



STORAGE INDUSTRY SUMMIT

The Future of Computing:
The Convergence of Memory
and Storage through
Non-Volatile Memory (NVM)

JANUARY 28, 2014, SAN JOSE, CA

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PCIe SSD Opportunities in Client and Enterprise



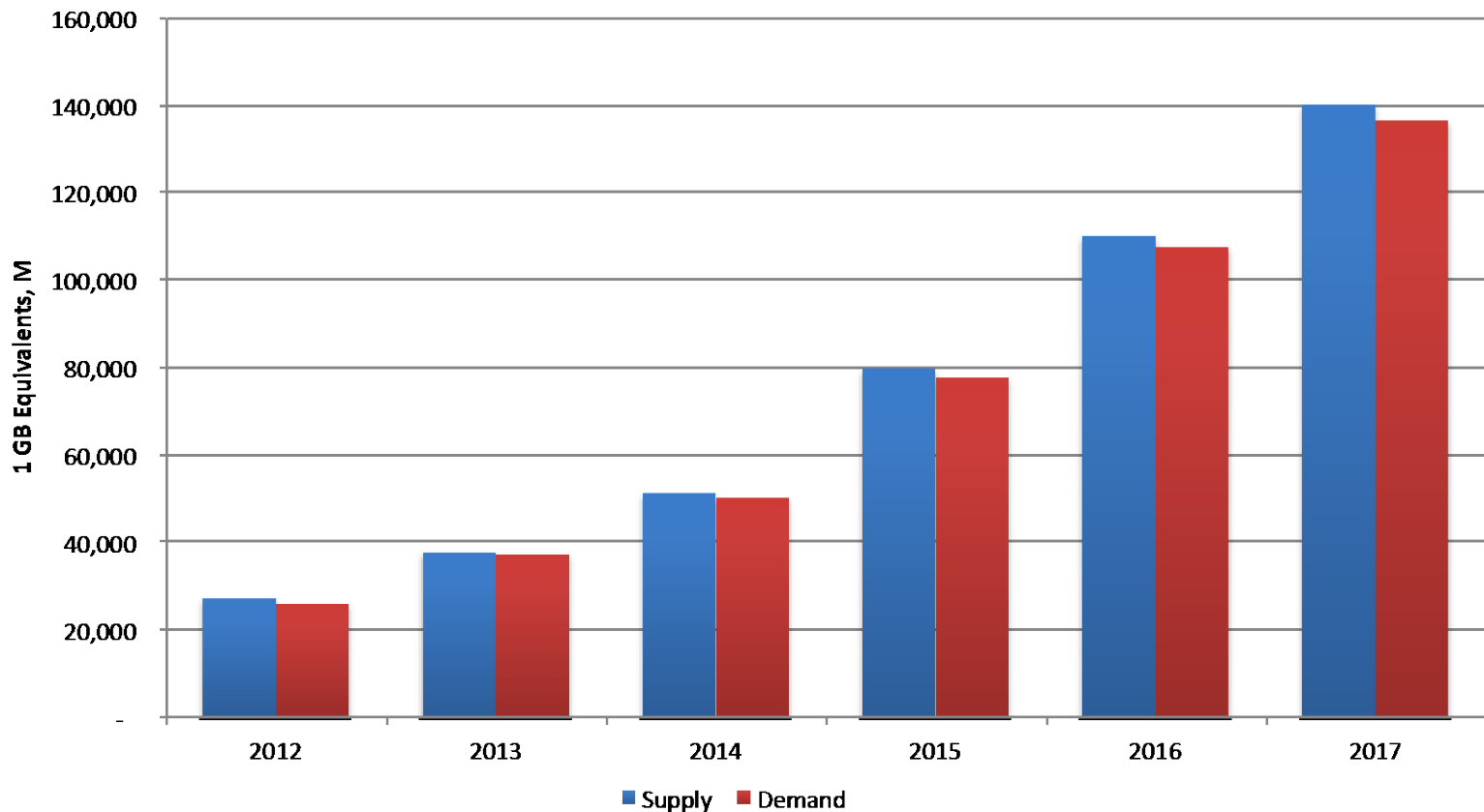
Agenda

- NAND supply dynamics
- PC/tablet market outlook
- Client SSD trends
- Enterprise SSD market outlook
- Enterprise SSD adoption trends



