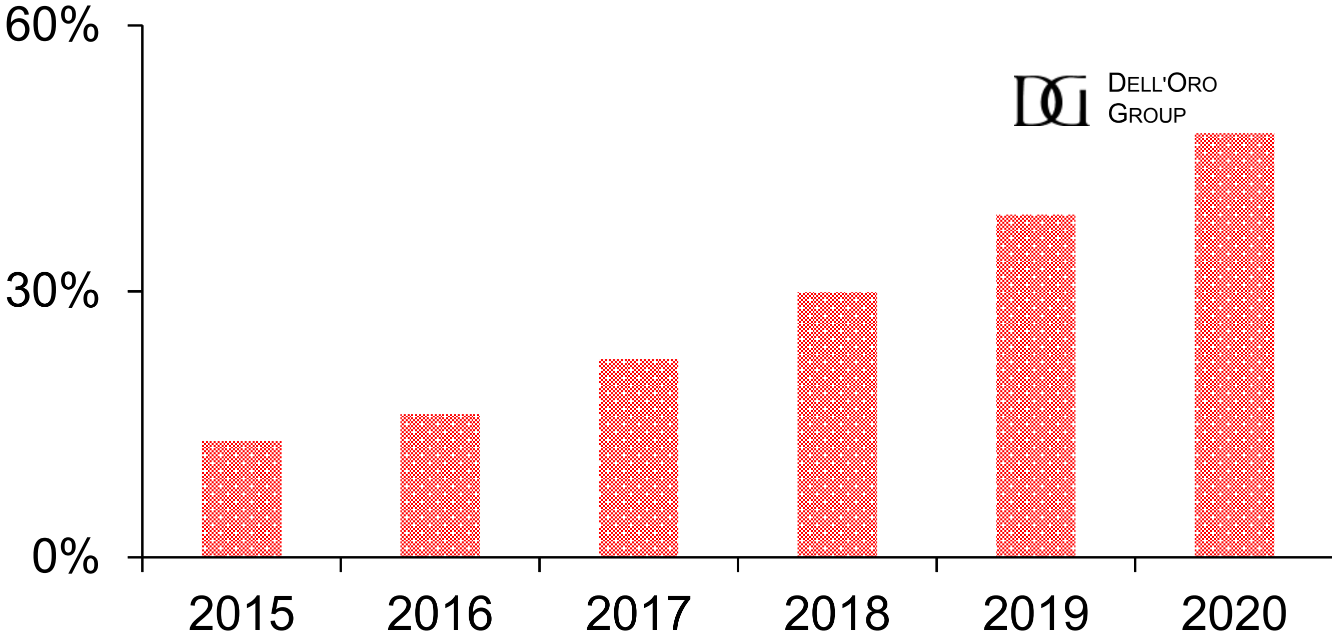
Chris DePuy, Dell'Oro Group

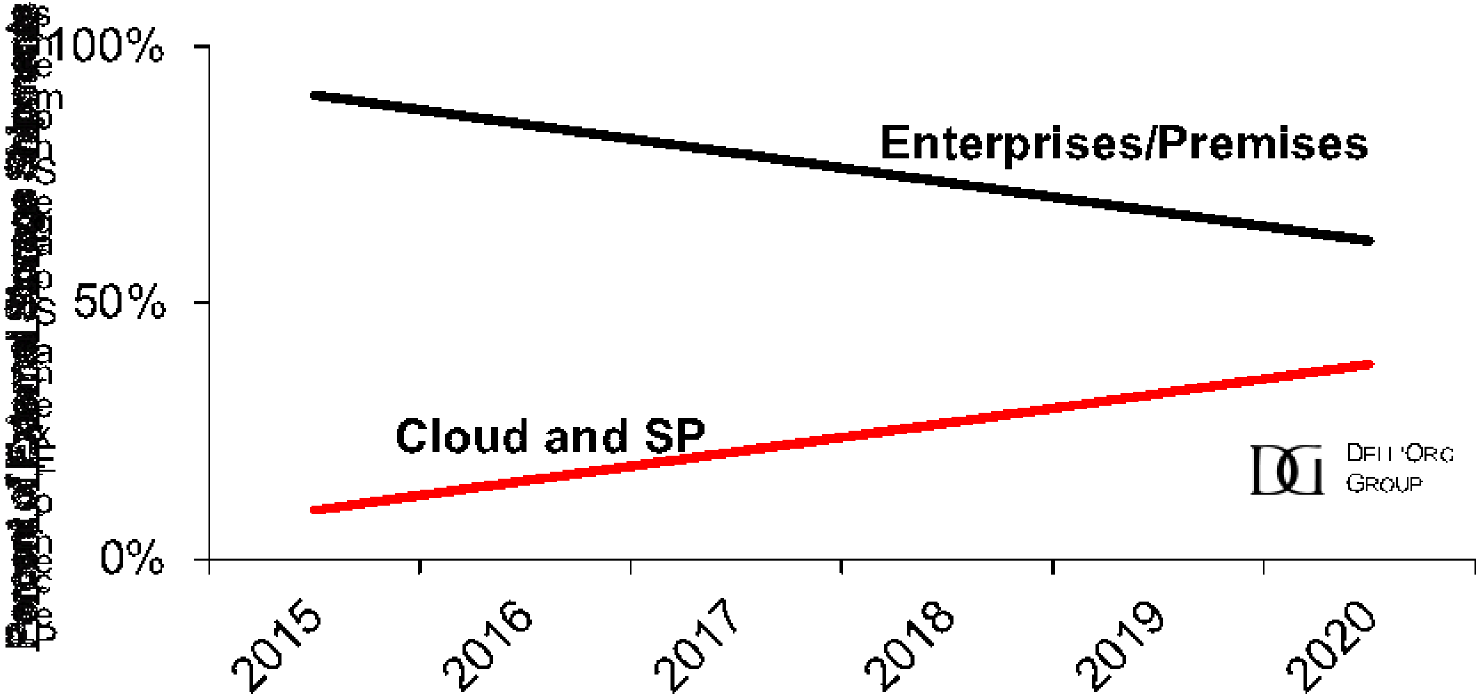
Agenda

- Forecast of flash growth in storage infrastructure market
- The role storage will play in transition from on-premise data centers to clouds
- Discussion about external storage system architectures
- Acquisition candidates in converged trend

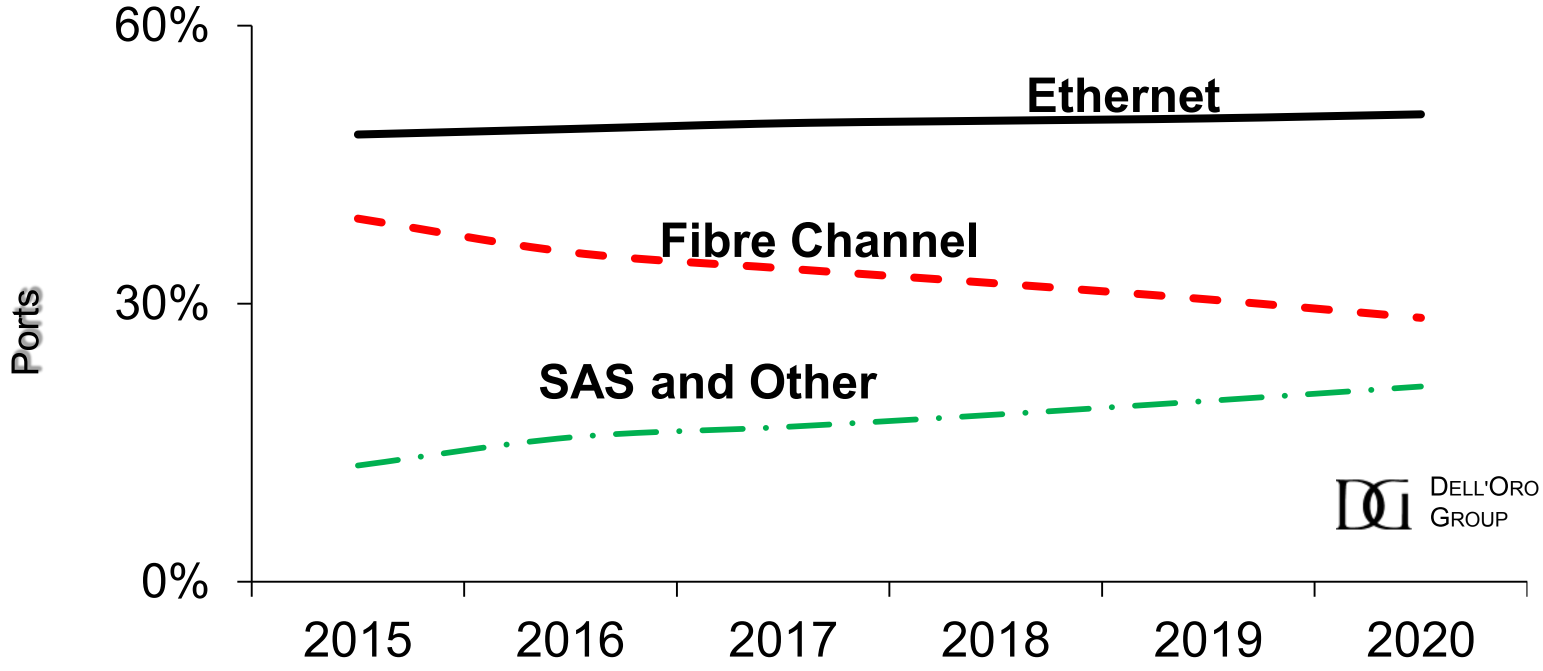
Flash as % of Total Capacity in External Storage Systems



External Systems – Cloud vs Enterprise



Ports on External Storage Systems and Their Connected Servers



Share – Converged Components

DELL'ORO GROUP

Branded Vendor	Storage	Servers	DC Switch
EMC	●		
HPE	◕	●	◑
DELL	◑	◕	◔
NetApp	◑		
IBM	◑	◕	
Huawei	◑	◑	◔
Hitachi	◑		
Lenovo	◔	◑	
Cisco		◑	●
Oracle	◔	◔	
Arista & Juniper			◑
Others		◔	◔

**2015 data; Data Center (DC) Switch from Ethernet Switch Deployment Location Report, Mar. 2016; Servers from 4Q15 Server Report*

