



Enterprise Flash Storage Annual Update

Or how the data center is replacing
spinning rust with solid state

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Your not so Humble Speaker

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- Flash moves mainstream
- Server side caching falters
- 3D/TLC enters the data center
- PCIe/NVMe rising
- Advances on the horizon

Flash has gone mainstream

(Volume)

- ~400PB AFA ship 2014
 - Flash based arrays \$11.3 billion
 - 1.3 AFA, 10.0
- Enterprise SDD:
 - 2012 \$3billion
 - 2013 \$4.4billion
- ~80% of VNX/FAS ship w/flash

Flash Goes Mainstream (Function)

- Single controller rack mount SSD – DEAD
- Even upstarts have full features
 - Snapshots, two replication methods
- AFAs scale to 100s PB
- Data reduction now table stakes for price
 - Deduplication and compression

And the market matures

- Consolidation in components
 - HGST (Virident, Stec, Velobit)
 - Sandisk (Smart, FlashSoft, Fusion-IO)
 - Seagate (LSI)
- Flash systems shakeout
 - Astute networks closes
 - HGST devours Skyerea
 - Cisco shutter Whiptail

And Everyone is the Market Leader

- EMC is #1 in dollar revenue (Gartner)
- IBM is #1 in PB shipped (Gartner)
- Netapp #1 in units shipped (Gartner)
- Pure #1 in growth (700%)

Evolution of Enterprise Flash



2010

- 100K+ IOPS
- Consistent sub-millsec latency
- Go fast for special cases



2012

- Still a point solution
- Becoming cost effective
- Limited data services
- Data reduction



2015

- Flash is mainstream
- Full data services & data reduction
- Cost effective for many applications

The All Flash Data Center?



- All flash is inevitable
- Facebook...
- Murphy's law
- Growing our TAM
- Flash cheaper than disk, really?
 - No enterprise SSD 25X cost/GB of 8TB disk
- Kryder's law

