The Market Case for NAND Caching in PCs

Flash Memory Summit – 2012

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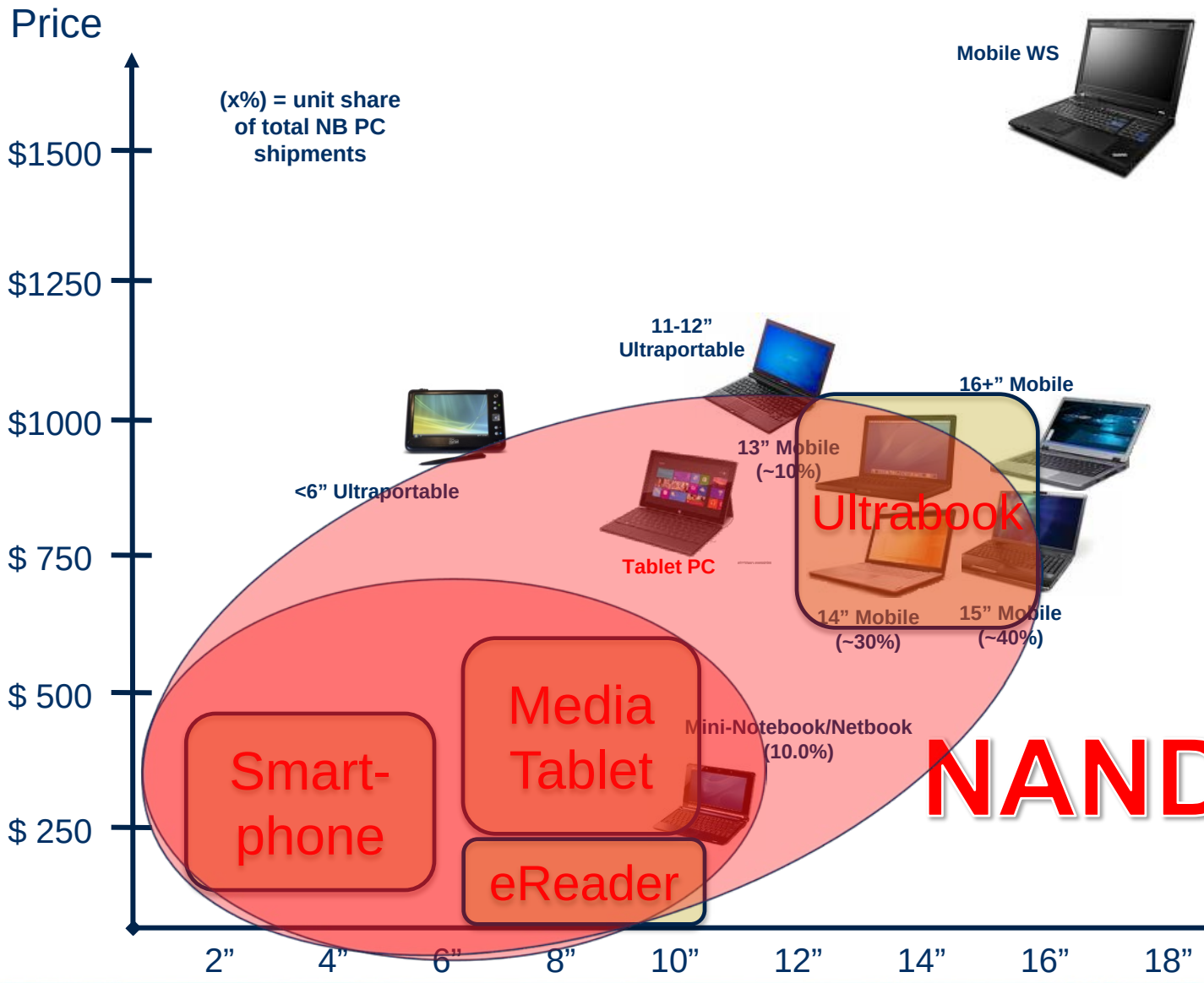
Mobile Device Definitions

PC		▪x86 CPU ▪Notebook or desktop ▪Desktop (file-based) OS
Tablet PC		▪Desktop (file-based) OS ▪Slate or convertible ▪7”-12” Screen
Media Tablet		▪Mobile OS ▪Slate form factor ▪>5” Screen
Smartphone		▪Mobile OS ▪Voice+data focus ▪≤5” screen
eReader		▪Custom OS ▪Purpose built ▪e-Ink screen

Mobile Device Landscape By Unit ASP and Screen Size



- 10 mobile PC form factor segments
- 226.4Mu
- $708 ASP
- 14" & 15" mobile PCs are mainstream
- Ultrabook addressing NB PC volume sweet-spot
- Tablet PC: the ASP is TBD…similar to Ultrabook?

