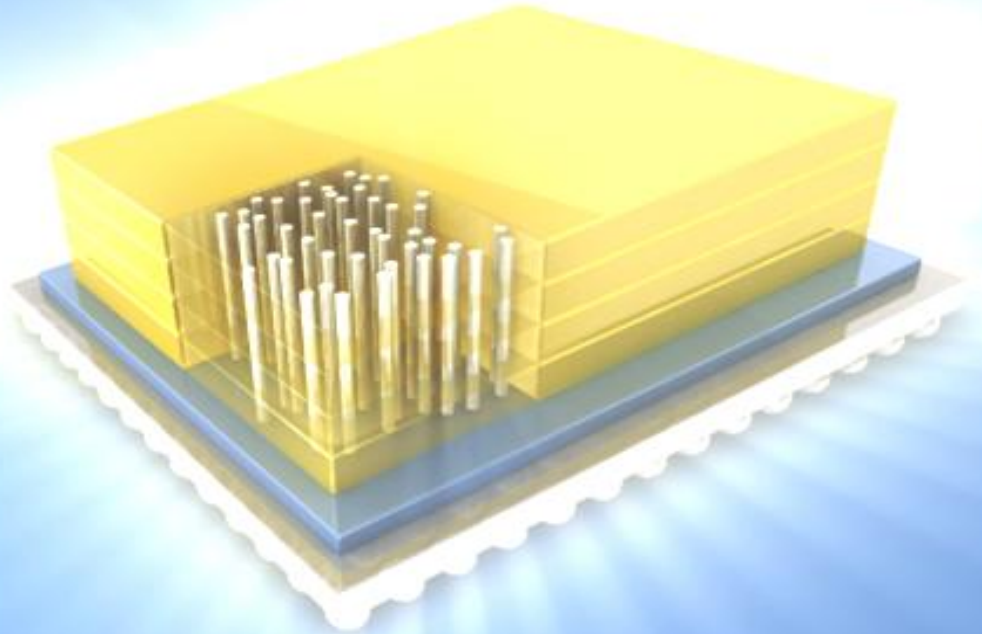


# HYBRID MEMORY CUBE (HMC)

**Todd Farrell**  
**Director, Technical Marketing**  
**Senior Member Technical Staff**  
**Micron Technology**

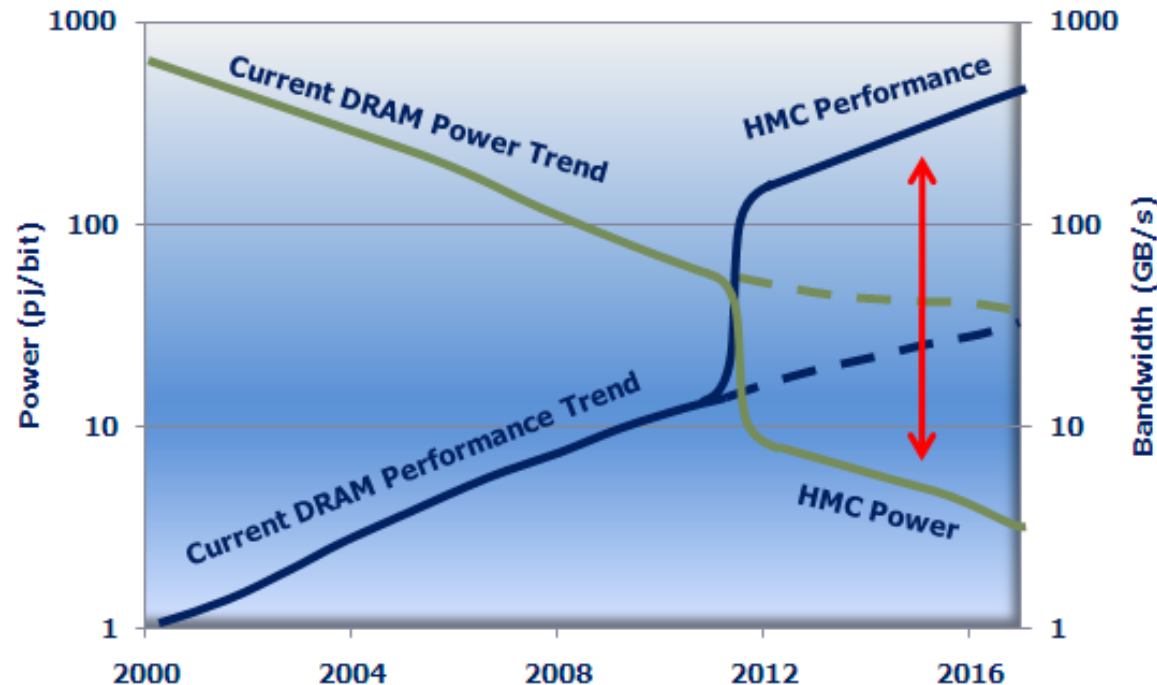
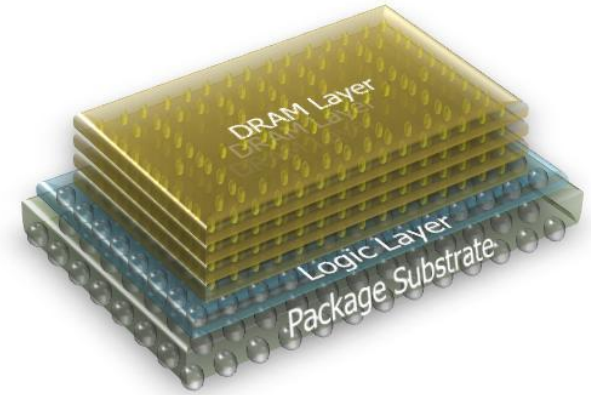