NAND Market Overview

New technology transitions will challenge supply/demand balance in coming years



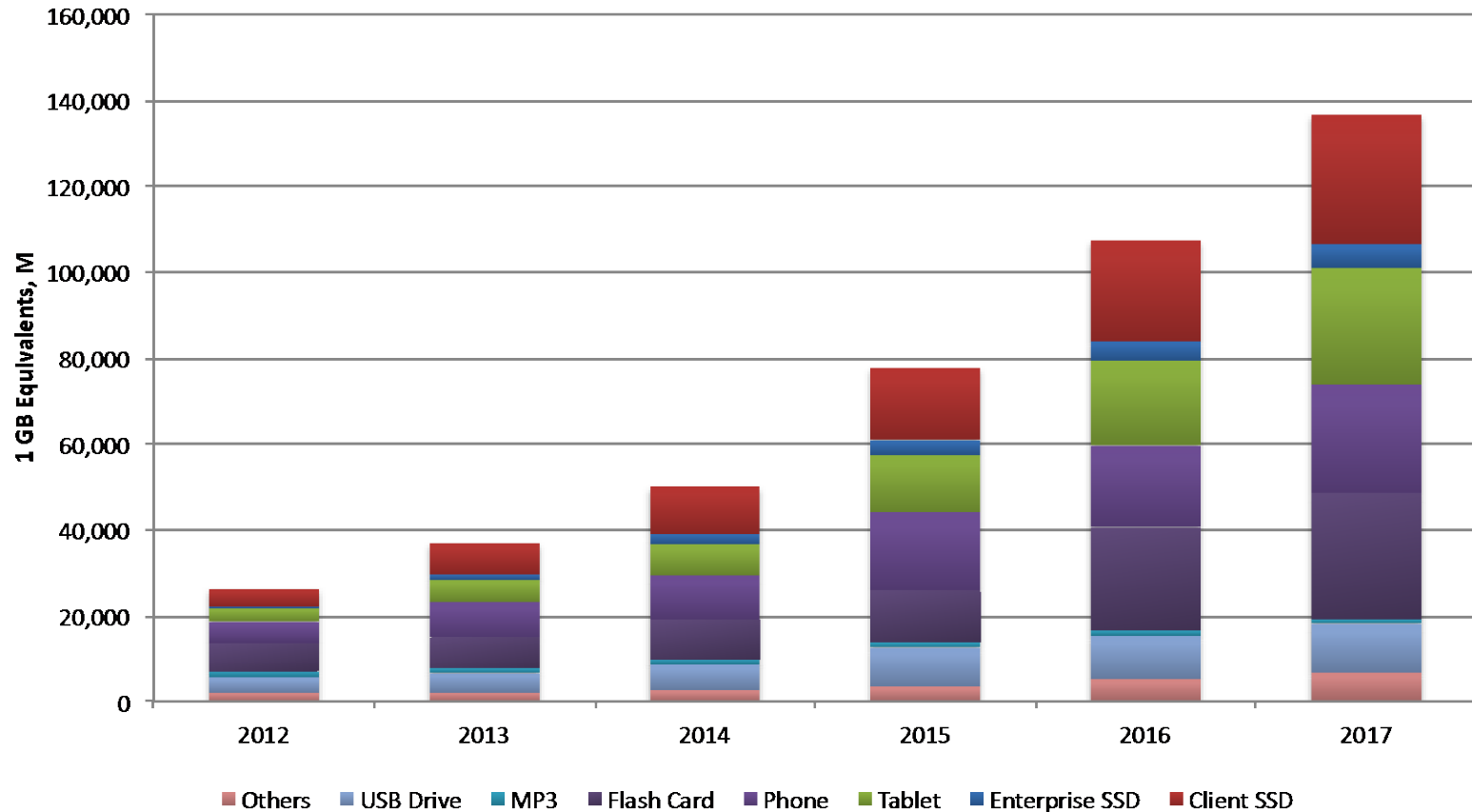
Wall Street Bull Thesis

- New technologies change ROIC math
- Most markets have become price inelastic
 - Cell phone and tablets purchase/capacities
- Samsung profit is tied to devices
 - Better off with higher priced memory content?
- While all great arguments for conservative capacity adds, industry still needs to hit a moving target



NAND Absorption Forecast

SSD an important driver of NAND usage



NAND Supply

- With tablet and smartphone markets maturing, NAND absorption may slow
 - Emerging markets may skew towards lower average capacities
- Despite careful expansion of NAND output in 2014, oversupply may occur
- Slow 3D NAND ramp into new fabs may temper total bit output growth this year



Why There Will Be Oversupply

- NAND growth is only expected to be off 10% Y/Y.
- Smartphone and Tablet growth rates (now over 1/3 of the end market) have slowed by ~50%.
- Cards & USB (1/3 of the market) look stagnant.
- 1H'14 is likely the worst period for supply/demand dynamics.