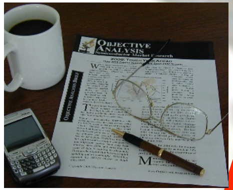
Big Changes For 2016 & Beyond

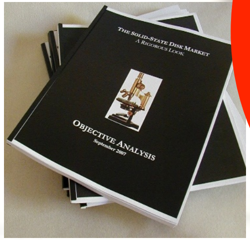
Jim Handy

OBJECTIVE ANALYSIS

OBJECTIVE ANALYSIS

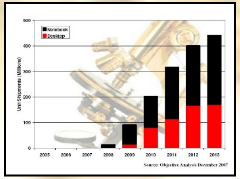
Profound Analysts

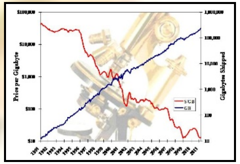


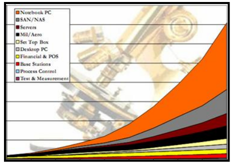


Reports & Services

Custom Consulting







Objective Analysis

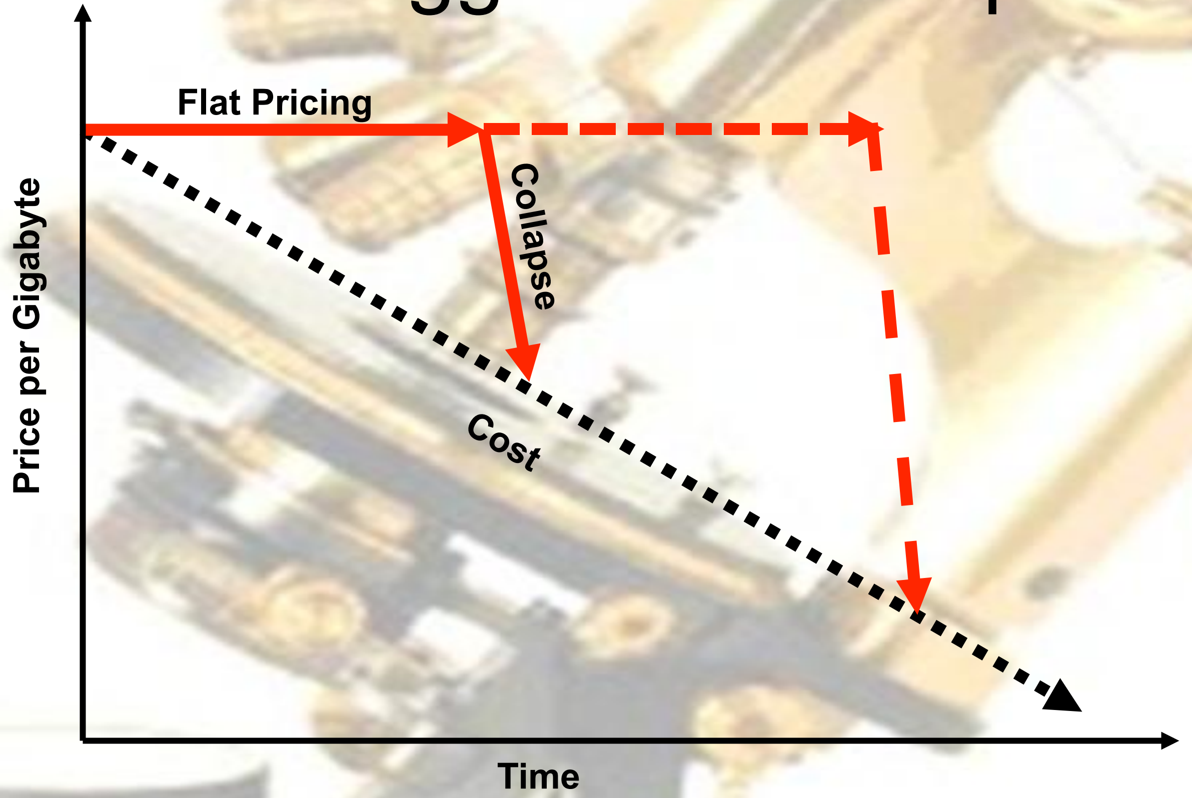
Semiconductor Forecast Accuracy

Year	Forecast	Actual
2008	Zero growth at best.	-3%
2009	Growth in the mid teens	-9%
2010	Should approach 30%	32%
2011	Muted revenue growth: 5%	0%
2012	Revenues drop as much as -5%	-2.7%
2013	Revenues increase nearly 10%	4.9%
2014	Revenues up 20%+	9.9%
2015	Revenues up ~10%	-0.2%
2016	Revenues up ~10%	TBD