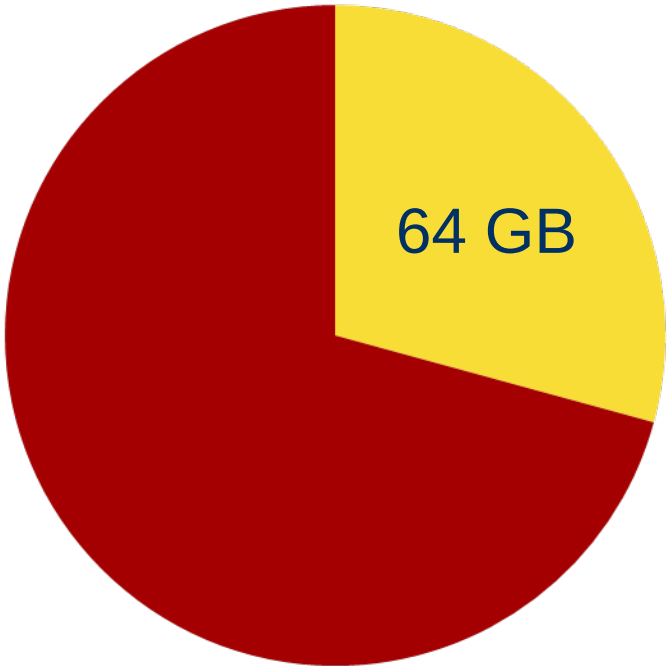
Mobile Device Mass Storage Requirements

Portable Device Form Factor:	Handheld Devices	Two-Handed Devices	Laptop
			
User's On-Board Storage Capacity Expectations	+	++	+++
Portable Device OEM Storage Expectations	Small, light, robust, low-power device. Low cost	Small, light, robust, low-power device. Will accept a higher cost.	High capacity storage at a steadily lower $/GB.
Storage Technology	NAND	NAND	**HDD and NAND**

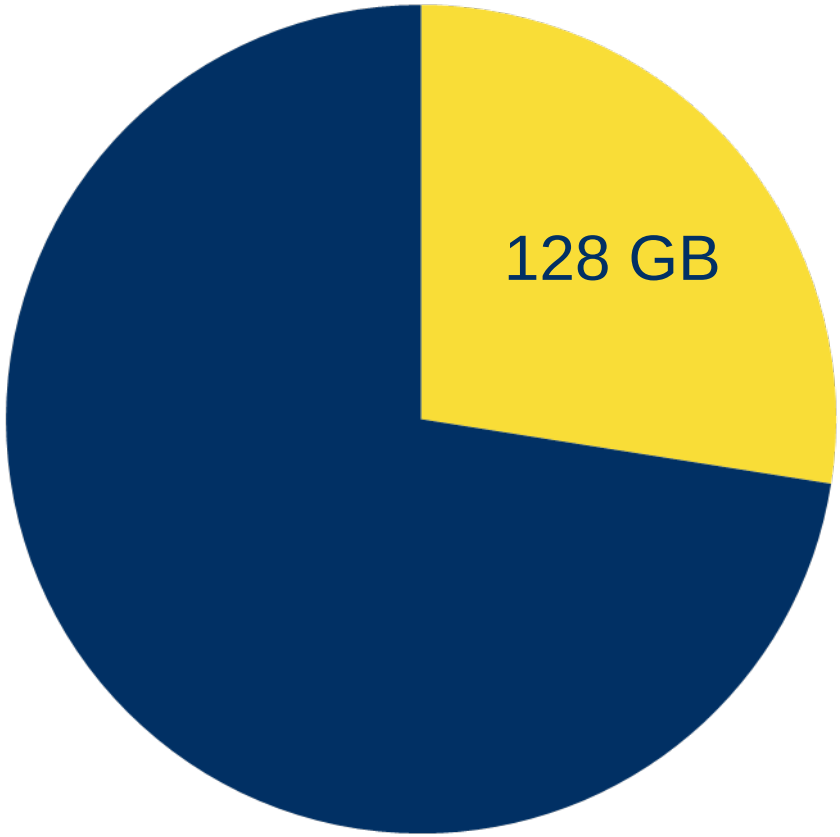
Mass Storage Is Needed: Consumer PC Storage Capacity Utilization - 2010