2013 Projected Bit Growth (YY)

Tablet/Phone	67%
Enterprise/Client SSD	87%
<i>Total</i>	<i>41%</i>

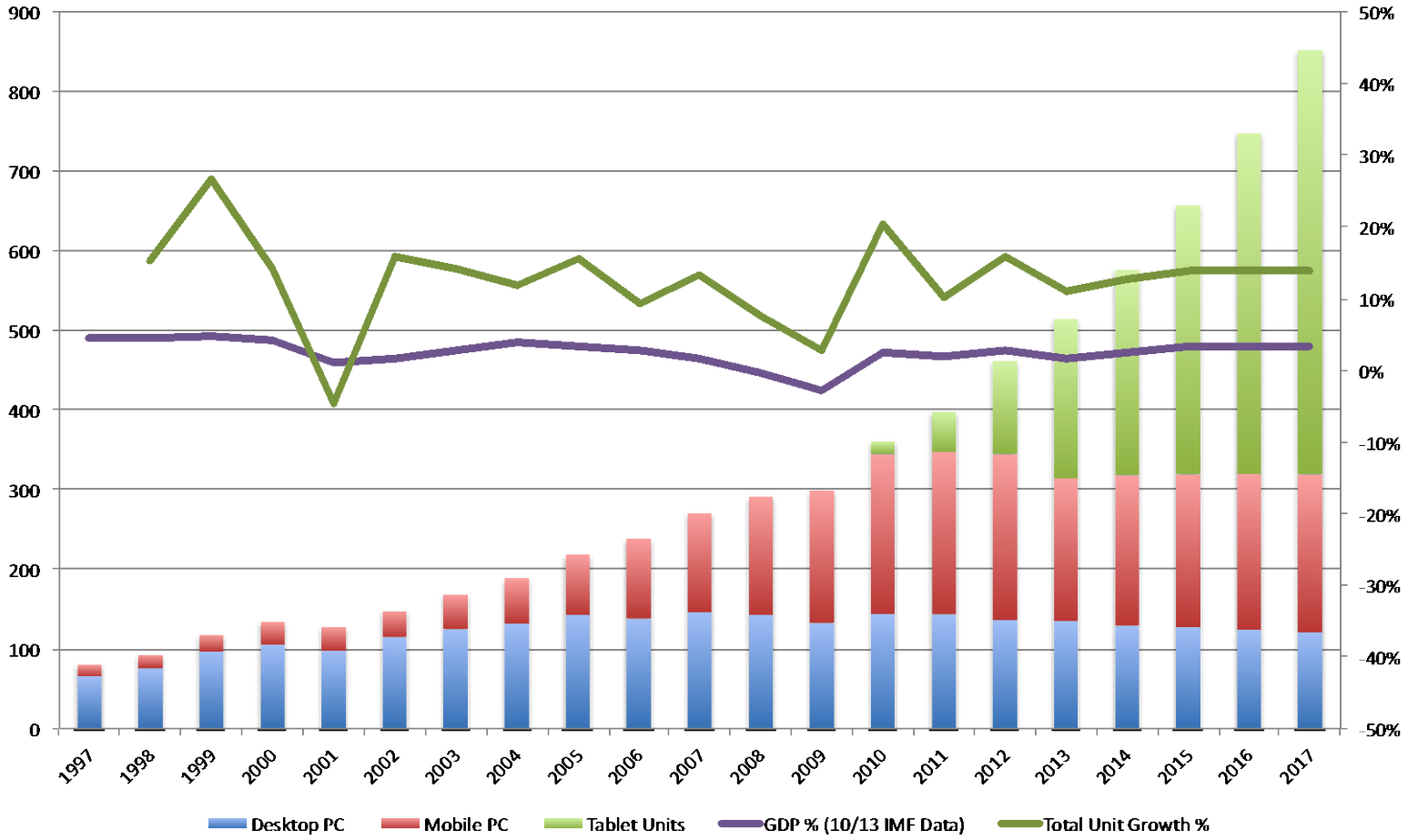
% of Market

Tablet/Phone	36%
Enterprise/Client SSD	23%