*"Of all the emerging memory technologies, HMC is the one that will likely have the most impact in the long run"*  
- Electronic Design

# Hybrid Memory Cube

## Micron's Newest Memory Innovation

We've combined fast logic process technology and advanced DRAM designs to create an entirely new memory category. HMC will provide a revolutionary performance shift that will enrich next-generation networking and enable exaflop-scale supercomputing:



**Reduced Power**  
Fraction of the energy per bit

**Reduced Footprint**  
90% less space than today's RDIMM

**Increased Bandwidth**  
15x performance of DDR3-1333 DIMM

# Enabling Technologies

## Abstracted Memory Management

### Memory Vaults Versus DRAM Arrays

- Significantly improved bandwidth, quality and reliability versus traditional DRAM technologies

### Logic Base Controller

- Reduced memory complexity and significantly increased performance
- Allows memory to scale with CPU performance

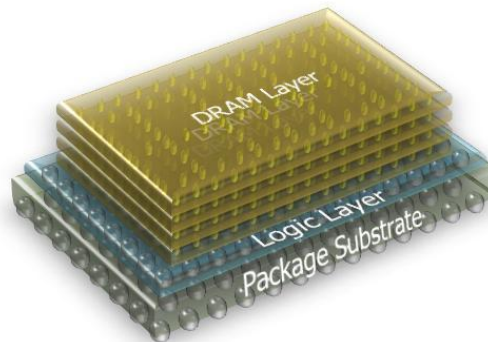
## Through-Silicon Via (TSV) Assembly

### Innovative Design & Process Flow

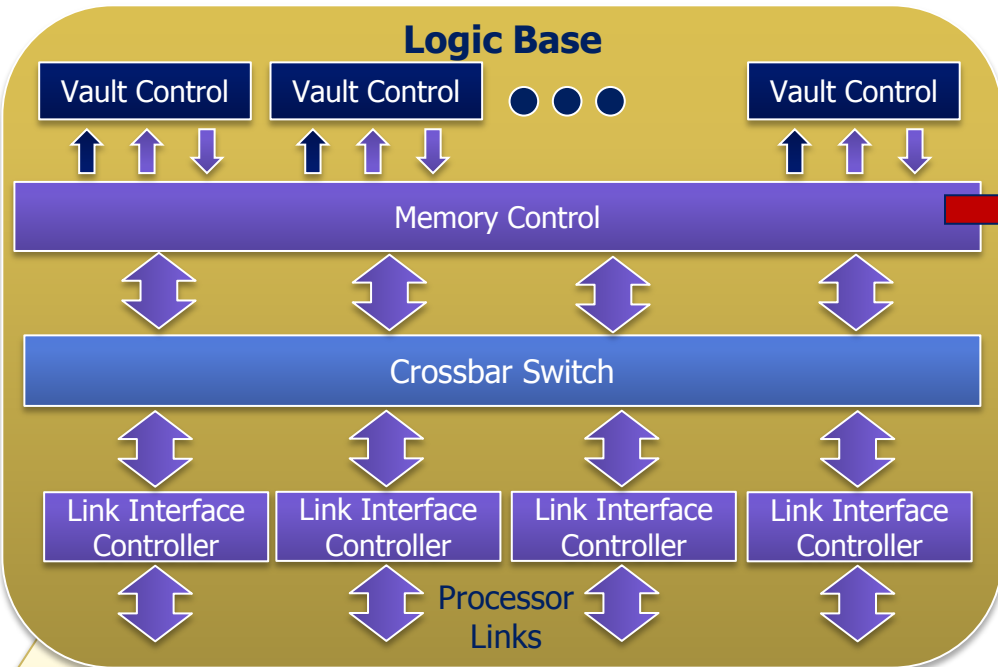
- Incorporation of thousands of TSV sites per die reduces signal lengths and reduces power
- Enables memory scalability through parallelism

### Sophisticated Package Assembly

- Higher component density and significantly improved signal integrity

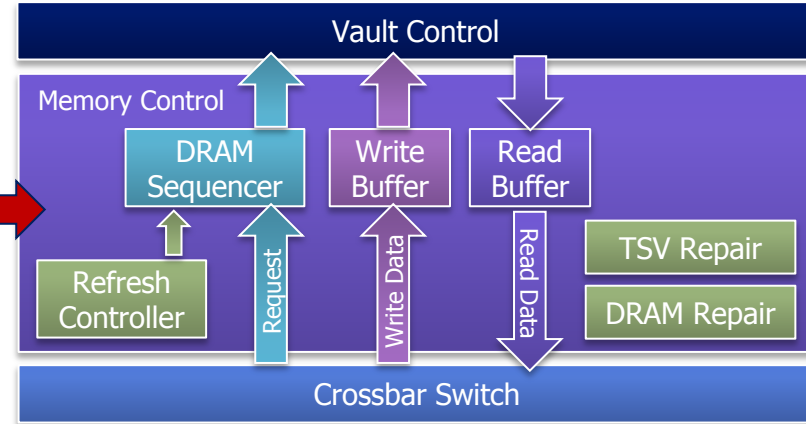


# HMC Architecture



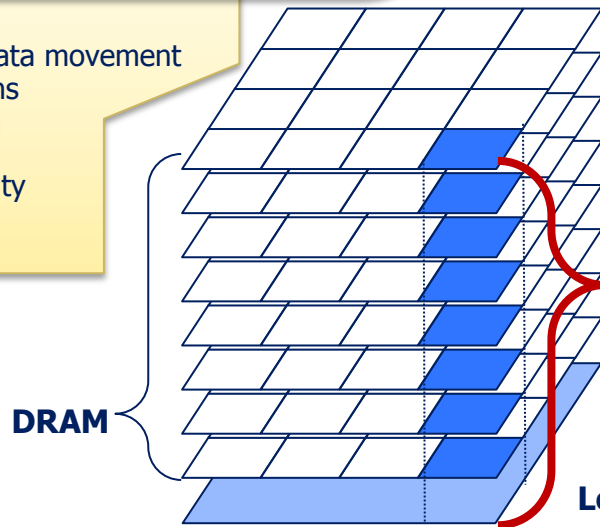
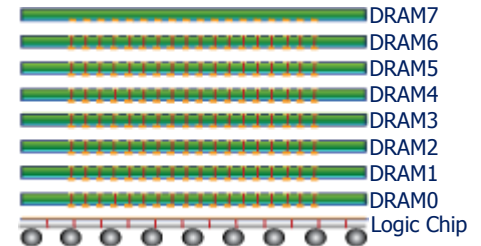
## Logic Base

- Multiple high-speed local buses for data movement
- Advanced memory controller functions
- DRAM control at memory rather than distant host controller
- Reduced memory controller complexity and increased efficiency