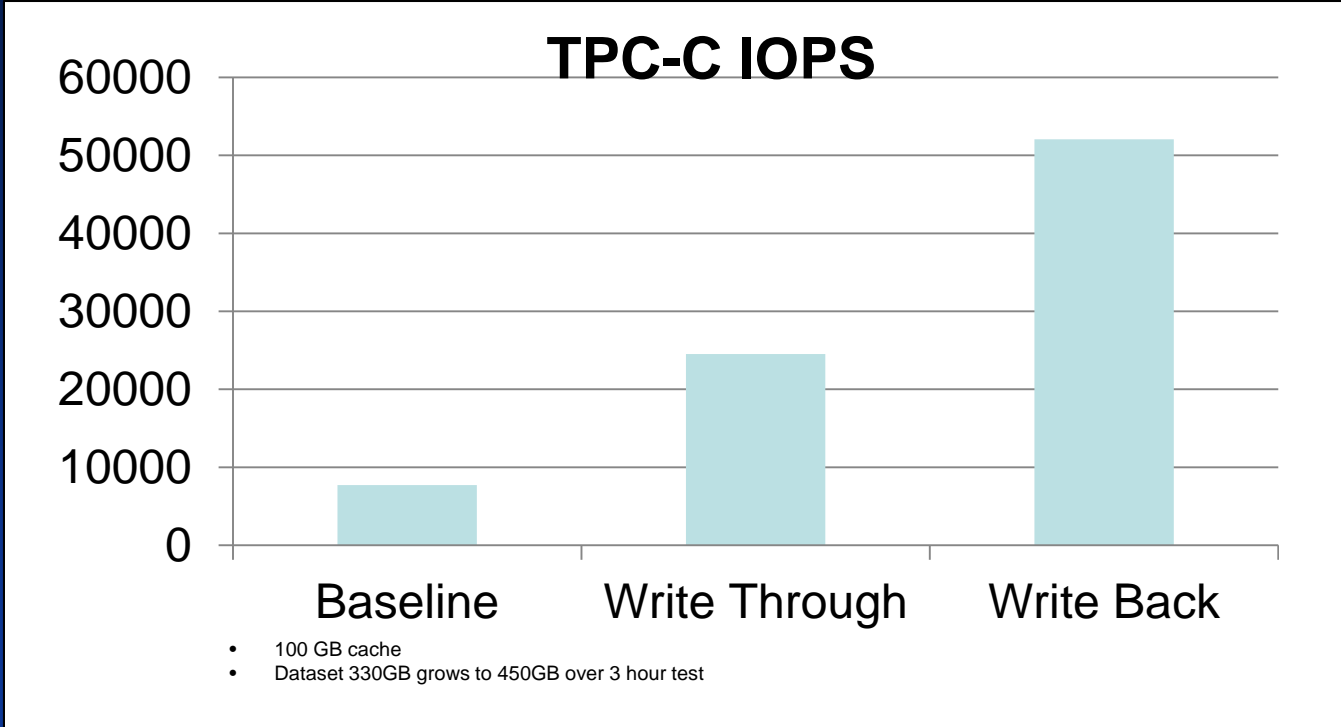
AFA Evolution

- 2012
 - Market leader Violin
 - No real data services
 - Just fast, fast, fast
- 5
 - Even mainline vendors adding data reduction
 - Data services now table stakes
- Dedupe increases CPU requirements
 - But has minimal impact on performance

Server Side Flash - 2015

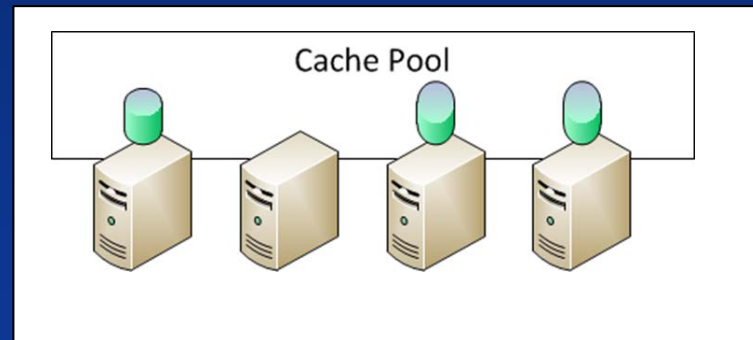
- Platforms add limited caching
 - VMware VFRC
 - Storage Spaces SSD tier & write back cache
- vSphere adds IO Filters
 - Integration points in ESXi kernel
 - “Technology preview” in 6.0

Write Through and Write Back

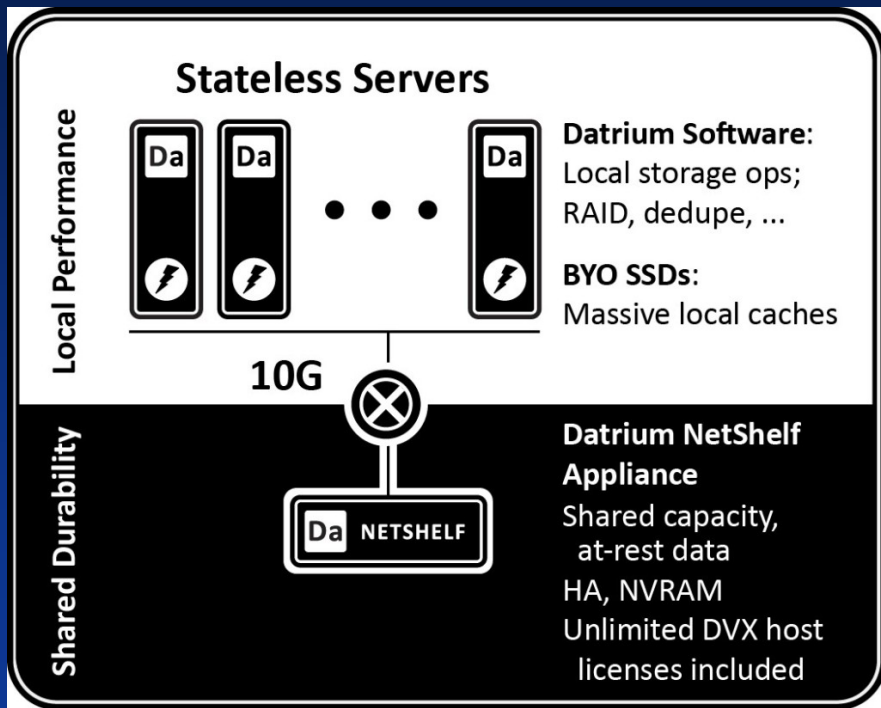


Distributed Cache

- Duplicate cached writes across n servers
- Eliminates imprisoned data
- Allows cache for servers w/o SSD
- Solutions
 - PernixData
 - Dell Fluid Cache
 - RDMA based
 - Integrates with Compellent



