Session 201-C:
PCIe Power Budgets, Performance, and Deployment

SSD performance vs price and power – then and now

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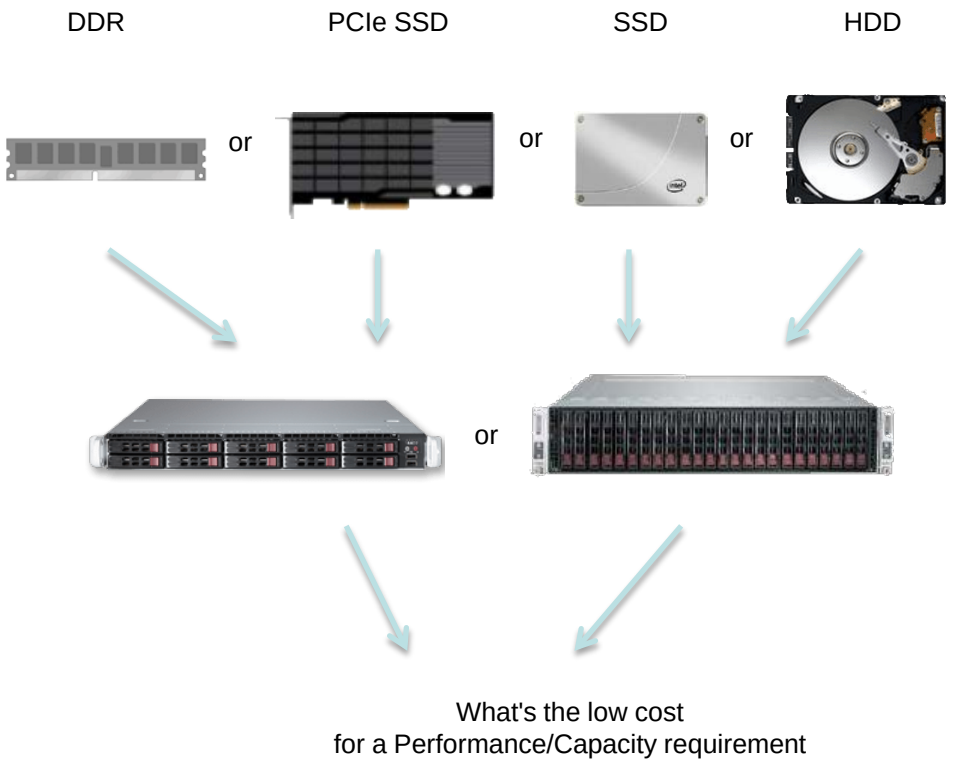
Where does pricing fit?

