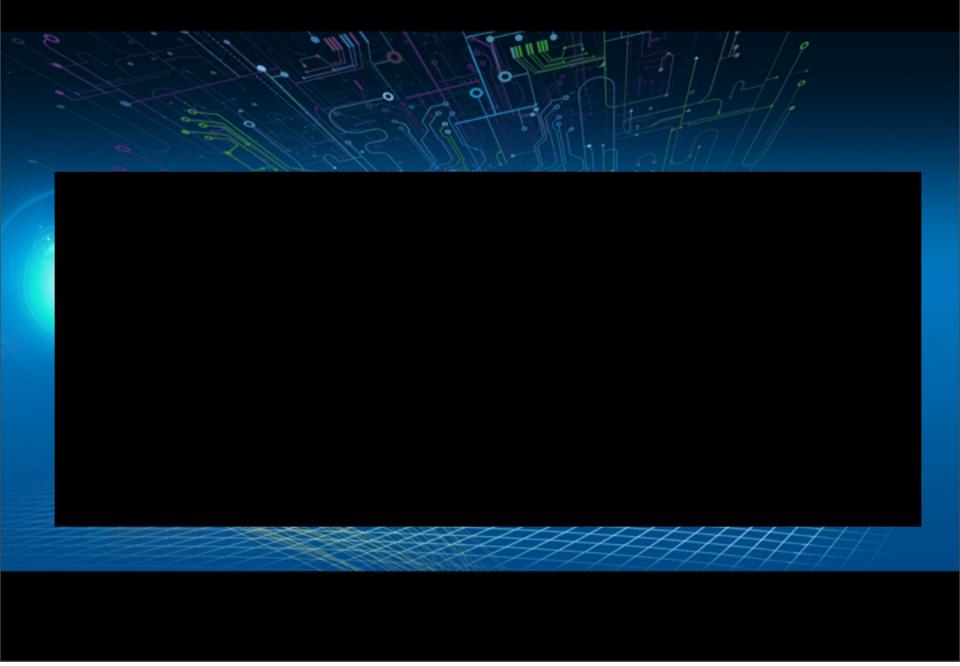
How SSDs Are Changing the Computing Paradigm The Miracle of Flash Francois Piednoel Senior Performance Analyst, Intel Corp.



Legal Disclaimers

•INFORMATION IN THIS DOCUMENT IS PROVIDED IN CONNECTION WITH INTEL® PRODUCTS. NO LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT. EXCEPT AS PROVIDED IN INTEL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, INTEL ASSUMES NO LIABILITY WHATSOEVER, AND INTEL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY, RELATING TO SALE AND/OR USE OF INTEL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. Intel products are not intended for use in medical, life saving, or life sustaining applications.

•Intel may make changes to specifications and product descriptions at any time, without notice.

•Designers must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined." Intel reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them.

•All products, dates, product descriptions, and figures specified are based on current expectations, and are subject to change without notice

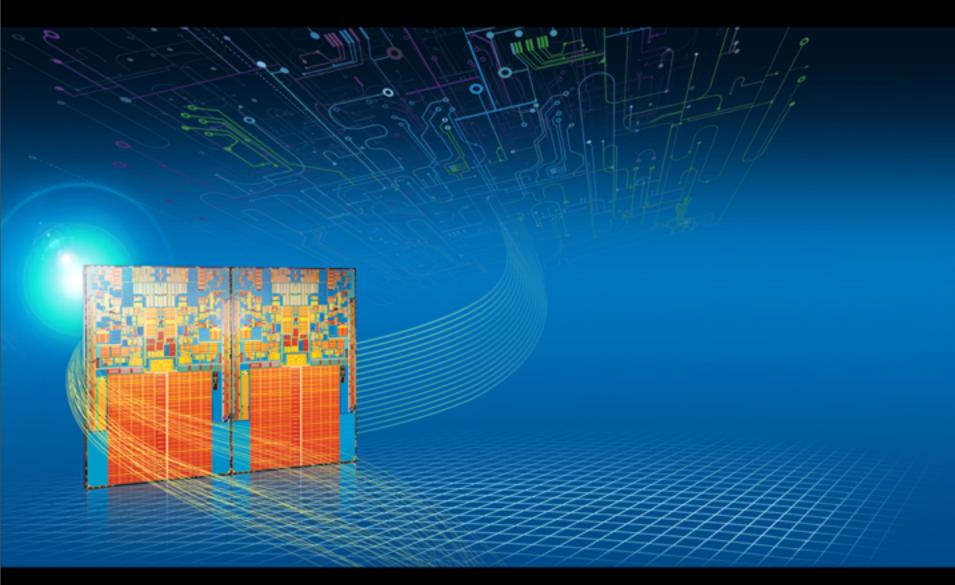
•Intel[®] High Performance Solid State Drive may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

•Contact your local Intel sales office or your distributor to obtain the latest specifications and before placing your product order.