IDC Analyze the Future

Consumer Notebook PC



Consumer Desktop PC



Source: IDC and PC Pitstop.com

Comparison of BOM Budgets for Mobile Device Mass Storage

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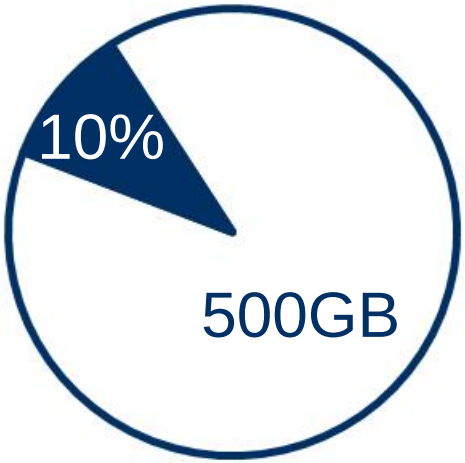
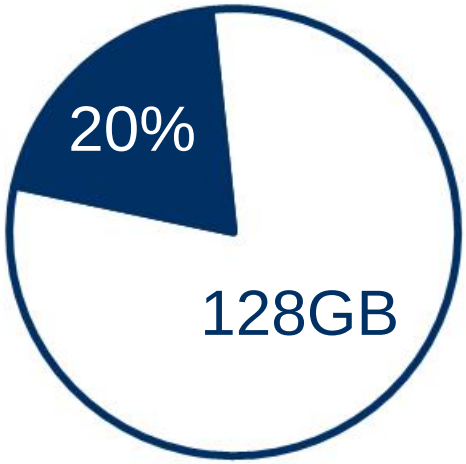
Analyze the Future