PC, Tablet Outlook

Stabilizing PC market will see SSD growth



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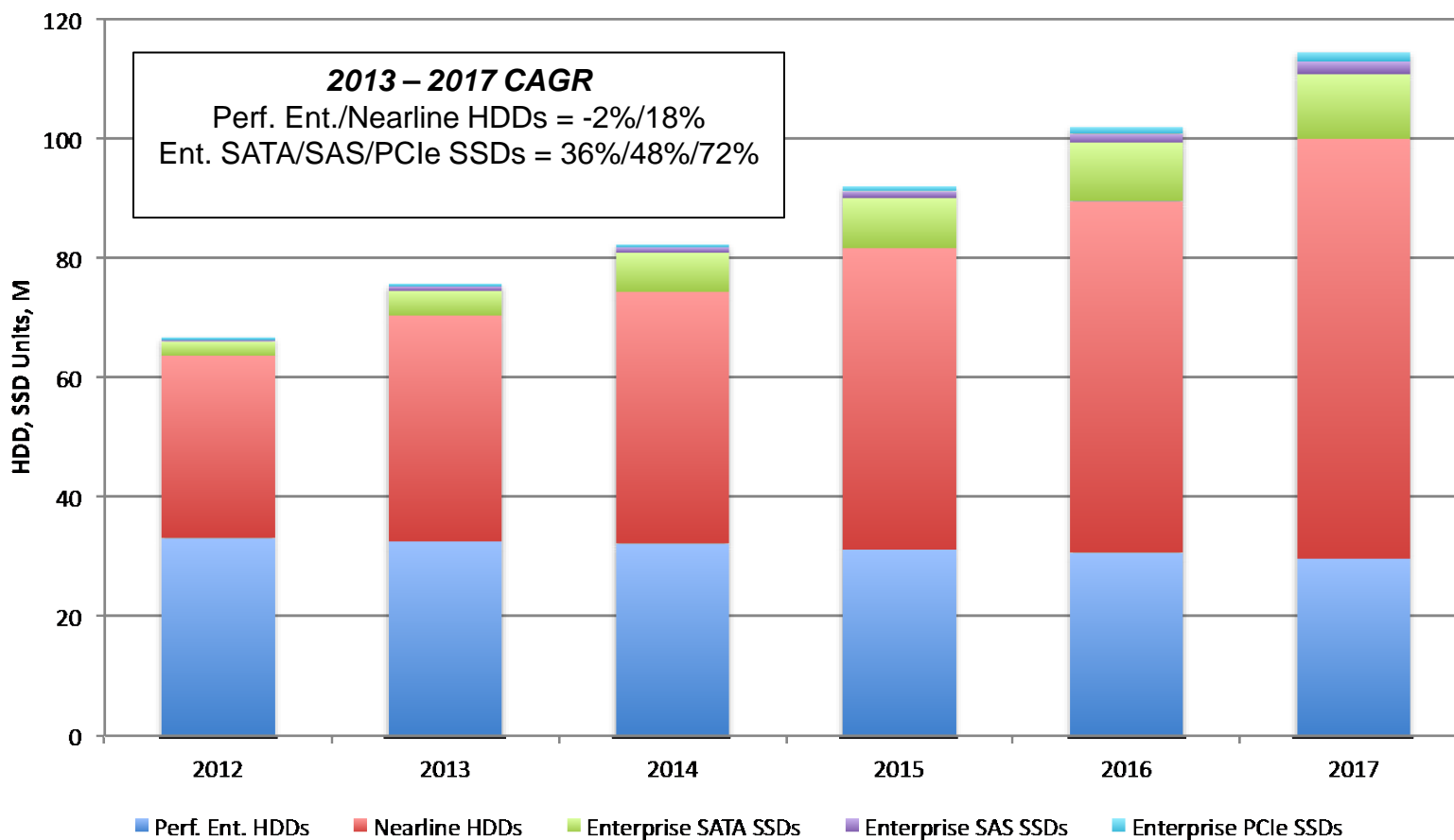
Client SSDs