•Intel and the Intel logo are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

•*Other names and brands may be claimed as the property of others.

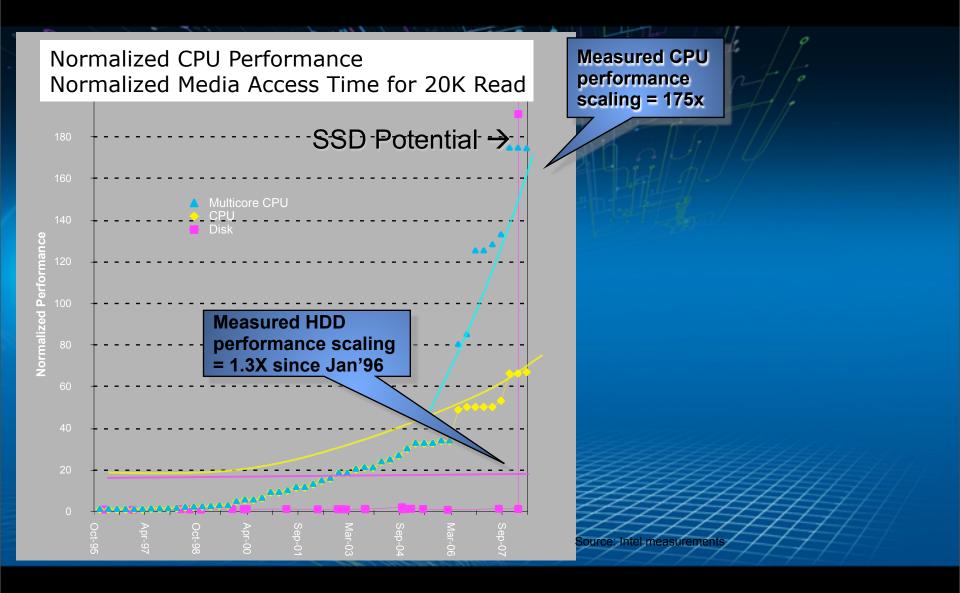
•Copyright © 2009, Intel Corporation. All rights reserved.