Average Notebook PC



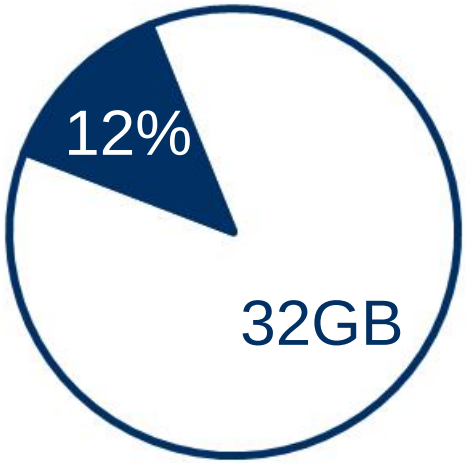
Average BOM Cost: $450

Ultrabook With SSD



Average BOM Cost: $685

Media Tablet



Average BOM Cost: $325

Source: IDC, Doc# 232512, *Sizing Up Storage In Ultrabooks*, January 2012

Ultrabook Performance Requirements

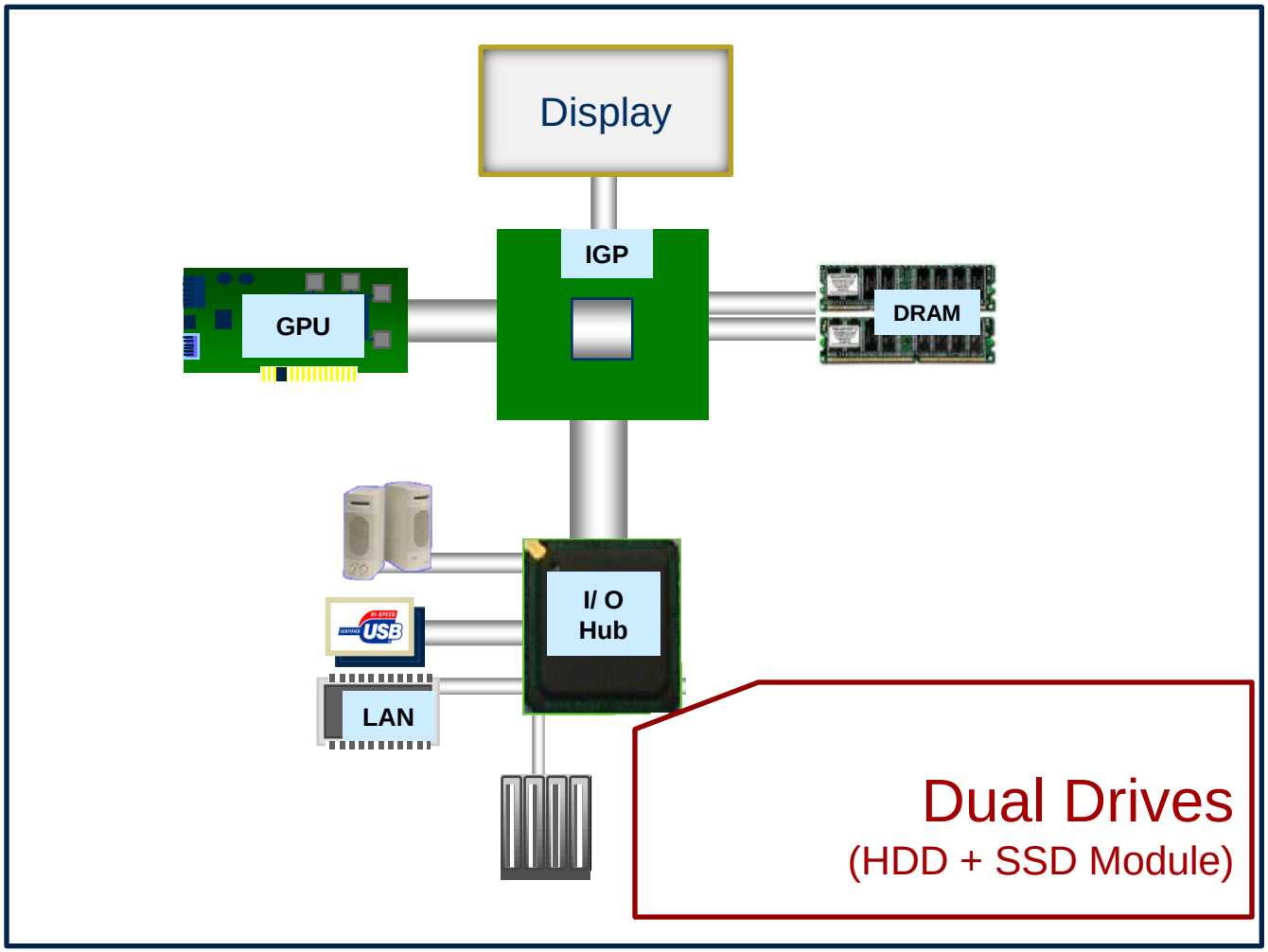
- ✓ Fast cold boot-up
- ✓ Quickly shut down to the S4 hibernate mode
- ✓ Resume from S4 hibernate in < 7 seconds