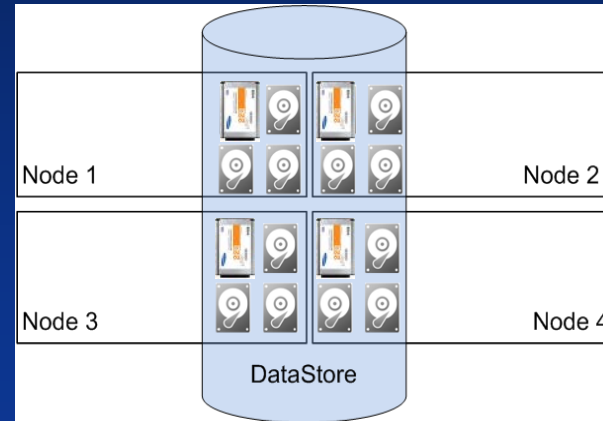
Datrium DiESL



- Host managed cache
- PCIe SSD in Host
 - Write through cache
- All flash NetShelf
 - Persistent layer
- NFS interface to vSphere
 - Per-VM data services
- Founders from Data Domain
 - Dedupe of course

Hyperconverged Infrastructure (ServerSAN)

- Use server CPU and drive slots for storage
- Software pools SSD & HDD across multiple servers
- Data protection via n-way replication
- Can be sold as hardware or software
 - Software defined/driven
- All flash versions appearing



Sample ServerSAN Products

- VMware's VSAN
 - Scales from 4-32 nodes
 - 1 SSD, 1 HDD required per node
- Maxta Storage Platform
 - Data optimization (compress, dedupe)
 - Metadata based snapshots
- EMC ScaleIO
 - Scales to 100s of nodes
 - Hypervisor agnostic
- Atlantis Computing ILIO USX
 - Uses RAM and/or Flash for acceleration
 - Works with shared or local storage

Enterprise SSD Evolution

- Density - Today's largest devices
 - SAS - 4TB
 - SATA – 2TB
 - PCIe – 4.6TB
 - PCIe vendors discontinuing 200-600GB models
- Interfaces
 - U.2 PCIe from several vendors
 - NVMe from all enterprise vendors
 - Server support from most vendors

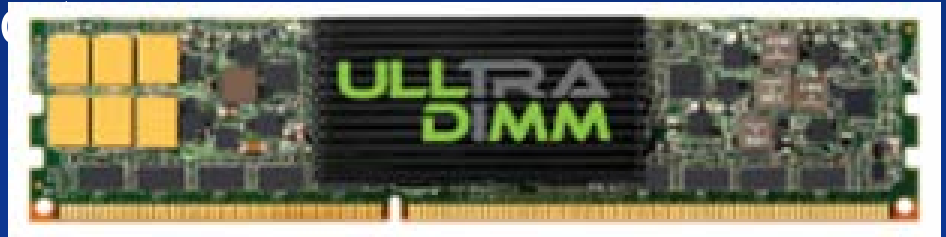
U.2/SFF-8639 PCIe for 2.5" SSDs

- Adds x4 PCIe 3.0 lanes to SAS/SATA connector
 - Dual ports to x2
- Appearing on new servers
 - Making PCIe/NVMe SSDs hot swappable
- Next step for storage arrays



