UNITY SEMICONDUCTOR

Flash Memory Summit
Storage Class Memory

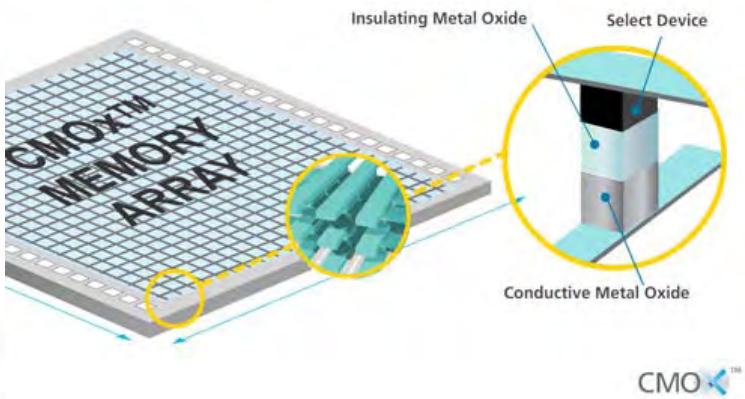
CMOx™ Memory Technology - Applications & Products

August 2009

Memory Cell Advantages

CMOx™ MEMORY TECHNOLOGY

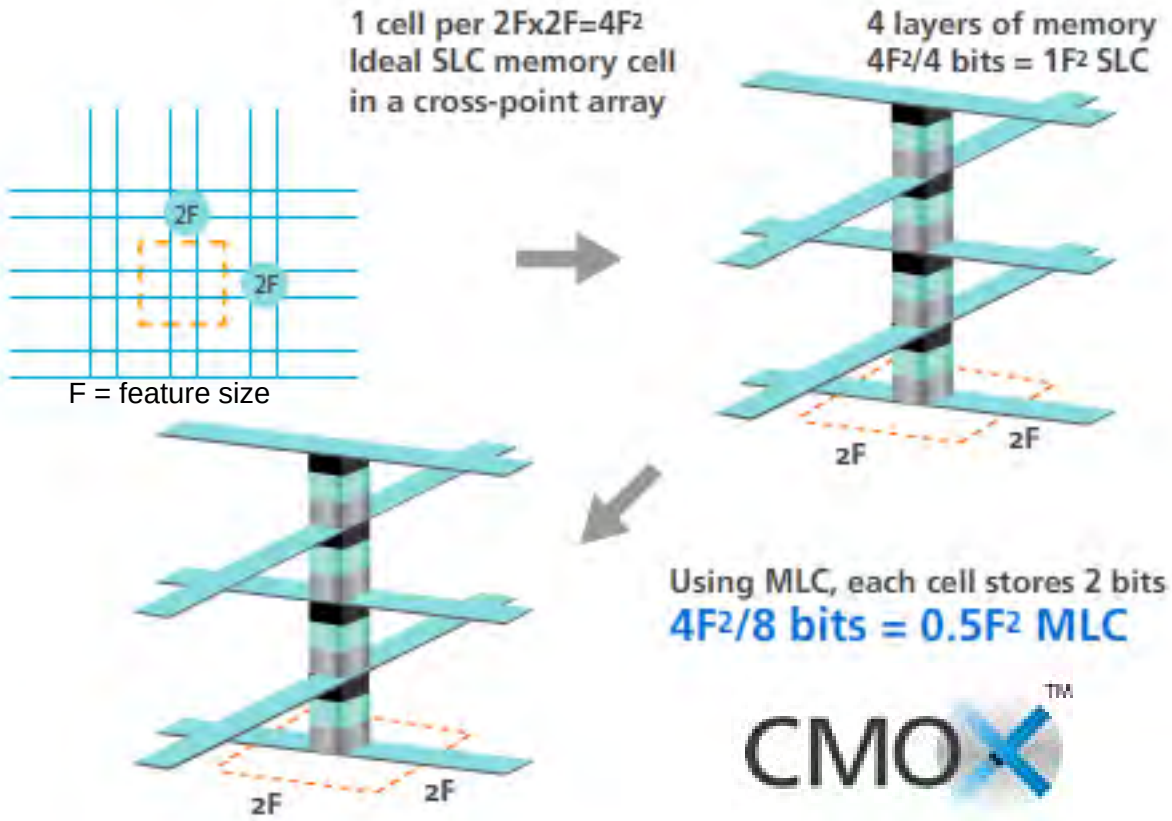
- World's first R/W passive cross-point memory array
- No transistor in memory cell
- Non-volatile
- Multi-layer memory
- Multi-level cell (MLC)
- 0.5F² memory cell size
- 4x the density of today's NAND Flash
- Fast write speed