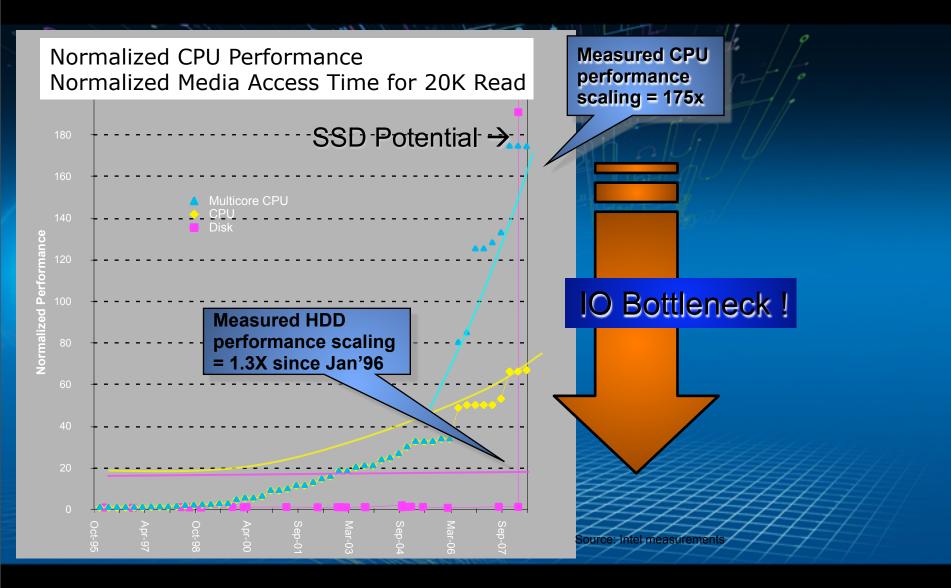


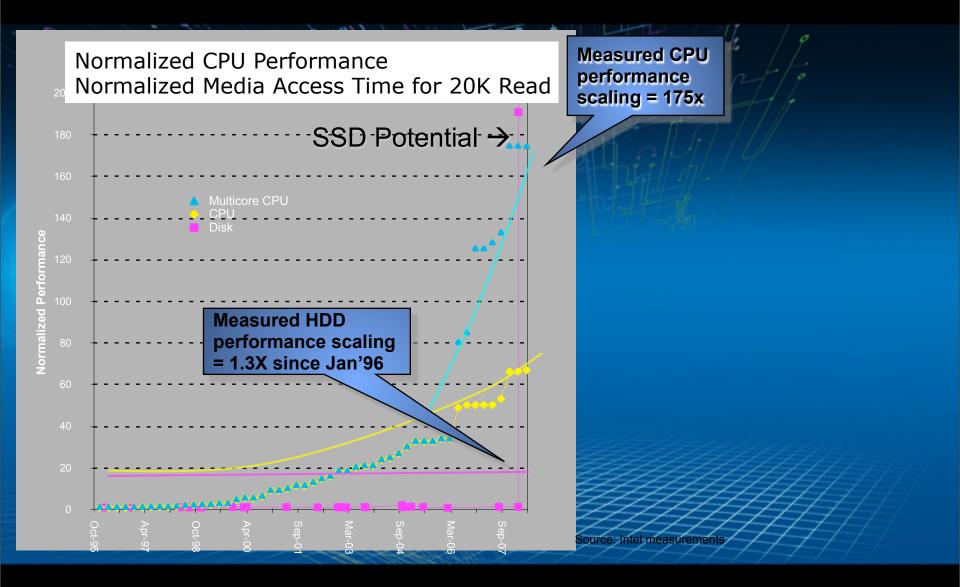
PC Bottleneck

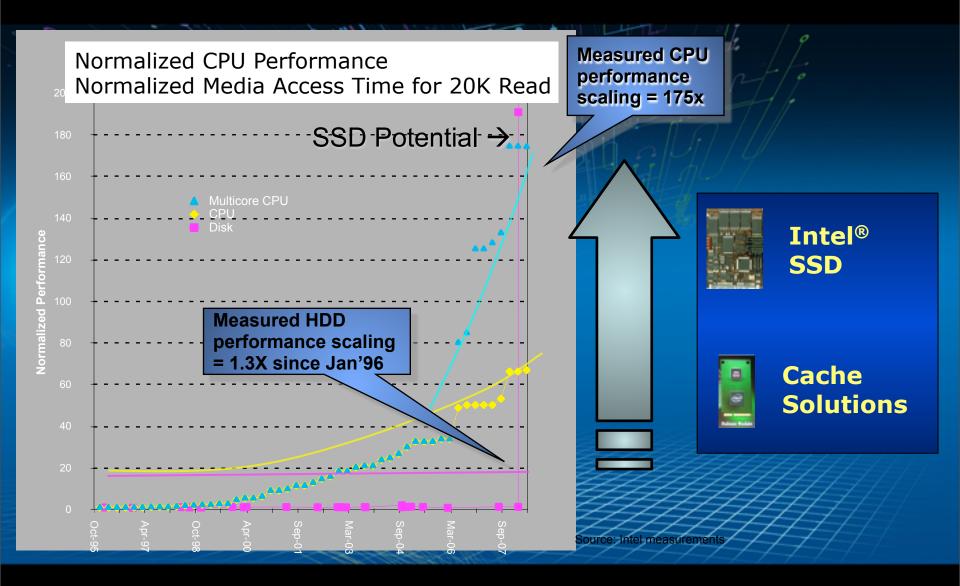


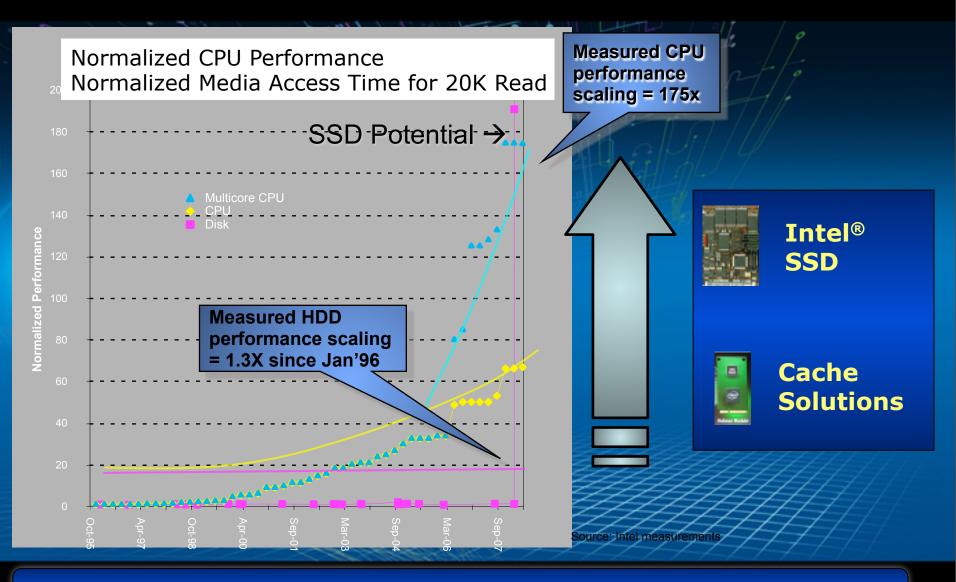
Memory → Nehalem : Done
IO → PCI express : Done
Integration coming
Storage?



