



Using Software and DRAM to Double Flash SSD Speeds

By

Jason Caulkins, Chief Technologist
Dataram Corporation (NASDAQ: DRAM)

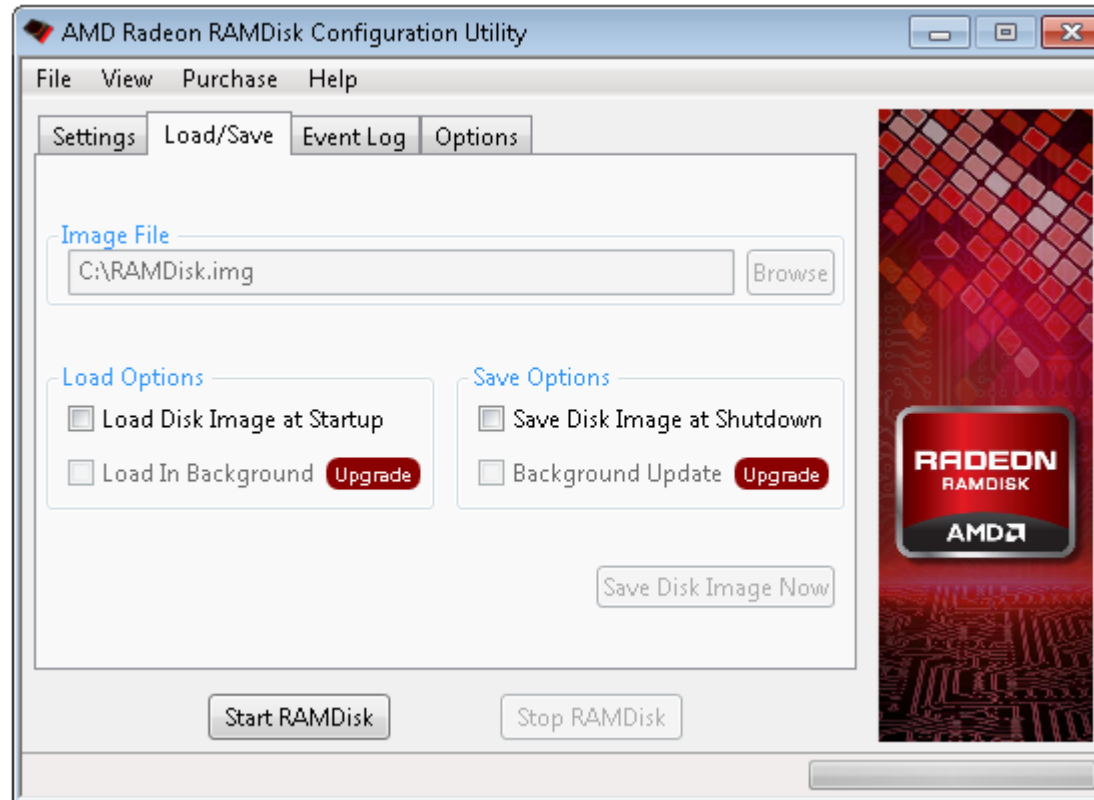


Flash SSDs are fast, right?

Average consumer flash SSD: 250 MB/s

Disk in this PC: 8.5 GB/s

RAM Disk



Who is using a RAM Disk?

- 2 Million user installed base
- 70 of the Fortune 100 companies
- Tens of thousands of smaller enterprises
- Double digit growth year-over-year

What do they use it for?

Client

- Games
- Video Editing/Rendering
- Compiling/Building Code

Server

- Database Temp Files
- Swap Space
- Custom Apps

Dealing with DRAM

- DRAM is not permanent storage
- Cost per GB is higher than flash

BUT

...34x speed!

Using software to set speed/risk tradeoff

- Client applications with non-mission critical data can tolerate moderate risk
- Smarter software further mitigates risk
 - Streaming backup
 - Tunable DRAM allocations

How is a RAM Disk currently used with a flash disk?

Flash disk as permanent, backing storage
for the RAM Disk

Combine RAM Disk with flash disk to
create logical disk

Benefits of DRAM/flash disk

Performance tunable

Wear tunable

Capacity tunable

Simple Example

1 to 1 Ratio of DRAM to Flash

- 2x performance of flash drive alone
- $\frac{1}{2}$ write wear of flash drive alone
- 2x capacity of RAM Disk alone

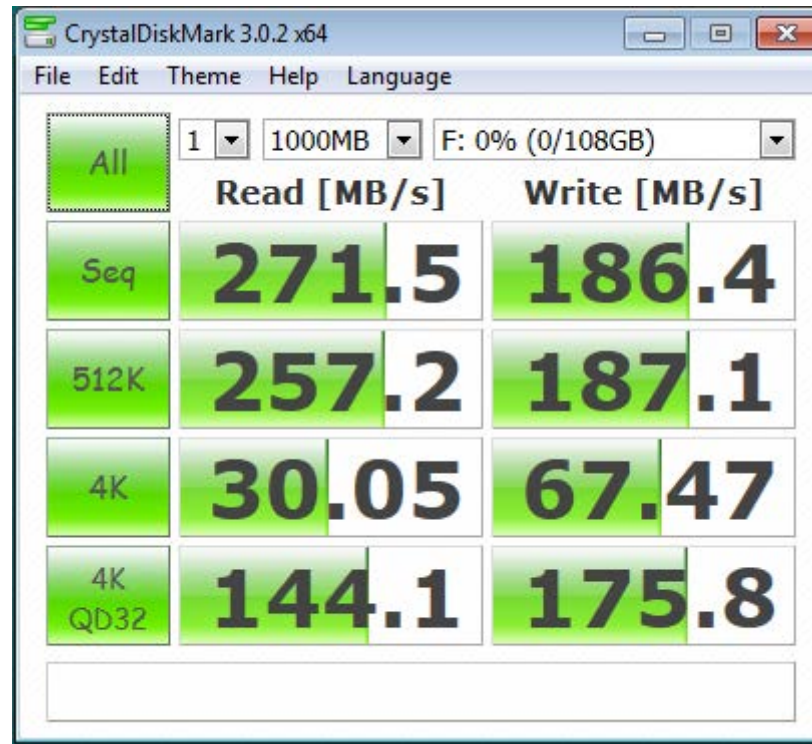
Any ratio works!