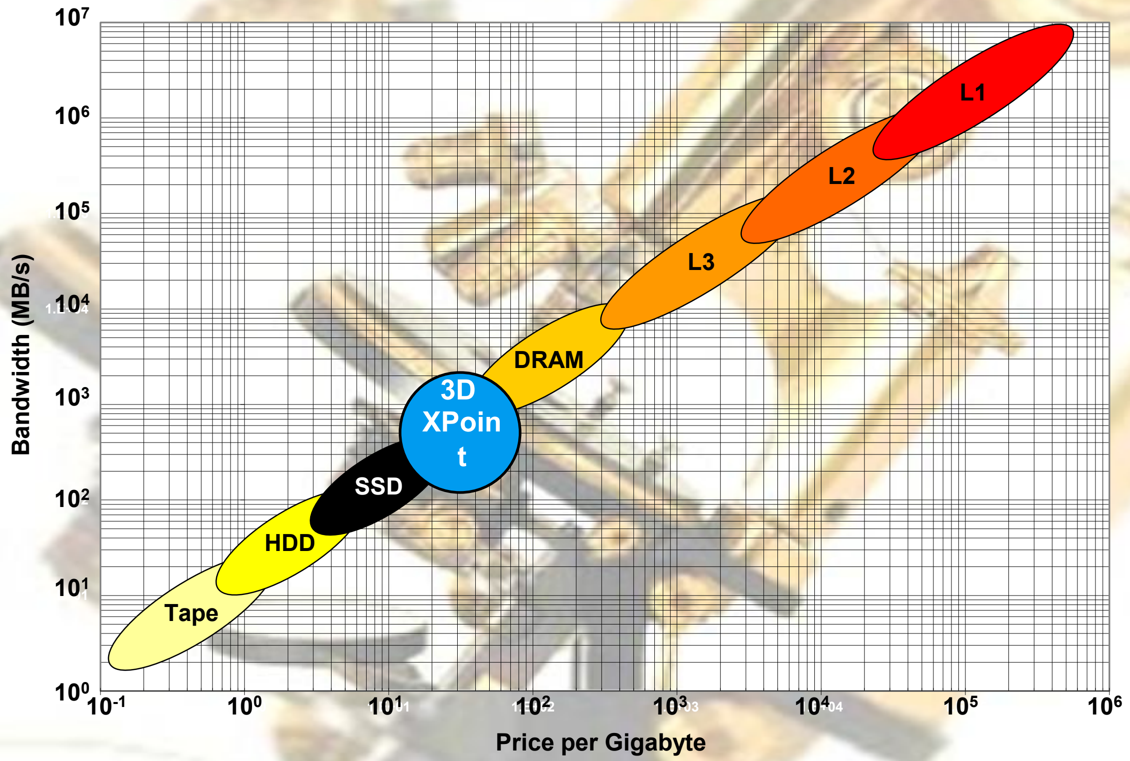
Outlook

- 3D NAND stall through 2017
  - – Breakthrough will occur in 2018
    - Big collapse after that
- 3D XPoint won't hurt NAND sales
  - – DRAM is threatened
- China will begin <u>huge</u> CapEx spend
- SSD unit growth steady
  - – But revenues will cycle

The Longer The Shortage, The Bigger The Collapse!



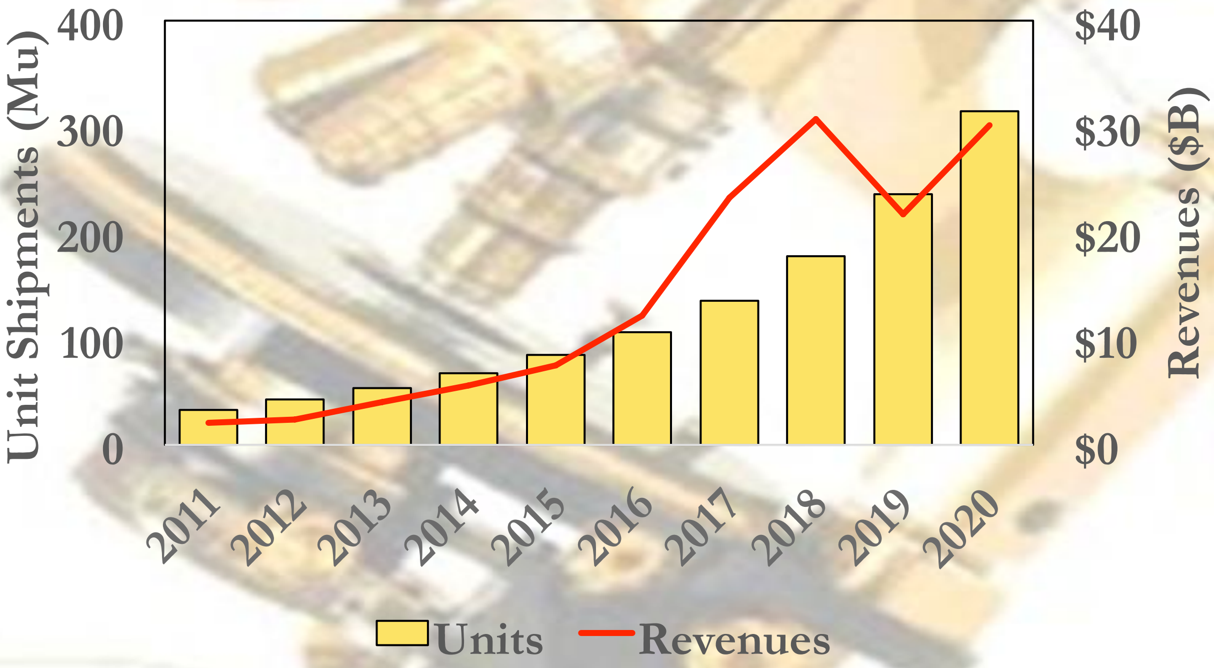
3D XPoint Helps Reduce DRAM Needs



Source: ***A Close Look at the Intel/Micron 3D XPoint Memory***, Objective Analysis 2015