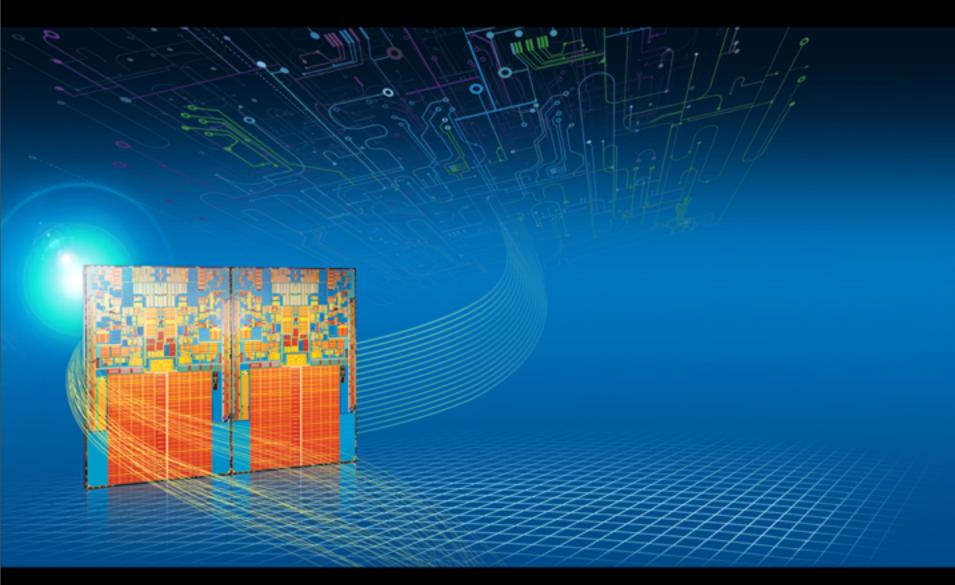








Our Mission is to remove the IO bottleneck







Rise in NAND Flash will lead to further increase in the price of solid-state disk (SSD) ITPRO, 9th July, 2009

Price hike could damage the data center. The memory market price hike could be one reason why data center managers start to think twice... zdnet.co.uk 10th up 2009 Price Hikes killing SSD sales for laptop. NAND Chip prices have increased 127% since late '08 Computerworld.com, 8th July, 2009

Intel® Decreases SSD Price by up to 60%

Rise in NAND Flash will lead to further increase in the price of solid-state disk (SSD) ITPRO, 9th July, 2009

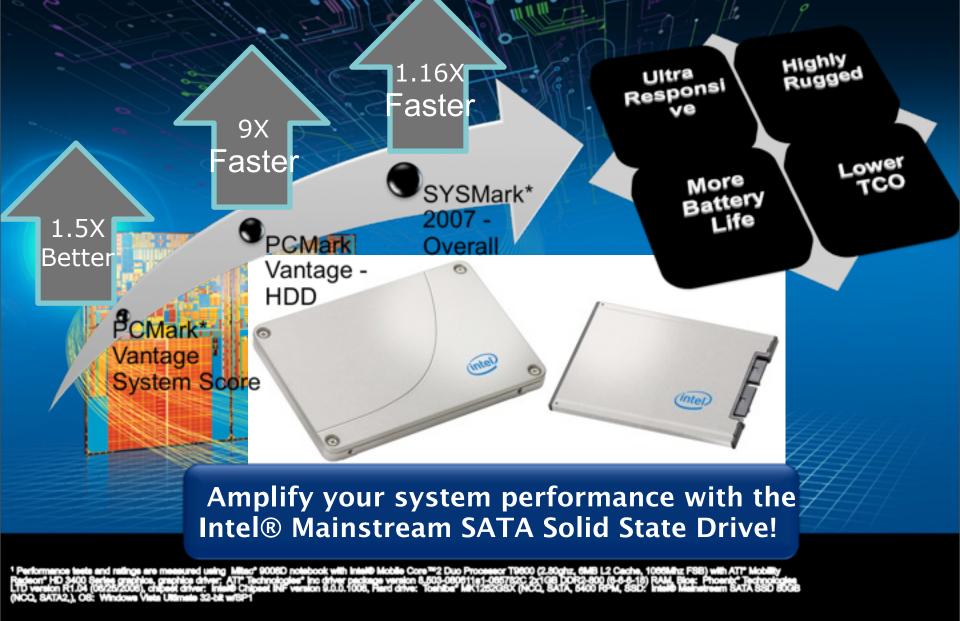
Price hike could damage the data center. The memory market price hike could be one reason why data center managers start to think twice... zdnet.co.uk 10th up 2009 Price Hikes killing SSD sales for laptop. NAND Chip prices have increased 127% since late '08 Computerworld.com, 8th July, 2009