Technology for Terabits

© 2009 Unity Semiconductor Corporation

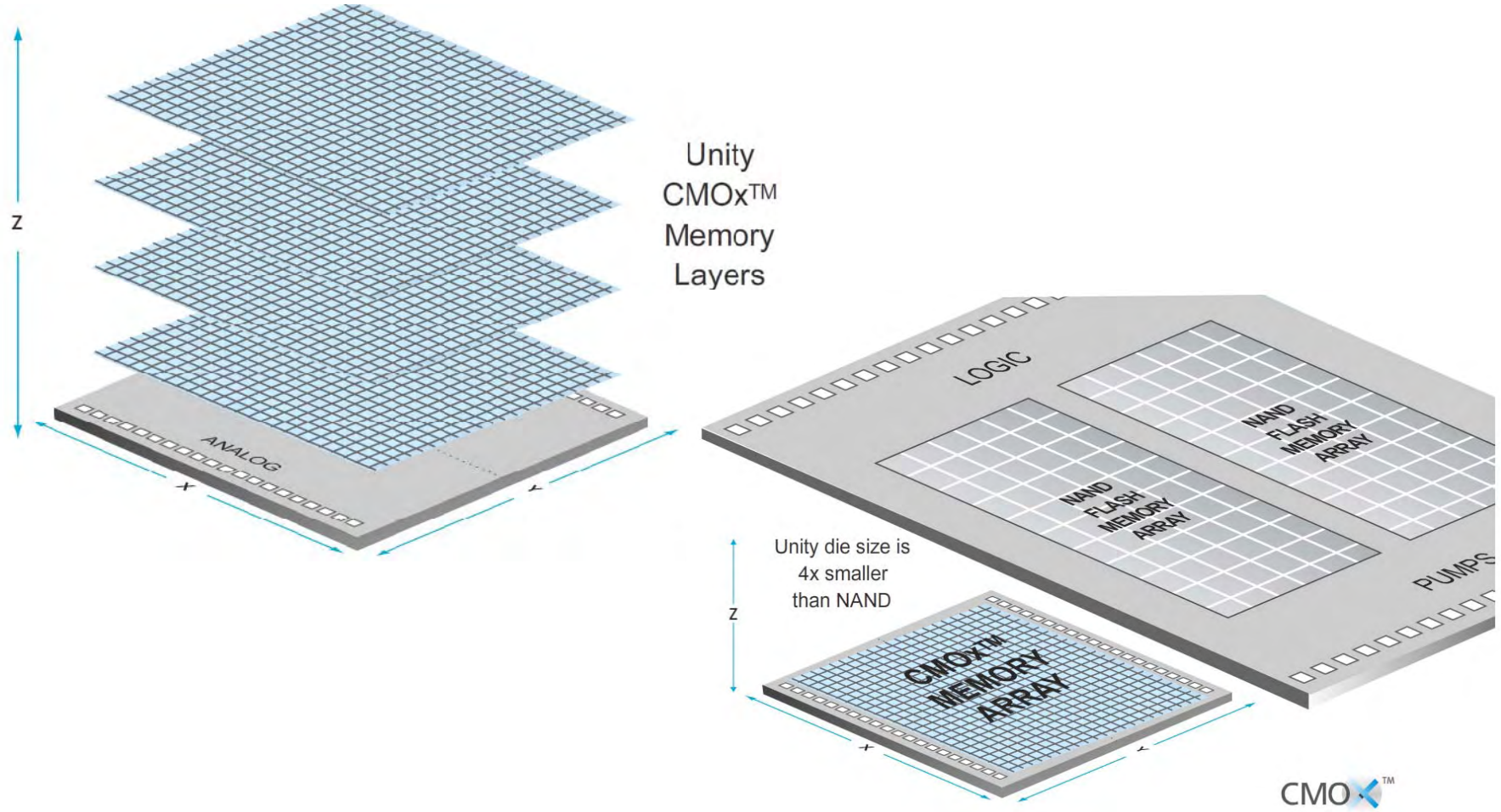
The 0.5F² Memory Cell



Unity achieves a 0.5F² cell size by fabricating 4 physical layers of transistor-less CMOx™ memory in a cross-point array, and storing 2 bit/cell MLC.