Many Paths to Reduce Latency/ Improve PC Performance…

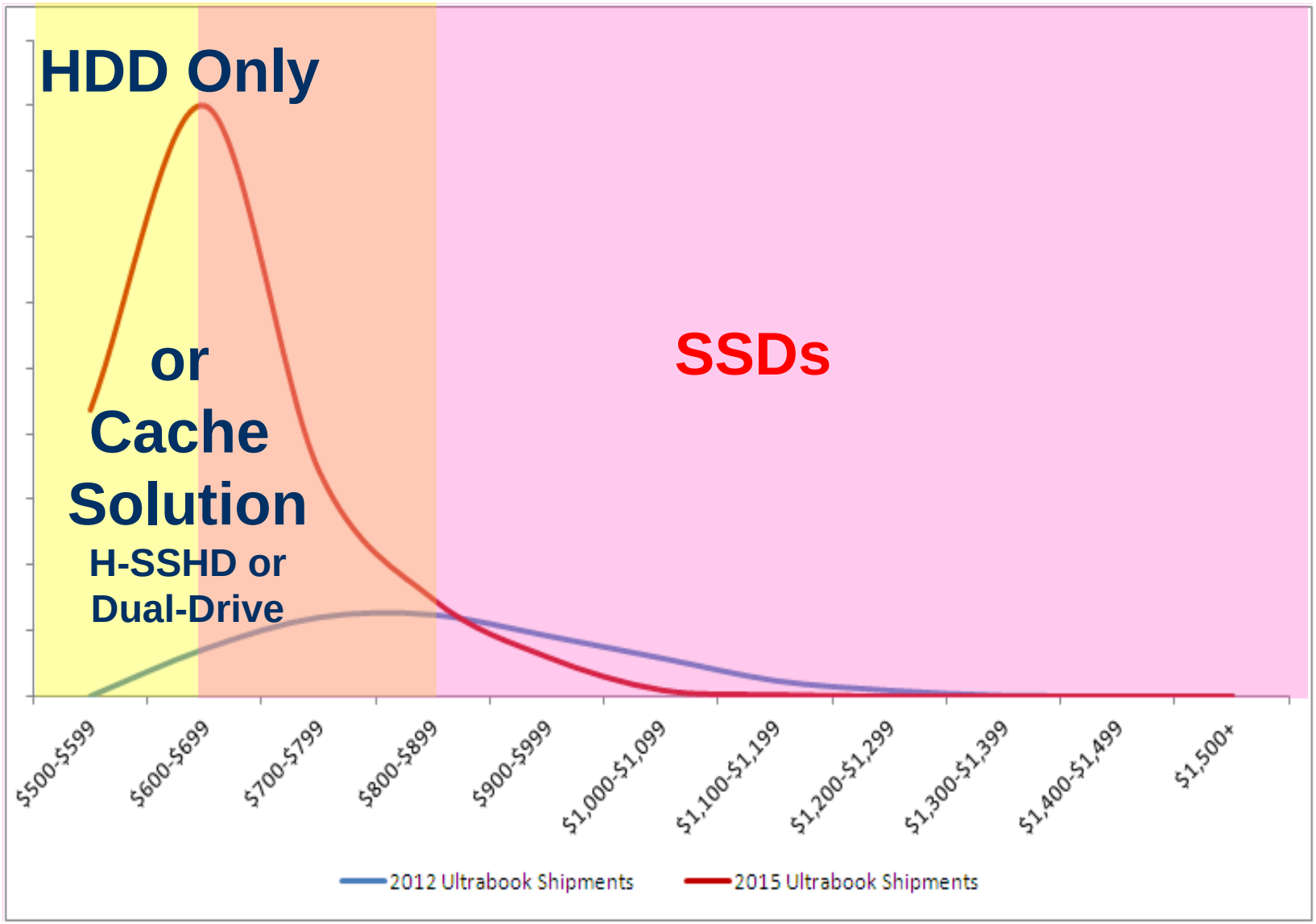
IDC Analyze the Future

1. Improving the OS boot-up process
2. Improving power transitions (resume from standby or hibernate)
3. Using a NAND-flash SSD as a mass storage device
4. Caching data with a relatively small capacity of NAND flash in the systems (in conjunction with the use of a mass storage device)