Intel® Decreases SSD Price by up to 60%



Intel[®] Mainstream SATA Solid State Drive

Benchmark improvements compared to a 5400 RPM HDD¹





¹ Performance tests and ratings are measured using Mitac* 9008D notebook with Intel® Mobile Core[™]2 Duo Processor T9600 (2.80ghz, 6MB L2 Cache, 1066Mhz FSB) with ATI* Mobility Radeon* HD 3400 Series graphics, graphics driver: ATI* Technologies* Inc driver package version 8.503-080611a1-065782C 2x1GB DDR2-800 (6-6-6-18) RAM. Bios: Phoenix* Technologies LTD version R1.04 (06/25/2008), chipset driver: Intel® Chipset INF version 9.0.0.1008, Hard drive: Toshiba* MK1252GSX (NCQ, SATA, 5400 RPM, SSD: Intel® Mainstream SATA SSD 80GB (NCQ, SATA2, fw8510), OS: Windows Vista Ultimate 32-bit w/SP1

Intel[®] Mainstream SATA Solid State Drive Benchmark improvements compared to a 5400 RPM HDD¹

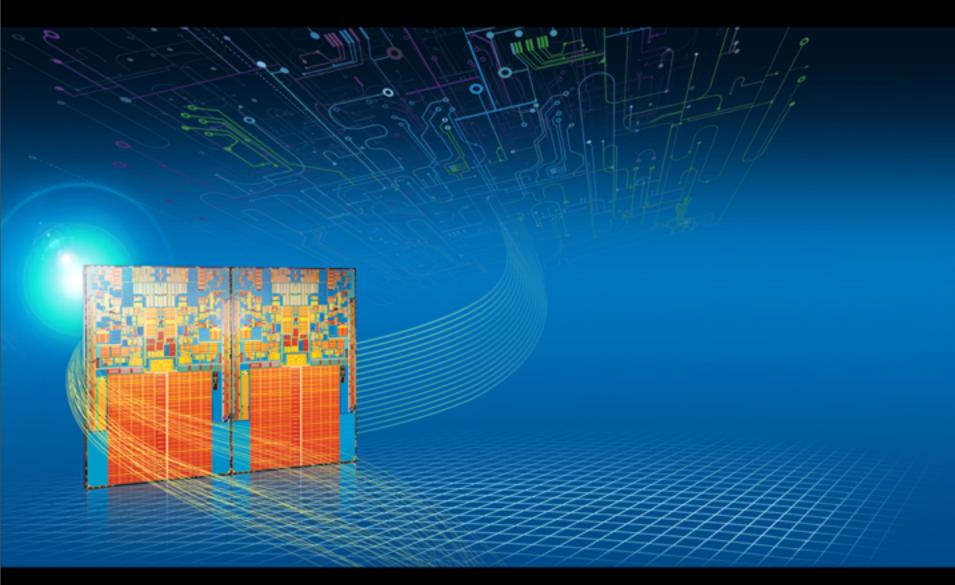


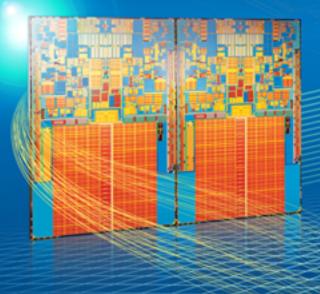
¹ Performance tests and ratings are measured using Mitac* 9008D notebook with Intel® Mobile Core[™]2 Duo Processor T9600 (2.80ghz, 6MB L2 Cache, 1066Mhz FSB) with ATI* Mobility Radeon* HD 3400 Series graphics, graphics driver: ATI* Technologies* Inc driver package version 8.503-080611a1-065782C 2x1GB DDR2-800 (6-6-6-18) RAM. Bios: Phoenix* Technologies LTD version R1.04 (06/25/2008), chipset driver: Intel® Chipset INF version 9.0.0.1008, Hard drive: Toshiba* MK1252GSX (NCQ, SATA, 5400 RPM, SSD: Intel® Mainstream SATA SSD 80GB (NCQ, SATA2, fw8510), OS: Windows Vista Ultimate 32-bit w/SP1



Breeze through daily tasks with Intel® Mainstream SATA SSDs!

¹ Performance tests and ratings are measured using Mitac* 9008D notebook with Intel® Mobile Core[™]2 Duo Processor T9600 (2.80ghz, 6MB L2 Cache, 1066Mhz FSB) with ATI* Mobility Radeon* HD 3400 Series graphics, graphics driver: ATI* Technologies* Inc driver package version 8.503-080611a1-065782C 2x1GB DDR2-800 (6-6-6-18) RAM. Bios: Phoenix* Technologies LTD version R1.04 (06/25/2008), chipset driver: Intel® Chipset INF version 9.0.0.1008, Hard drive: Toshiba* MK1252GSX (NCQ, SATA, 5400 RPM, SSD: Intel® Mainstream SATA SSD 80GB (NCQ, SATA2, fw8510), OS: Windows Vista Ultimate 32-bit w/SP1

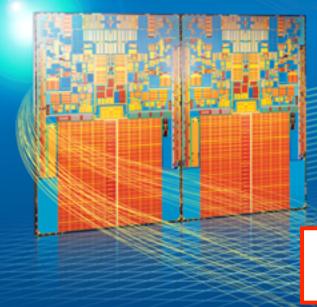




Next step ...