Elegant Example

Use DRAM + Software as cache

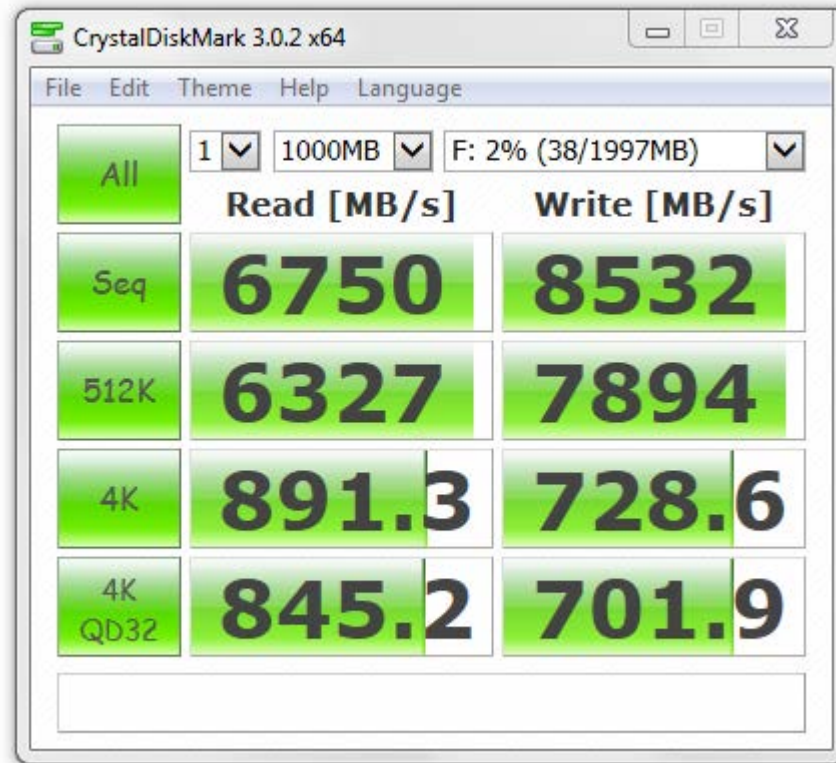
- Transparent
- Cache hit ratio benefits
- Tunable
- Resource efficient

Performance Results



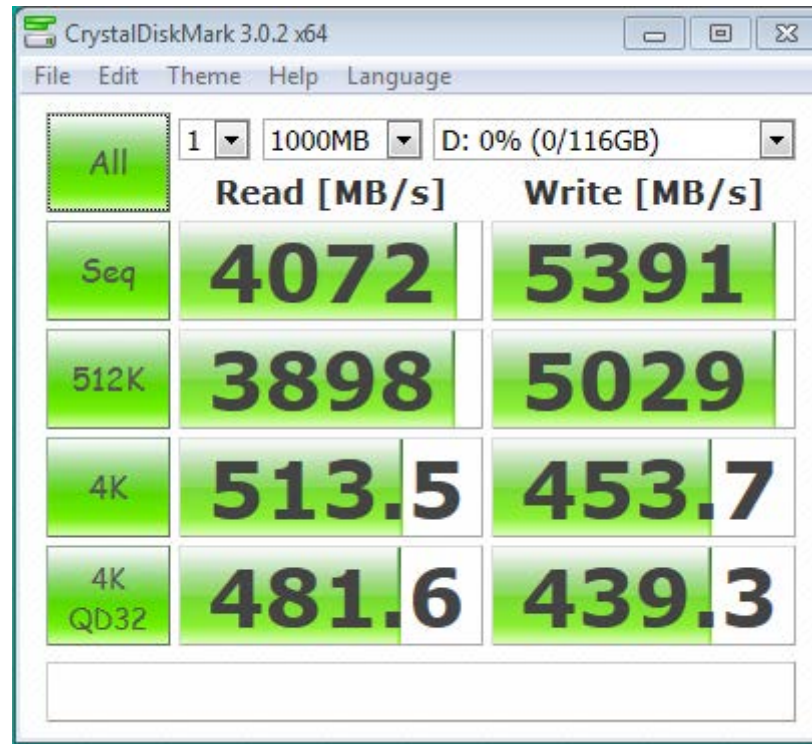
Intel X25M

Performance Results



RAM Disk

Performance Results



RAM Disk with Intel X25M

Key Takeaways

Flash with DRAM yields:

- Greater speeds than flash alone
- Less wear
- Flexibility – tune for optimal speed, reliability and wear



Thank You!!

Jason Caulkins, Chief Technologist

jcaulkins@dataram.com 609-799-6734

Dataram Corporation
777 Alexander Road
Princeton, New Jersey
800.DATARAM