- Notebook SSD attach rate has exceeded 10%
- Drive towards thinner and convertible designs motivating OEMs to abandon HDD bays
 - M.2 will become the default form factor
 - NVMe will drive transition from SATA to PCIe
- SSD cost for 128 and 256 GB preventing adoption into mainstream \leq \$500 PCs
 - HDD bays, hence SATA, will remain for low cost PCs for the next couple of years



Enterprise Device Units

Enterprise SSDs target performance applications



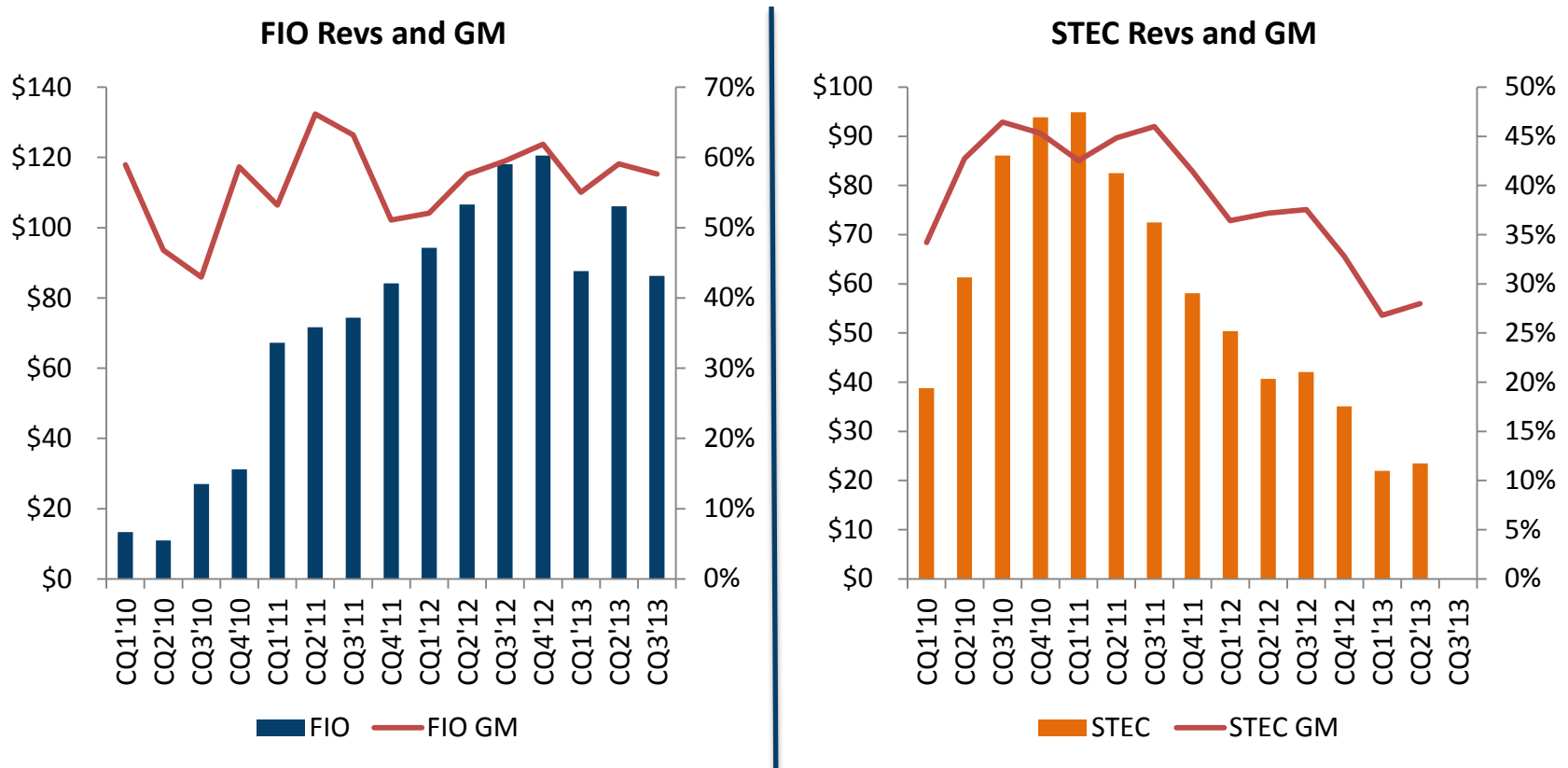
Economics of the Enterprise

- Margins make the enterprise opportunity an attractive investment
 - Fusion I/O and STEC highlight margin opportunities for innovators
 - HDDs exemplify how margins are sustainable over time
- Conversely, technology shifts create greater risk
- Larger Opex requirements can blunt GM benefits