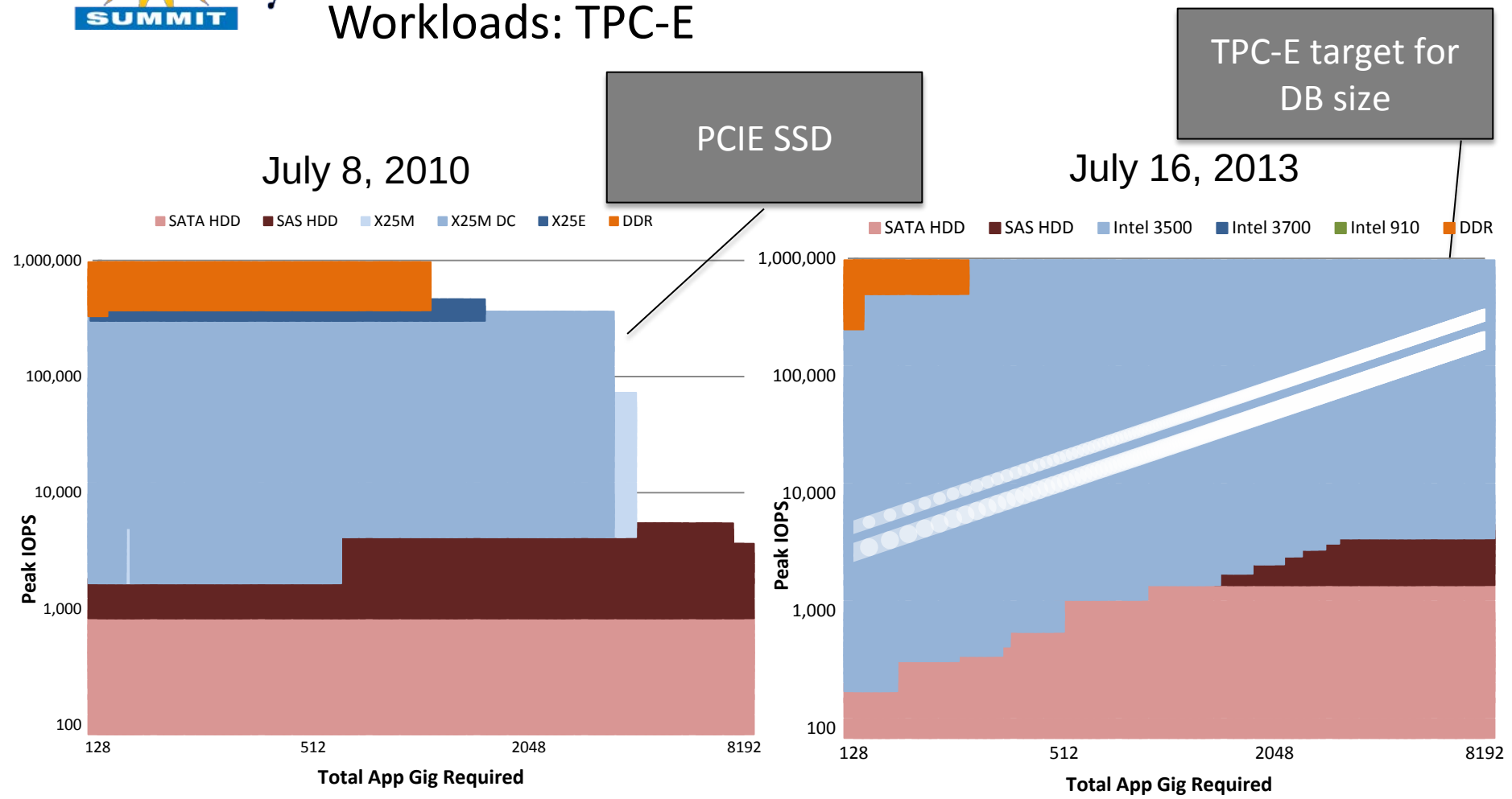
- Storage decision are driven by
  - Capacity
  - Performance
  - Price
  - Power?
- In a world of many technologies and usage models
  - what's a simple visualization of the above
  - propose best price tradeoff for single server configs