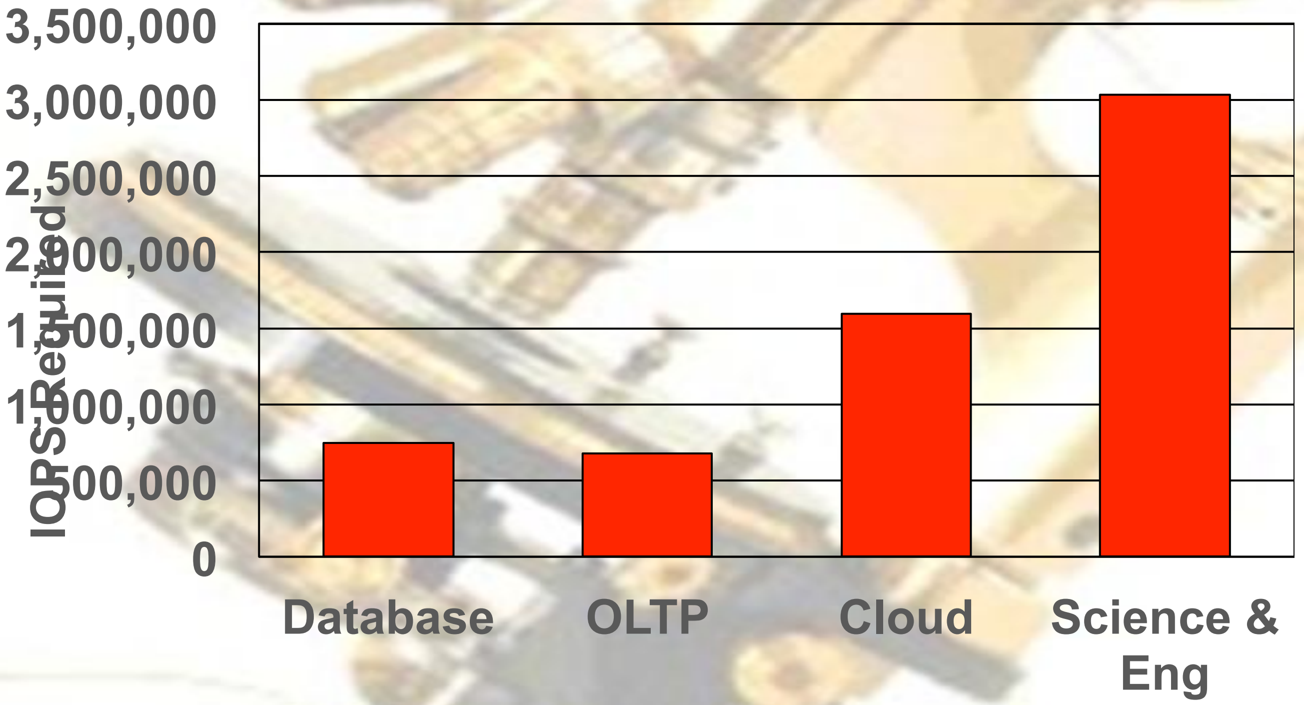
China Spending About to Begin

Steady SSD Unit Growth, But A Revenue Rollercoaster



Source: Objective Analysis SSD Market Update 2015

Average IOPS by Application



From: *How Many IOPS Do You Really Need?* Objective Analysis & Coughlin Assoc.

Summary

- 3D NAND Stall will break through to an oversupply
- 3D XPoint is a threat to DRAM
- Major China CapEx coming
- SSD units grow, but revenues gyrate

Thank You!

Jim Handy

OBJECTIVE ANALYSIS

Beyond Traditional NAND Flash Marketing Research

Brian Dargel

The views expressed here are solely those of the author in his private capacity and do not in any way represent the views of Micron Technology Inc.