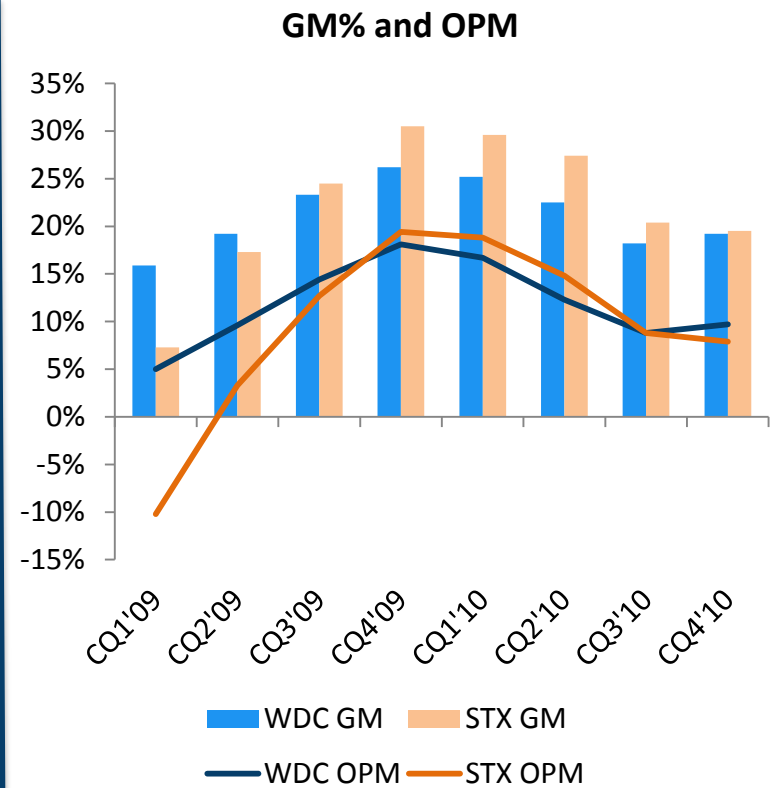
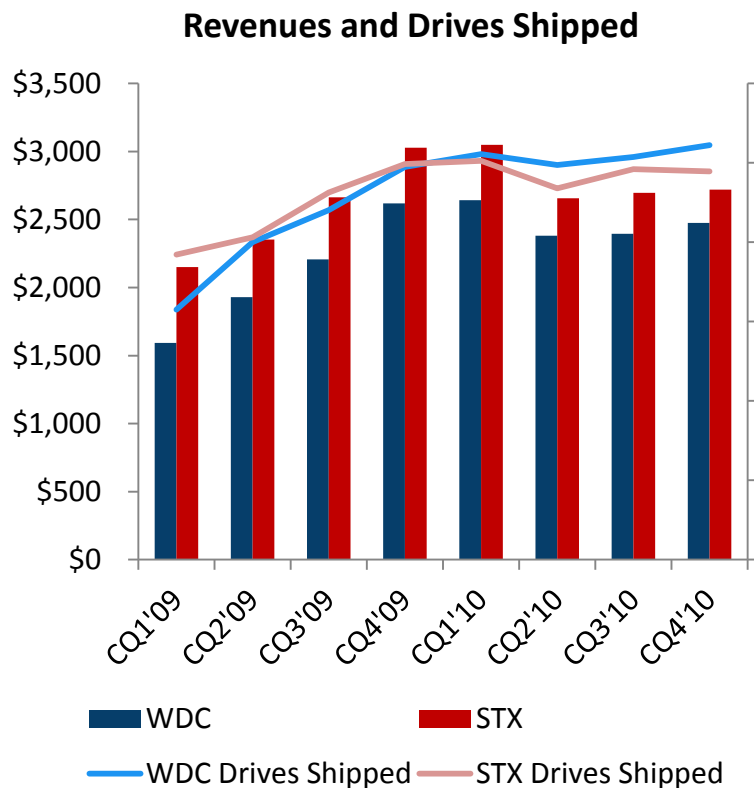
Economics of Enterprise