assumes a "commodity" model for storage hardware

Random 4K 90% Read, 10% Write

Workloads: TPC-E



Clear PCIe card opportunity in 2010 – reduced # drives and performance

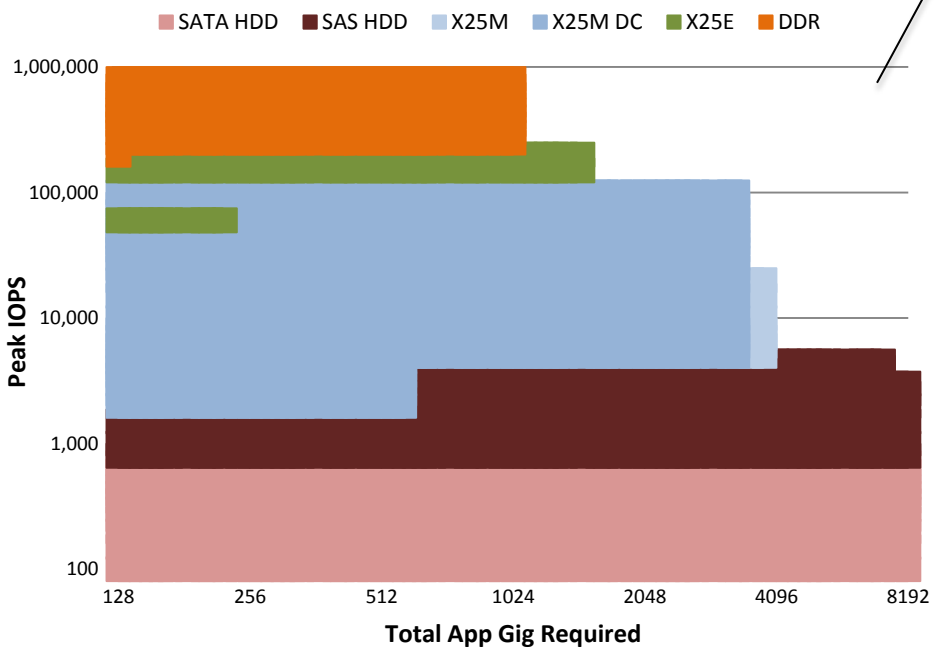
Random 4K 70% Read, 30% Write

Workloads: TPC-C

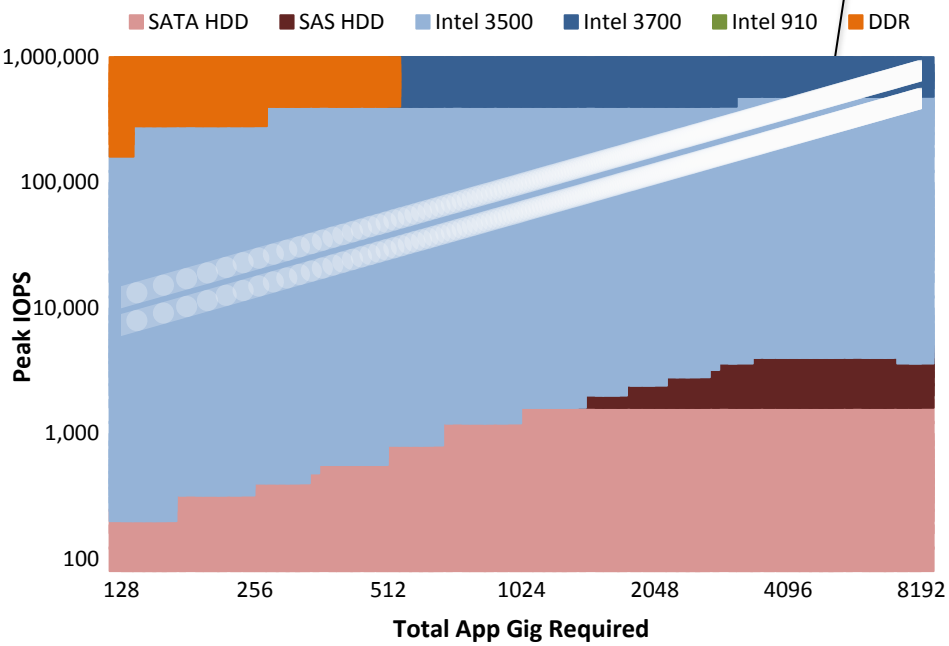
PCIE SSD Opportunity

TPC-C target for DB size

July 8, 2010



July 16, 2013

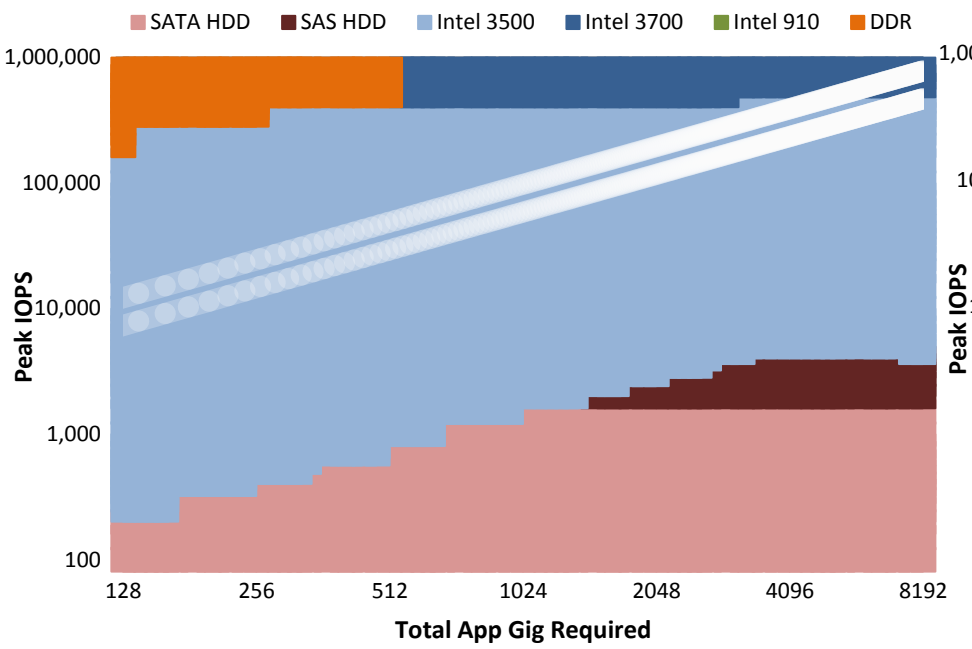


Clear PCIe opportunity in 2010 – reduced # drives and performance

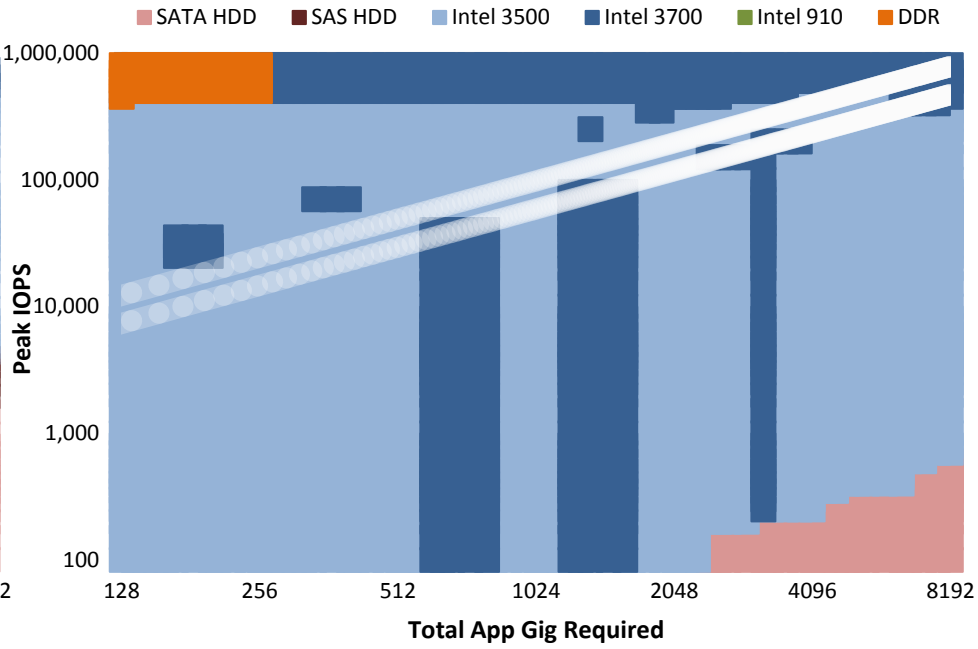
Random 4K 70% Read, 30% Write

TPC-C: selecting on power

Power - July 16, 2013



Power - July 16, 2013



When focused on just power, SSDs almost always beat HDDs and DDR

Summary

- For a simple study on spec price/performance
  - Commercial SATA SSDs have significantly improved in 3 years
  - Can cover most of the common usage cases
- For typical usage models, performance of SSD seems largely good enough
- For typical usage models, SSD seem to be the lowest power for almost all usage models