Traditional Flash Market Research

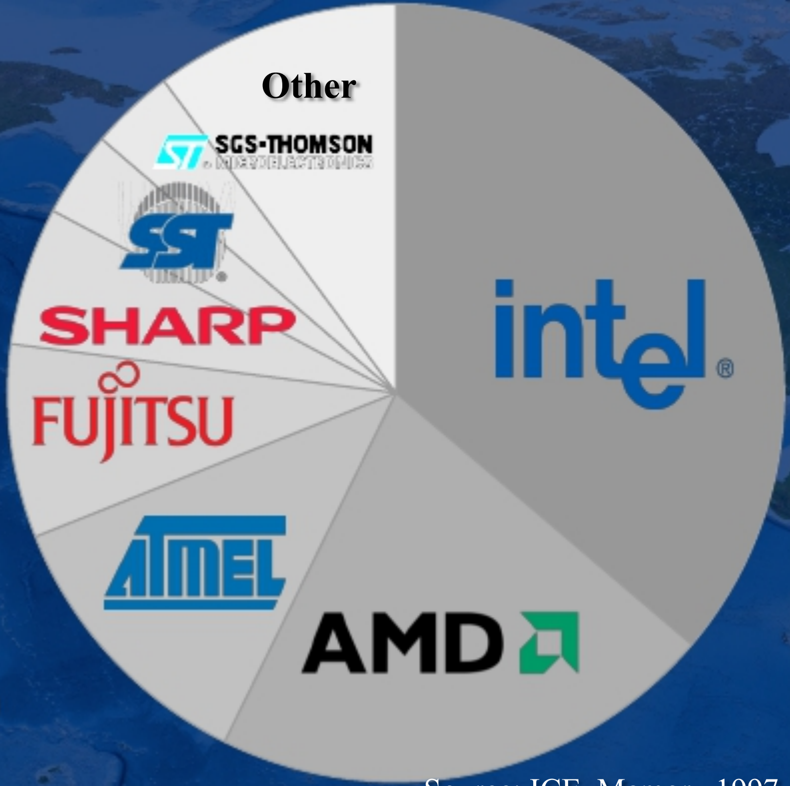
- Financial Research
- Market Share Predictions
- Technology Trends
- Application / end-Market trends

- Geopolitics / Industrial Policy / National Initiatives

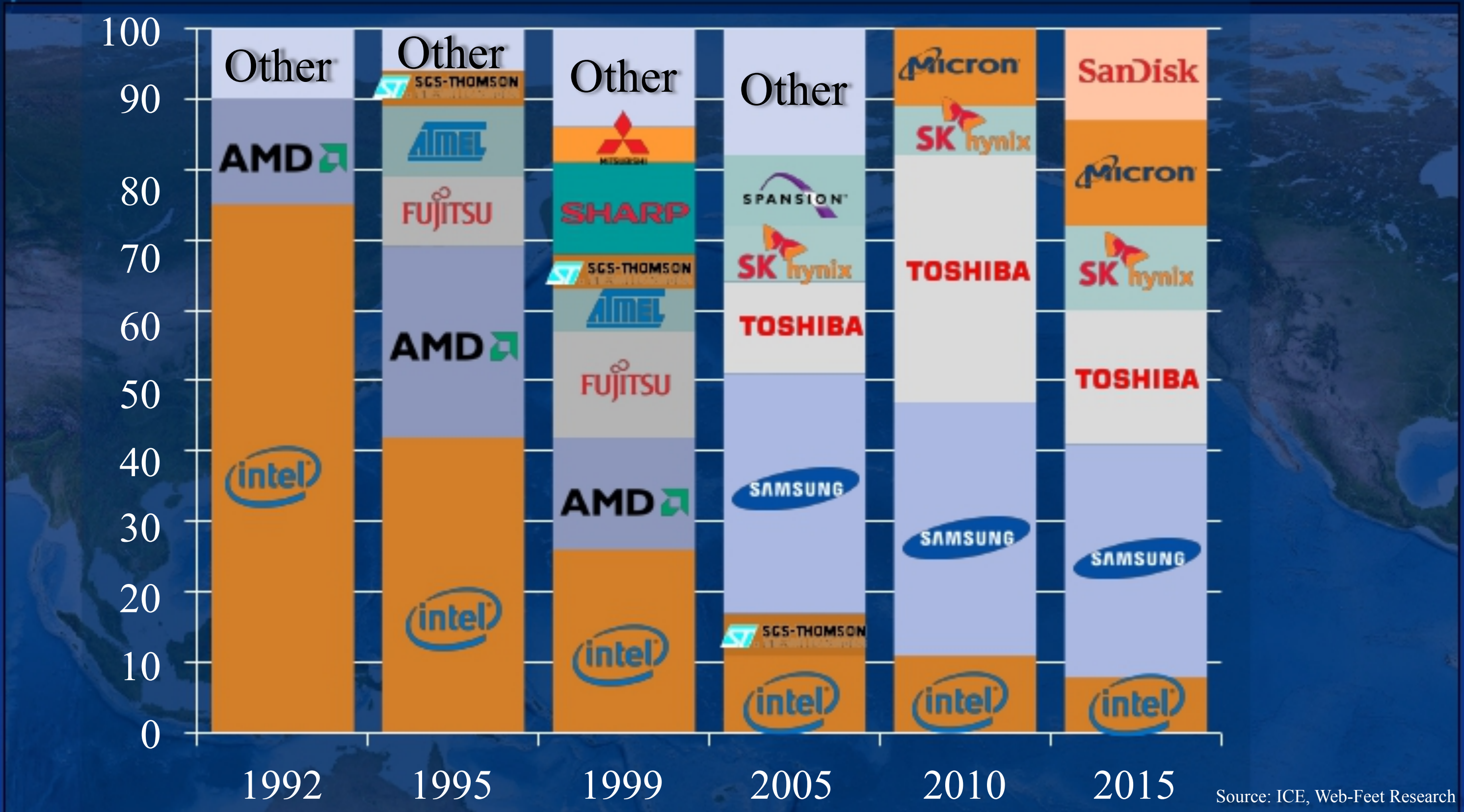
Source: WSJ
Source: Time
Source: Wikipedia
~1997~
Source: Time
Source: CNN
Source: Wikipedia
Source: Wikipedia
Source:AOL