## Detail of memory control

## 3DI & TSV Technology

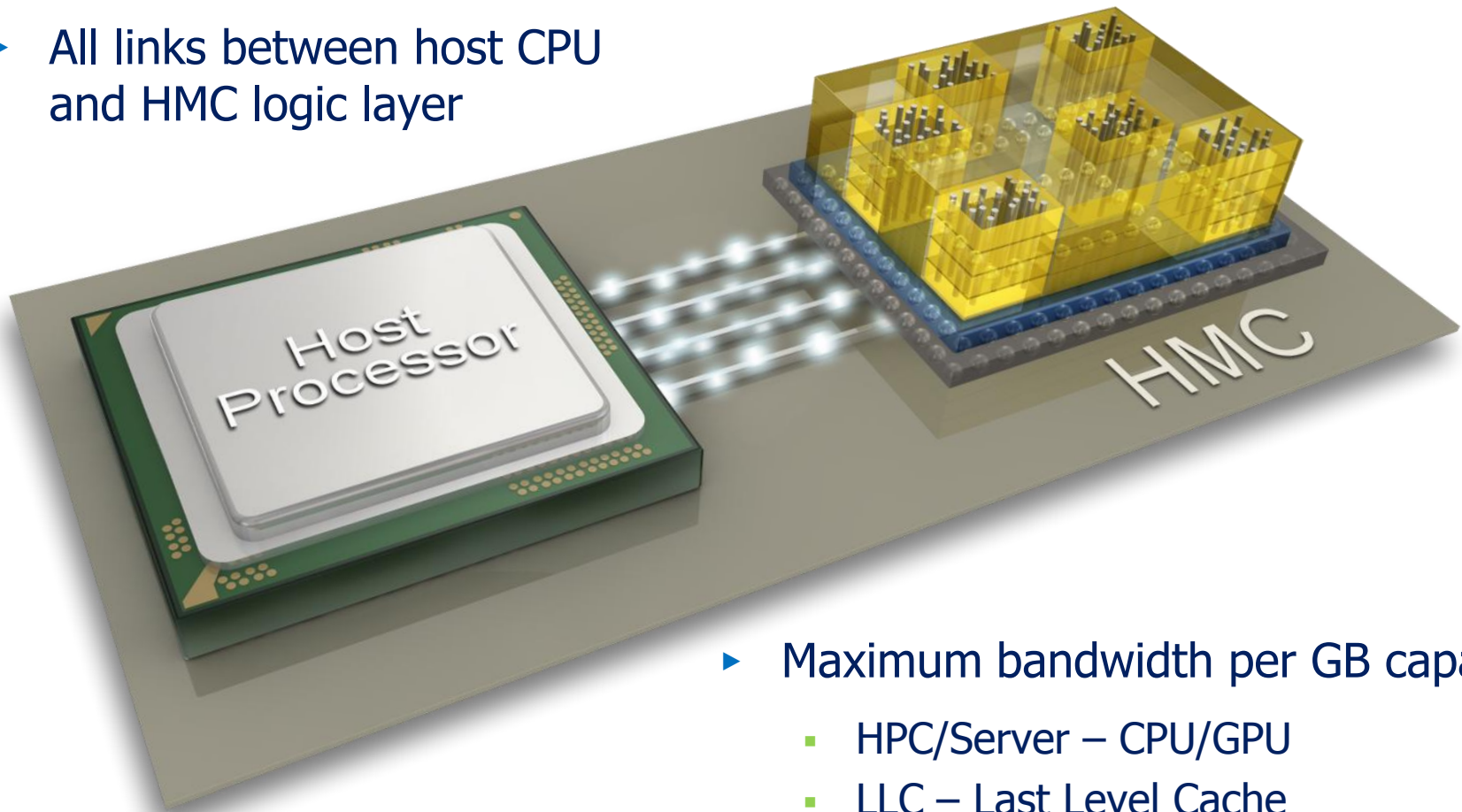


**Vault** Vaults are managed to maximize overall device availability

- Optimized management of energy and refresh
- Self test, error detection, correction, and repair in the logic base layer