Storage Caching Options: Notebook PCs



2012 and 2015 Ultrabook Shipments by Priceband



Source: IDC, Doc# 232512, *Sizing Up Storage In Ultrabooks*, January 2012

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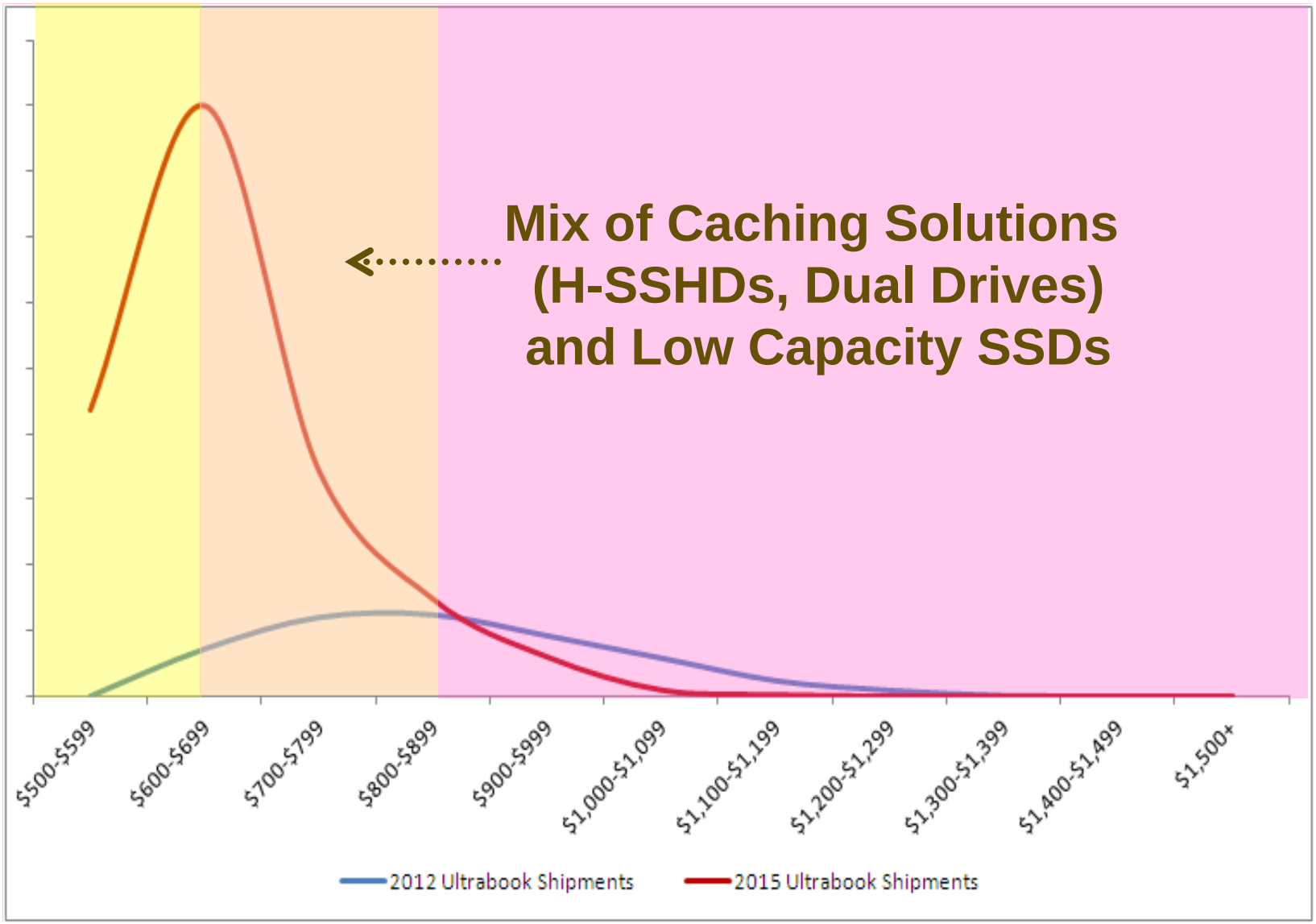


Source: IDC, Doc# 232512, *Sizing Up Storage In Ultrabooks*, January 2012

Stack-Up Challenge for HDDs in Thin-Chassis NB PCs

PC Chassis Thickness	21mm (0.82”)	18mm (0.72”)	15mm (0.60”)	12mm (0.47”)
9.5mm z-height 2.5” HDD				
7.0mm z-height 2.5” HDD				
5.0mm z-height 2.5” HDD				
≤ 5mm z-height 2.5” SSD				
Single-sided SSD Module				