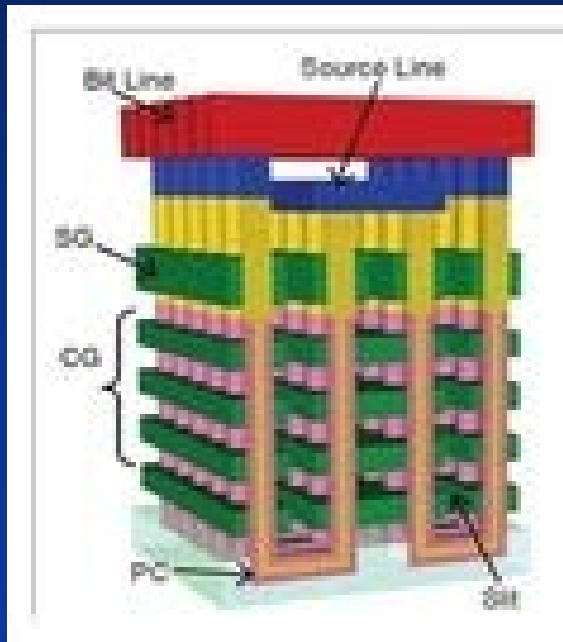
Diablo Puts Flash on the Memory Bus

- Memory Channel Flash
(SanDisk UltraDIMM)
 - Block storage or direct memory
 - Write latency as low as 3 μ sec
 - Requires BIOS support
- Memory1
 - 400GB/DIMM
 - No BIOS/OS Support
 - Volatile



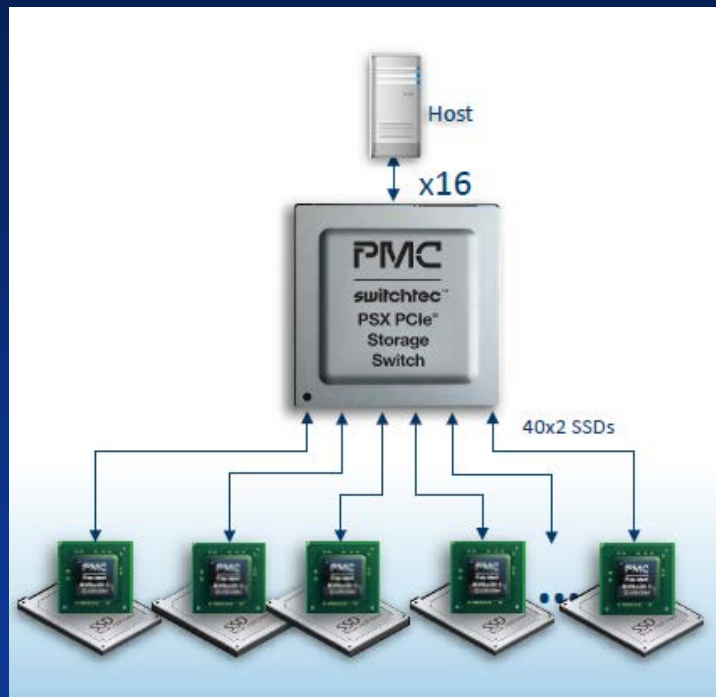
Flash Goes 3D

- Smaller cells are denser, cheaper, crappier
 - Today's 1x nm cells (15-19nm) last planar node
- 3D is the future
- 3D allows larger cells
 - Makes TLC useable
 - Faster write, higher endurance
- Samsung 3D-TLC SSD
 - Others foundries sampling



The Future is PCIe

- PCIe offers:
 - Low latency, high bandwidth, RDMA
- PCIe Switch chips
 - PLX and PMC – 96 lane
- Use for:
 - Controller to controller link
 - U.2 SSDs in storage system
 - Rack scale switched system (DSSD)
 - External PCI standards exist



The Future

- All PCIe storage systems
 - As conventional storage
 - With memory interfaces
- Next-gen memory (PCM, 3d Xpoint, Etc)
 - First as write cache in SSD (2017)
 - Later as memory
- More persistent memory as memory
 - Needs application support ala SAP Hana



THANK YOU

GRACIAS

ARIGATO

SHUKURIA

JUSPAXAR

DANKSCHEEN

TASHAKKUR ATU

YAQHANYELAY

SUKSAMA

MEHRBANI

GRAZIE

MEHRBANI

MERCIE

BOLZIN

MERCIE

BIYAN SHUKRIA

TINGKI

YOU

SHUKRI

YUSPAGARATAM

WAREEJA MAITEKA

HUI

EKHMET

SPASIBO DENKAUJA NENACHALHYA

UNALCHESH

HATUR GUI

EXOUJI

SIKOMO

MAKETA

MIMMONCHAR

CHALTU

SPASSIBO

SNACHALHYA

NUHUN

DHANYADAAD

ANHA

ATTO

MAAKE

LAH

SAIKO

KOMAPSUMNIDA

MERASTAWHY

GAEJTHO

TAUTAPUCHI MEDAWAGSE

GOZAIMASHITA

EFCHARISTO

AGUYJE

FAKAAUE

BARIKA

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