Your Digital life is turning MASSIVE



204 Gigs of Pictures

- 19 Gigs of Videos
- 21700 Pictures
- 250 videos.

230 Tera Pixels!

and the second second	de a Loathacti a Pos	4 N Intel				
Report Management	1000					-
Parcella Looks	Testa .	the notified	tax	500		
Coloreste .	2 298,31,32 Patrien .		All Automatica			
D Patrone	- 00,1,1 - Annahi		Alla Fulder			
P	4.588(3.2) Shipe	11209-1019-0	Alla Falater			
-	2 598,31,31 - 108ppr	84(98)40 PM	This Postster			
Accelly Compet-	4.08(3.) ² Shipe	1100010700	Alla Sublet			
i landa	2.398,3,3 Oktor	8.4 (MR-6.) (MA	Alle Public			
August .	# 88(3,5-1der	84(00041)764	Trie Trainier			
	4.04(0,0) index	8 N 24016 21744	All Automatic			
	# 298,21,2 - helper	84 2004 (KIM)	Rise Rubber			
	# 888,0,0 - Helper	84208062294	Tria Trolphan			
	# 208,2,2 - https:/		Ring Russier			
	# DR.2.3 Hotelse	84 (189-8.9-76)	The Public			
	# 310,0,0 totalna	10000000000	Rite Rulpher			
	\$396(2,877-box).		Alle Robber			
	2.01(3),8-3miles	EA INDERIGHT	The Fulger			
	a limited and a limited	A NUMBER OF TAXABLE PARTY.	Ana Australian			
	8.08(3) - Wood 5		And Public			
	100,0,0 Seck	AND AL	Tax Loope			
	2.000,0,0 Made					
	2 594, 12, 15 Mail an		Trans Property			
	2.000,0,0, h MARINE		And Partners			
	2.207.0.0 - Tubel	A 4 DEPARTMENT	Rig Lotate			
	# BR 3.5 Ing the		Star Purchase			
	a 201 (d.) R. Sang Yan		All Autom			
	2.387.31,8-LongPL		Alle Autom			
	2.001(0.00 Long PL		Kite Fulder			
	a.287(8,3)-Long-h.		Right Republics			
	# 887;8,31-LungNa		Alla Folder			
	4.001(A,A-1argat		Alla Autober			
	a BUR, D. Camba		Wite Tradition			
	· BULLA MARAN		This Turiper			
	a 367 (K, H- Seatto.		Alle Autolet			
	107.0.3-3millio		Rite Robber			
	# BH (R. H. Chainte.		All Automatics			
	4.387,8,3. He fee	84000438763	Ally Public			
	# 80.5C.R - Ph.Pen	840001.00	The Turber			
	a MUDUE Medde		Alle Fulger			
	A SHT (C/D) Mandalay		Risk Rudgier			
	8-80.50 Beat	8.4 (MID 6.1 VM	Tria Turbier			
Falales /		AN DEPARTURE	Alle Fulder			
Did dama						

Real time on HDD requires sacrifice.

Seek time ...

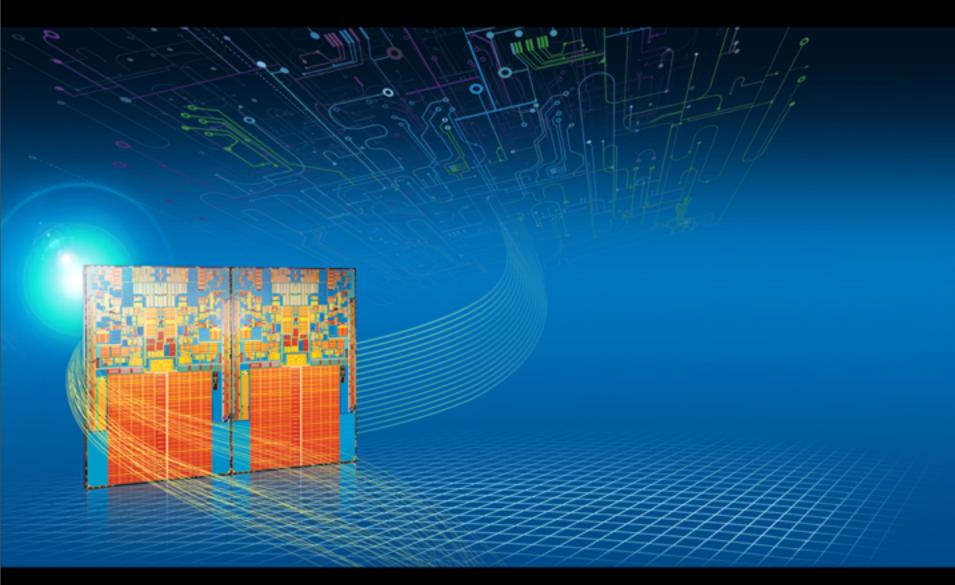
21700 files x 12ms = 260.4 Seconds → 4> minutes of <u>seek time</u>...