Backup

Configuration

- Server configuration
  - Basic SuperMicro 1U and 2U rack 23.5" server
  - processor/board: Xeon E5 C600 Chipset – Single and Dual
  - drive slots: 1U - 10, 2U – 24, assume possible for either 2.5 or 3.5 (i.e. HDDs.)
  - PCIe slots: 1U – 2, 2U – 4, only consider half height, half width
  - DDR: up to 1TB per server
  - All configurations forced to single server
  - Servers Direct Pricing
- SATA/SAS HDDs
  - Seagate 15K/10K and 7.2K SATA
  - Servers Direct pricing
  - IOPS based on rotational speed
- SATA SSDs:
  - SATA SSDs (Intel)
  - Amazon and NewEgg pricing
  - Spec sheet 4K random performance
- PCIe SSD:
  - Intel 910, Amazon Pricing
  - Not Fusion because no public price or performance info
- DDR DRAM:
  - Kinston
  - Servers Direct Pricing
- Notes/Assumptions
  - IOPS Performance scales linearly as drives are added
  - No extra drives for reliability or avialbility

Base data for price calculation

July 8, 2010

Media	Capacity	Random IOPS from specs (K)		
Type	GB	100R	100W	$/G
DDR-1066	2, 4, 8, 16	390,625	390,625	$30.00, $40.00, $68.75, $68.50
DDR-800	32	195,313	195,313	$71.93
X25E	32, 64	35, 35	3.5, 3.5	$11.25, $9.38
X25M	80, 160	35, 35	0.3, 0.3	$2.63, $2.63
X25M-E	73.6, 147.2	35, 35	2, 2	$2.42, $1.46
SAS HDD-15K	73.4, 146.8, 300, 450	0.20	0.18	$2.87, $1.82, $1.00, $0.98
SATA HDD-7.2K	1024	0.08	0.07	$0.15

July 16, 2013

Media	Capacity	Random IOPS from specs (K)		
Type	GB	100R	100W	$/G
DDR-1333	2, 4, 8, 16, 32	325,439	325,439	$14.50, $9.75, $10.50, $9.13, $24.00
DDR-1600	2, 4, 8, 16	390,625	390,625	$14.50, $12.25, $11.75, $10.31
Intel 910	400, 800	90, 180	38, 75	$5.00, $4.75
Intel 3700	100, 200, 400, 800	75, 75, 75, 75	9.5, 16.5, 19.5, 20	$2.84, $2.82, $2.81, $2.81
Intel 3500	80, 120, 160, 240, 300, 480, 600	70, 75, 75, 75, 75, 75, 75	7, 4.6, 7.5, 7.5, 9, 11, 11	$1.74, $1.33, $1.25, $1.29, $1.32, $1.29, $1.34
Intel 33x-335	180, 240	42, 42	5.2, 5.2	$0.99, $0.90
Intel 33x-330	60, 120	42, 42	5.2, 5.2	$1.87, $1.14
SAS HDD-15K	300, 450, 600	0.20	0.18	$0.56, $0.72, $0.61
SAS HDD-10K	300, 450, 600, 900	0.14	0.13	$0.63, $0.68, $0.59, $0.53
SATA HDD-7.2K	500, 1024, 2048, 3072, 4096	0.08	0.07	$0.12, $0.10, $0.07, $0.06, $0.09

Base data for power calculation

Media	Capacity	Random IOPS from specs (K)		
Type	GB	100R	100W	Power (Watts)
DDR-1333	2, 4, 8, 16, 32	20,828	20,828	2.43, 3.947, 4.19, 5.526, 6.741
DDR-1600	2, 4, 8, 16	20,828	20,828	2.497, 5.478, 4.433, 6
Intel 910	400, 800	90, 180	38, 75	25, 25
Intel 3700	100, 200, 400, 800	75, 75, 75, 75	9.5, 16.5, 19.5, 20	3.1, 4.6, 7.7, 8.2
Intel 3500	80, 120, 160, 240, 300, 480, 600	70, 75, 75, 75, 75, 75, 75	7, 4.6, 7.5, 7.5, 9, 11, 11	2, 2.4, 2.7, 3.2, 3.9, 5.5, 5.5
SAS HDD-15K	300, 450, 600	0.20	0.18	7.9, 7.9, 7.9
SAS HDD-10K	300, 450, 600, 900	0.14	0.13	7.9, 7.9, 7.9, 7.9
SATA HDD-7.2K	500, 1024, 2048, 3072, 4096	0.08	0.07	8, 8, 8, 8, 8