# HMC Maximum Memory Bandwidth

- ▶ All links between host CPU and HMC logic layer

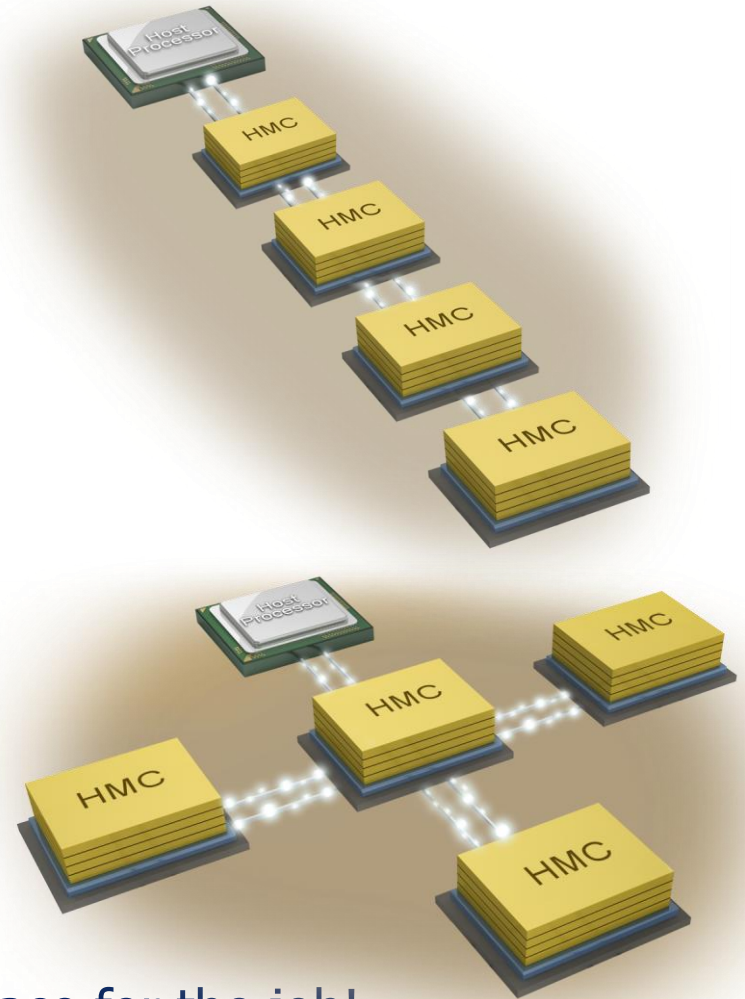


- ▶ Maximum bandwidth per GB capacity
  - HPC/Server – CPU/GPU
  - LLC – Last Level Cache
  - Graphics
  - Network Infrastructure
  - Test/Measurement equipment



# HMC Memory Flexibility and Scaling

- Maximize Density and Scale
  - ▶ Some HMC links connect to host, some to other cubes
  - ▶ Scalable to meet system requirements
  - ▶ Can be in module form or soldered-down
  - ▶ Create your own network/fabric
- Future interfaces may include
  - ▶ Higher speed electrical (SERDES)
  - ▶ Optical
  - ▶ Whatever the most appropriate interface for the job!



# Industry Support and Momentum

## Developer Member Companies



**Adopters Companies: 100+ Member Companies to date!**



Hybrid Memory Cube  
C O N S O R T I U M

[www.hybridmemorycube.org](http://www.hybridmemorycube.org)

[Home](#) [About Us](#) [The Technology](#) [Membership](#) [Contact Us](#) [News](#) [Login](#)

HMCC has delivered the first Draft HMC Specification to Adopters! Be among the first to review by visiting the [About Us](#) page and requesting the Adopters Agreement.