1997

Publication of 1996 Flash Memory Market Data (Start of the NAND *ramp*)



Source: ICE, Memory 1997



Source: ICE, Web-Feet Research

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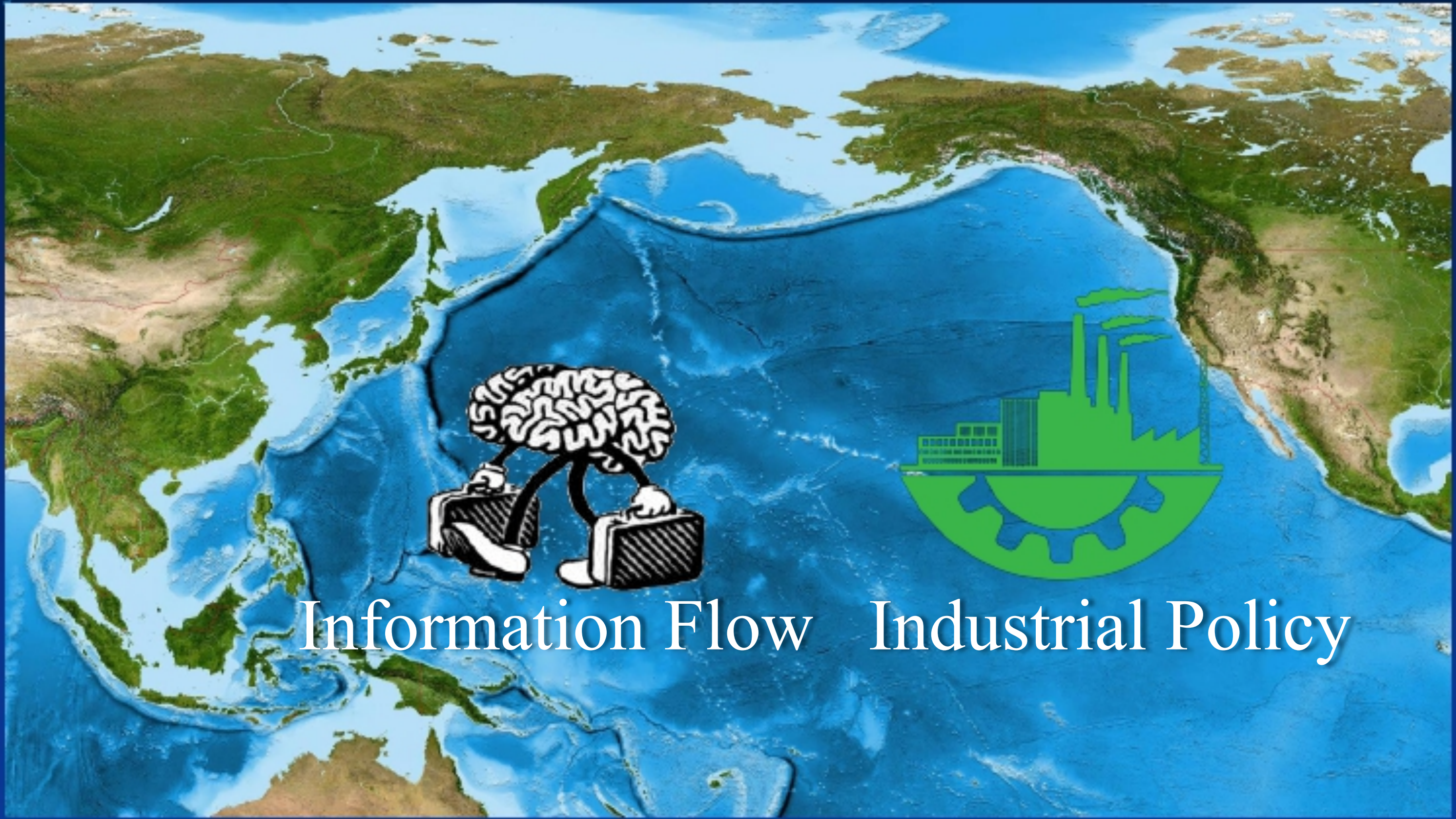
Industry ‘Pivot’


Information Flow
Industrial Policy


• Chaebols
• Korean Peninsula
•Abenomics
• The IT decline
• Cross-strait relations
• IT dependence
• National Initiatives
• Socialism with Chinese characteristics
• Presidential Election
• CFIUS
Where is the rest of the world