Real time on HDD requires sacrifice.

And A Date	del a Locathacti) a Pada				A Designation	_
Conception in the				_		
Parcella Looks	Textus	the notified	tope .	Sea		
E fromme	2 598(3)(2) Patrien .	84084894	Alla Autoine			
	- DR. D. H. Annahl.	41000349764	Alle Autom			
E Adum	2.398(3.2) Uniper	14 200-14 PM	Ally Public			
9 mar	# 598,31,30 - 108ppr	84(9864) 744	this further			
2 Averily Correct	4.88(3.) ² Shipe	1100010704	Alla Suble			
E banks	2.398(3,3) Ohiper	8.4 (MIRAL) (MA	Alle Public			
A 444	6.08(3),0-348pc	84(8866)/M	Trie Trainier			
	- 106, 11, 31 (helper	8 N 2401 6 24794	All Autom			
	4.098;3,3-148per	84 (2004 (A.PM	Ring Replace			
	4.588(3,3)-Indeput	84/2000/L/C/PM	The Toldar			
	# 396(2,2) highers.		All Autom			
	# 596,31,34 - Incalment	84084876	The Public			
	# 398,0,8 totalmar	1000010070	Rite Rulpher			
	1.398(3.307 loss).	84 209 6 2 76	Alle Autom			
	# 595,3,8-36aline	LA DOLLARS	The function			
	2-306(0)3-3mildar	A NUMBER OF THE OWNER.	Ana hunder			
	BRUD-Wordb.		The Public			
	8-390,0,0 -3mil	and the state	Tax Loop			
	1.04,0,0 Makes	10	Tax Lotax			
	2 198, 12, 15 Mail an 1	_				
	2.04,0,3 Make	10.00	An Loss			
	2.207.0.0-1-tabl	SA DER ANT	Rep Lution			
	a dist, d., di-tang tang		And Party of			
	a 207 (4, 6 - Serg Yang		All Autom			
	2.00.0.8-LongPL		Ally Publics			
	2.00(0,0 Longh.		Rise Rubble			
	a 387,8,30-Langh.		Alla Public Alla Public			
	# 807;8;31-LungNa.		The Public			
	2.00(A,8-1sept	1402001-0744	The Public			
	a SHI R.D. Canche.		The Politics			
			No. Lotor			
	2.00(0,0-0aths.		The Lottine			
	a Mil M. M. Charles		And Address			
	107.0.3 Holes	8-4 (200 + 5 / Per	The Public			
	1.001.01.01.10.7as	And Distance in case	The Public			
	a BIT IC IC Metalan	8 N 2001 L 3 PM	The Public			
		8-1 (200-1-10-PM)	The Public			
	a dat of the larger	EN DER LI VM	The Public			
	a life in the second	AN DEPARTURE	The Public			
Falders #	a second second	100000000000000000000000000000000000000	101100			