- [Discover The Technology](#)
- [Review the FAQ](#)
- [Learn How To Participate](#)

### About the Technology

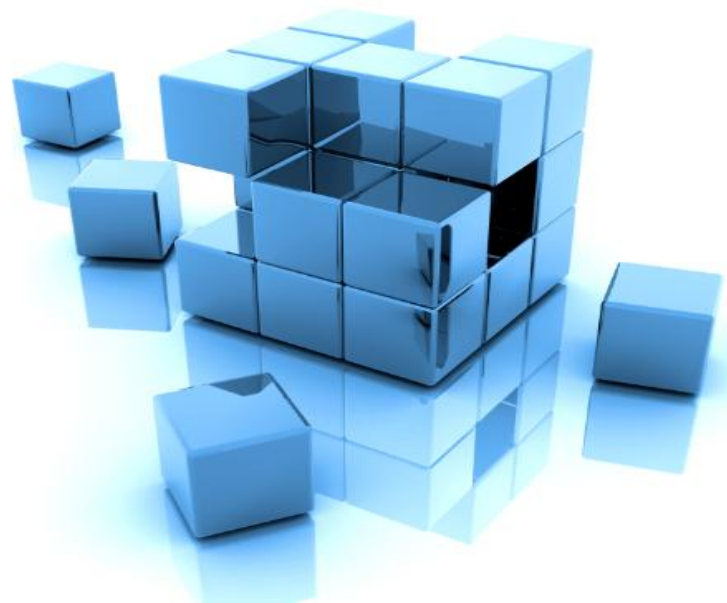
Hybrid Memory Cube (HMC) represents an entirely new category of high performance memory, delivering unprecedented system performance and bandwidth. [Learn More](#)

### About the Consortium

The HMC Consortium is a working group made up of industry leaders who build, design-in, or enable Hybrid Memory Cube (HMC) memory technology. The group works to innovate and expand the capabilities of the next generation of memory-based solutions. [Learn More](#)

### Download the Specification

The HMC Specification 1.0 is now available for public download and review. Download your copy below:



# Industry Validation

*"...like adding a turbocharger to your computer"*

- datacenteracceleration.com



*"...wicked fast"*

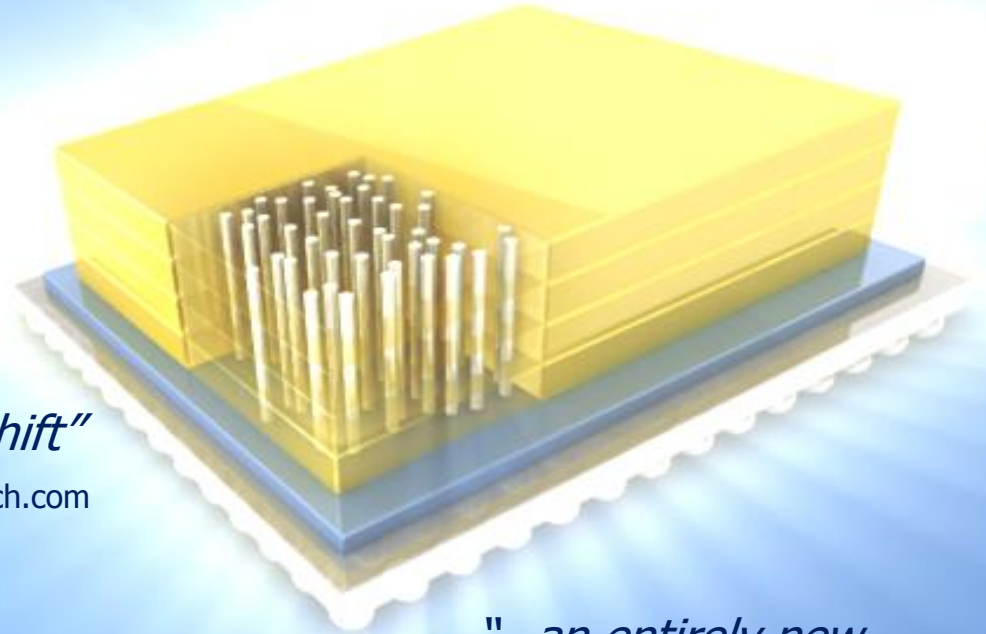
- gigaom.com

*"...a complete paradigm shift"*

- extremetech.com

*"...unprecedented levels of memory performance"*

- Electronic News



*"...an entirely new category of memory"*

- Tom's Hardware

**EE Times**

**EE Times 40<sup>th</sup> Anniversary:** "one of the top ten technologies expected to redefine the industry"



# Thank you



*Focused on Memory | Engineered for Innovation*