Flash/SSD Markets

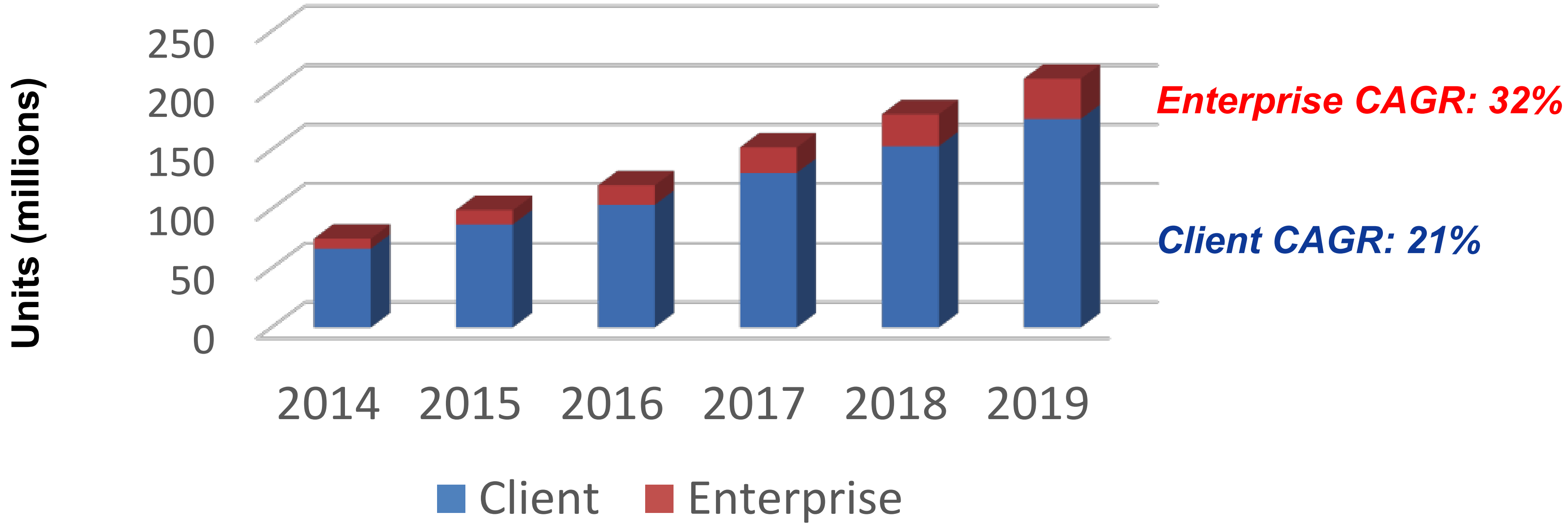
Mark Webb

MKW Ventures Consulting, LLC

Flash Market Projections

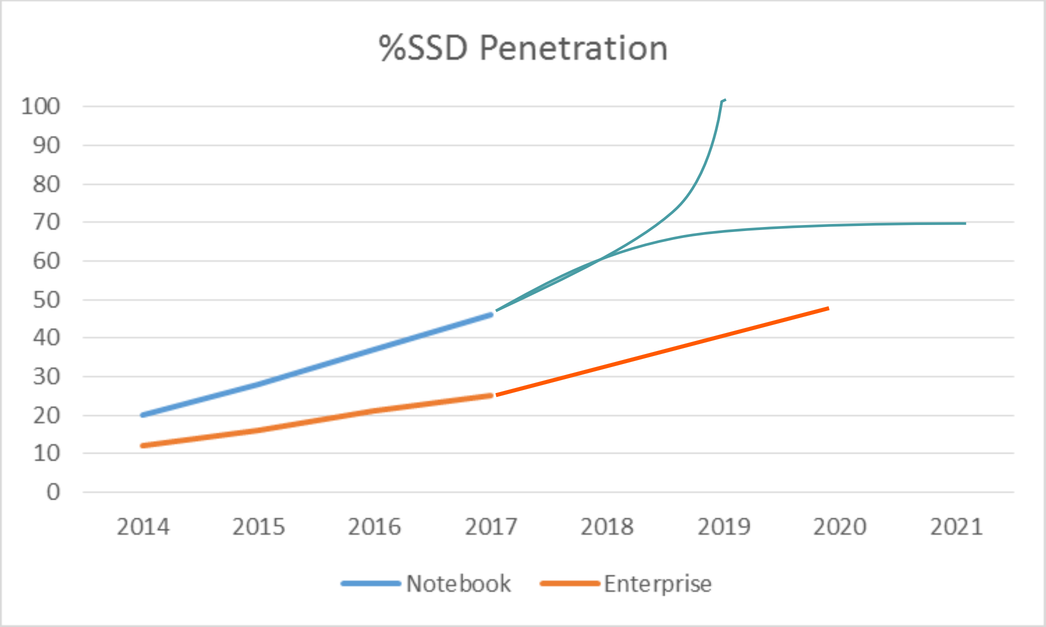
- Market Summary
  - SSD Units
  - SSD Adoption Rates
- Predictions
- What will not happen

SSD Unit Shipments



- SSD Unit shipments grow at modest linear rate

SSD Market Penetration



- SSDs are growing but still trail HDD
- Notebook: still TBD
  - Tipping if cloud storage is first storage for 100% of notebooks
  - Saturating if hybrid HDD or HDD still primary storage
- Enterprise: continues linear
  - 100% of performance enterprise
  - <5% of capacity enterprise

Predictions

- SSD cost/GB drop 25% per year
  - Prices 25% or more
- TLC becomes dominant in all SDDs
  - Client and Enterprise/Datacenter
- Cloud/Hyperscale becomes dominate SSD market
- Formfactors cost optimized for SSD applications
  - M.2 for all applications
  - BGA for Phone/ultramobile, Notebooks
- SCM memory has multiple suppliers and technologies for >$1B market

What Will NOT Happen

- HDDs will NOT go away
- SCM memory will not replace DRAM or NAND
- No new major 3D NAND companies will arise