A look at Fusion-IO and STEC



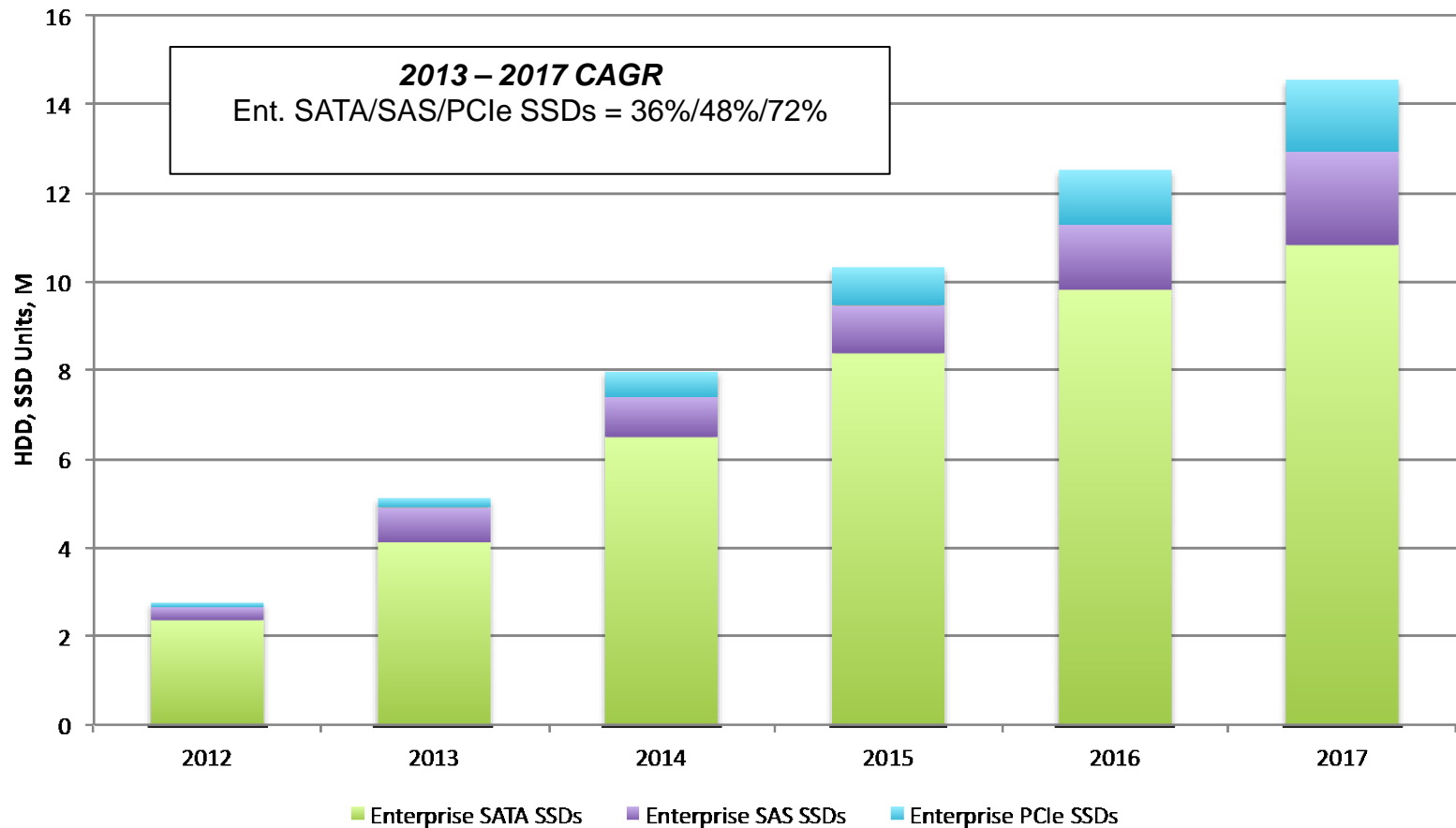
Enterprise Drives

GM upside, but also additional operating costs



Enterprise SSD Units

While SATA favored for cost, PCIe will post largest growth rates



PCIe Shifts

- PCIe cards have a limited sales horizon
- Product Issues
 - Expensive – conversions to SATA where the latter is “good enough”
 - Proprietary
 - Serviceability issues
- New Technology Threats
 - Non-volatile DIMMs
 - Phase Change and other non-volatile options
 - NVMe (non PCIe card form factor)



NVMe = New SATA/SAS

- If M.2 takes off, we fully expect that vendors will find ways to incorporate it into enterprise applications.
- Already seeing both hyperscale data centers and enterprise vendors working on this front
- LSI's Griffin provides an excellent segue into this market, assuming the chip achieves its potential



Conclusions

- The NAND industry will overbuild at some point
 - Varied opinions on when oversupply occurs
- Client SSDs will continue to gain traction
 - But for now the pace of adoption is unlikely to spike due to capacity cost
- The Enterprise SSD market has demonstrated significant growth paced by enterprise SATA drive adoption
 - We see reason to believe that PCIe will grow faster than other portions of the market gaining share going forward
 - The form factor and protocol may not be the cards that represent the vast bulk of PCIe solutions shipped today



Thank You!

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