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A joint report by Tom Coughlin and Jim Handy:

HDDs and Flash Memory:

A Marriage of Convenience

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HDDs and Flash Memory: A Marriage of Convenience

Tom Coughlin¹, and Jim Handy²

Executive summary

This report examines a new storage architecture that has been named “Paired Storage” by the Storage Networking Industry Association – SNIA. Paired storage is the combination of flash memory with conventional rotating storage.

Important findings are:

- Flash will become a necessary component in computing systems driven by a growing performance gap between DRAM and rotating storage.
- The first hybrid HDDs have appeared from Seagate combining flash memory and hard disk drives but more hybrid drives may follow.
- Paired storage using separate flash and HDD storage devices are already being used to help bridge this gap. Data centers and high performance computer users are the largest market for paired storage today. This will migrate to the broader PC in the future.
- Several paired storage approaches are being tried with no clear winner: Hybrid HDDs, flash on the motherboard, SSDs teamed with HDDs, and other approaches are each detailed in the report.
- Manual data placement is most common today, but several new software products automate this task, offering much better results at a low cost.
- Paired storage helps reduce system power consumption while improving system performance.
- The paired storage market will grow to 328 million units by 2016, with an additional 41 million units shipping in the Tablet market creating a new category of “fat tablets”.

The report ends with profiles of companies spearheading efforts in paired storage technology.

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About the Authors



Tom Coughlin, President, Coughlin Associates is a widely respected storage analyst and consultant. He has over 30 years in the data storage industry with multiple engineering and management positions at high profile companies. Tom is a frequent presenter at trade shows and technical conference and an organizer of several industry events.

Dr. Coughlin has many publications and six patents to his credit. Tom is also the author of *Digital Storage in Consumer Electronics: The Essential Guide*, which was published by Newnes Press in 2008. Coughlin Associates provides market and technology analysis (including regular reports on digital storage technologies and applications such as professional media and entertainment and consumer electronics and a newsletter). His company, Coughlin Associates also provides consulting services.

Tom is active with SMPTE, IDEMA, SNIA, the IEEE Magnetics Society, IEEE Consumer Electronics Society, and other professional organizations. Tom is the founder and organizer of the Annual Storage Visions Conference (www.storagevisions.com), a partner to the annual Consumer Electronics Show as well as the Creative Storage Conference. Tom is also the chairman of the annual Flash Memory Summit. He is a Leader in the Gerson Lehrman Group Councils of Advisors and a member of the Consultants Network of Silicon Valley (CNSV). For more information go to www.tomcoughlin.com. Coughlin Associates can be contacted at 408-978-8184 or by email at tom@tomcoughlin.com.



Jim Handy, a widely recognized semiconductor analyst, comes to Objective Analysis with over 30 years in the electronics industry including 14 years as an industry analyst for Dataquest (now Gartner) and Semico Research. His background includes marketing and design positions at market-leading suppliers including Intel, National Semiconductor, and Infineon.

A frequent presenter at trade shows, Mr. Handy is known for his widespread industry presence and volume of publication. He has written hundreds of articles for trade journals, Dataquest, Semico, and others, and is frequently interviewed and quoted in the electronics trade press and other media. Jim has served as the Senior Program Advisor for the Flash Memory Summit for the past four years and is a member of the SNIA Solid State Storage Initiative.

Mr. Handy has a strong technical leaning, with a Bachelor's degree in Electrical Engineering from Georgia Tech, and is a patent holder in the field of cache memory design. He is the author of "The Cache Memory Book" (Harcourt Brace, 1993), the leading reference in the field. Handy also holds an MBA degree from the University of Phoenix. He has performed rigorous technical analysis on the economics of memory manufacturing and sales, discrediting some widely held theories while unveiling other true motivators of market behavior.

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References

ⁱ Seagate Momentus XT Introduction Presentation, May 2010.

ⁱⁱ [Unleashing The Value of Solid-State Drives for DB2 Workloads](http://www.ibmddmagazinedigital.com/dmmagazine-sample/sample?pg=33#pg32), IBM Data Management Magazine, Issue 1, 2010, Volume 15, No. 1, <http://www.ibmddmagazinedigital.com/dmmagazine-sample/sample?pg=33#pg32>

ⁱⁱⁱ Shahed Ameer, Intel, IDF 2010

^{iv} [Flash and HDDs: Symbiosis or Survival of the Fittest?](http://www.tomcoughlin.com/techpapers.htm), T. Coughlin, J. Handy, R. Hoyt, White paper published in 2009 (available at <http://www.tomcoughlin.com/techpapers.htm>).

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