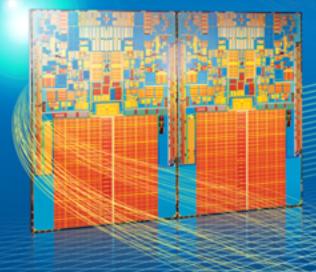




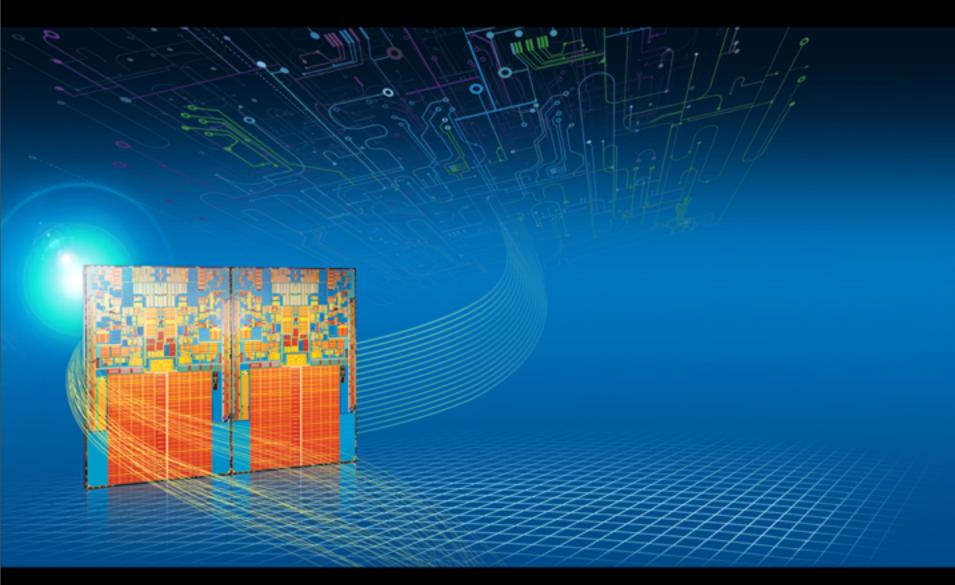


SSD = Processor amplifier

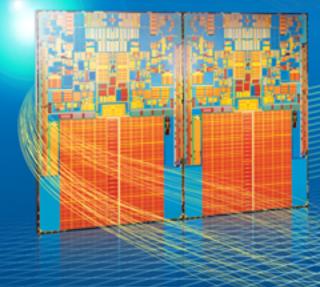
 100% CPU utilization on pictures



Dual SSD RAID 0 Maxed
Rich User Interface needs low latencies



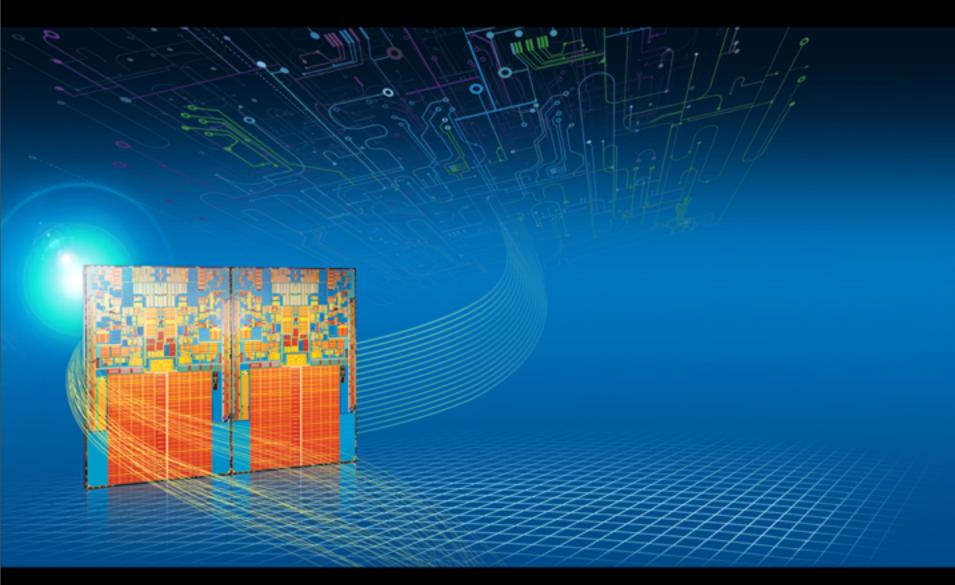
ERA of Parallelism



Multi Cores-Many Cores

 Storage need to have Low latency, high bandwidth to feed the cores

 HDD don't match CPU needs, Larrabee will increase needs



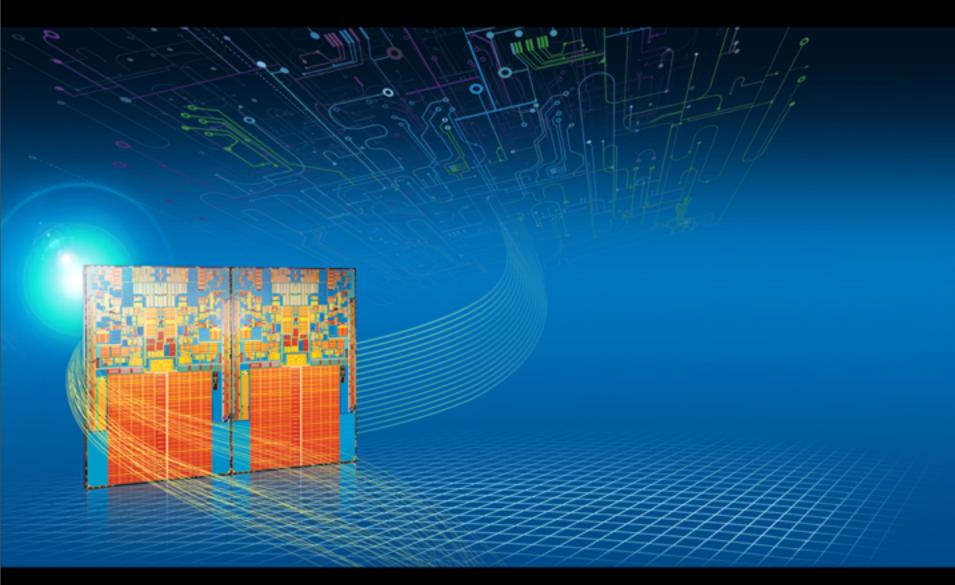
Conclusion



Keep increasing bandwidth
Keep decreasing latencies

Seek times...

Get read for thousands of files open competitively
Target mainstream



• Thanks!



Questions?