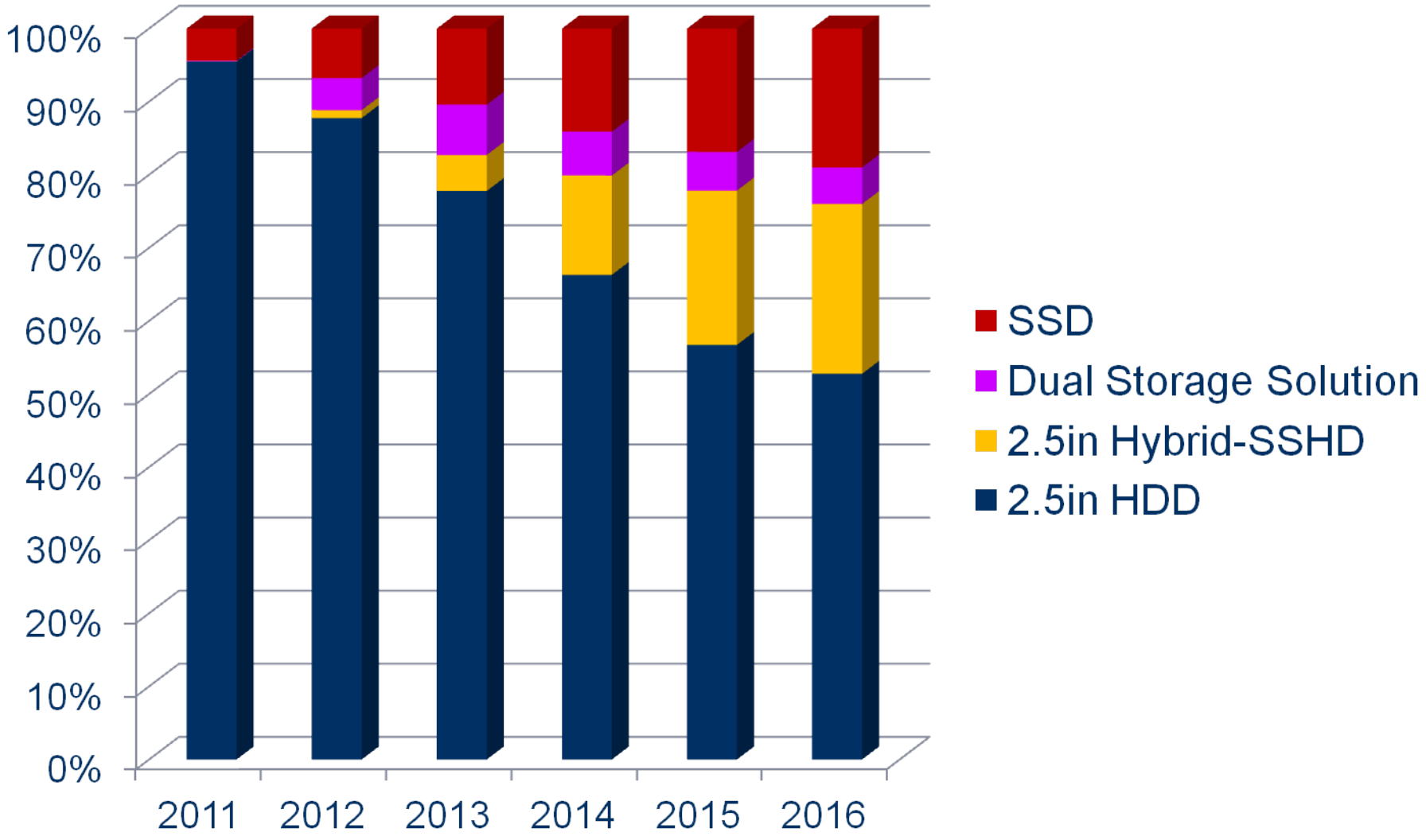
Note: Microsoft Surface is 0.37” thick

Source: Intel IDF 2012
Samuel Benn, Johnny Cheng

Other Hybrid-SSHD Key Adoption Assumptions

1. Two or more Hybrid-SSHD suppliers
   - *Expecting there will be at least two suppliers by 2013*
2. Thinner hybrid-SSHD designs
   - *Expecting 7mm z-height models will be available (in volume) to PC OEMs in 2013*
3. Economic value is sold to PC OEMs
4. Hybrid-SSHD marketing is stepped-up!

Portable PC Shipments: Percent by Mass Storage Solution Type



Thank you

Questions?

Shoot me an email:
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