© 2009 Unity Semiconductor Corporation

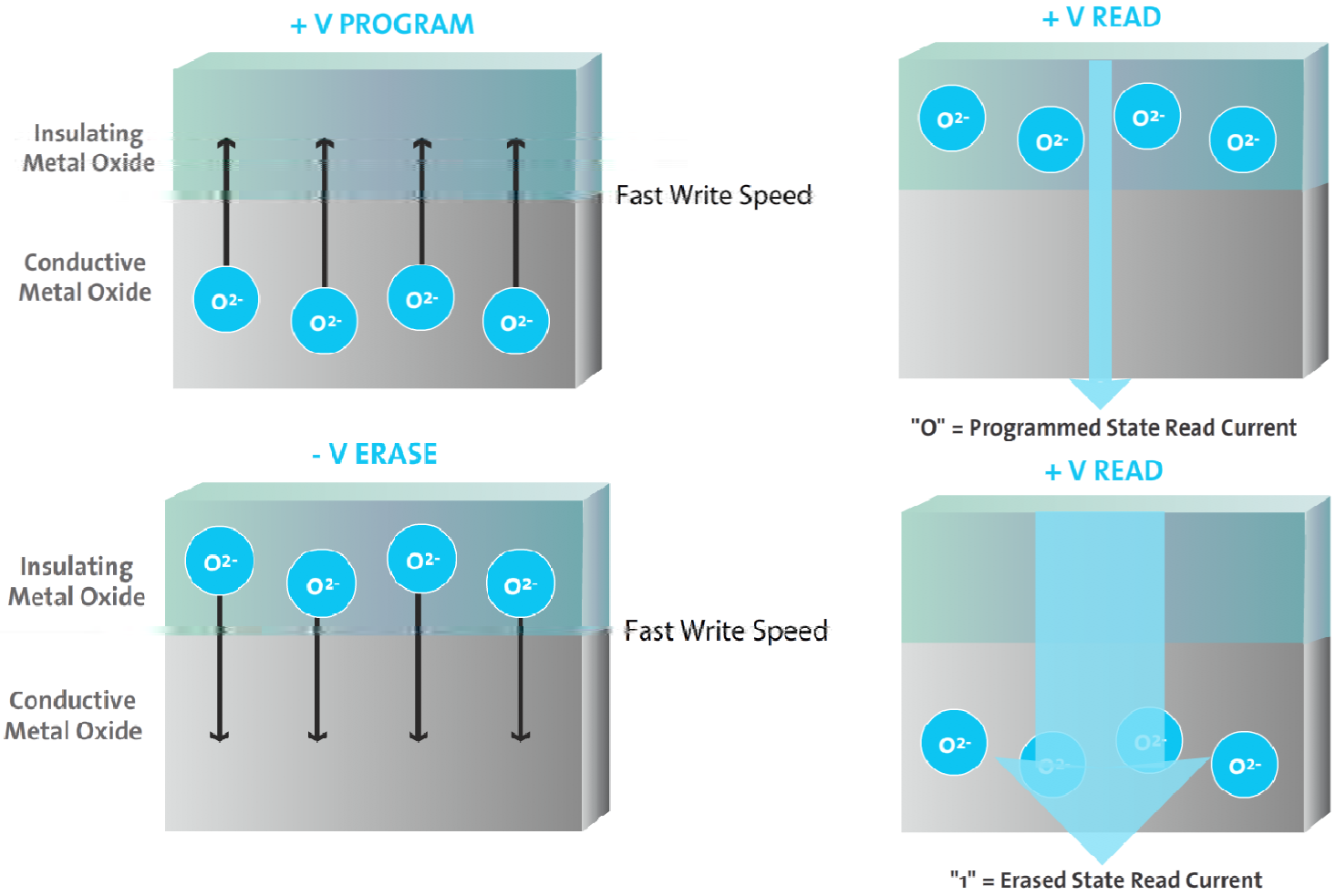
4x Density Advantage



Since CMOx™ memory technology uses 4 memory layers, Unity memory products have a 4x density advantage over today's NAND Flash.

© 2009 Unity Semiconductor Corporation

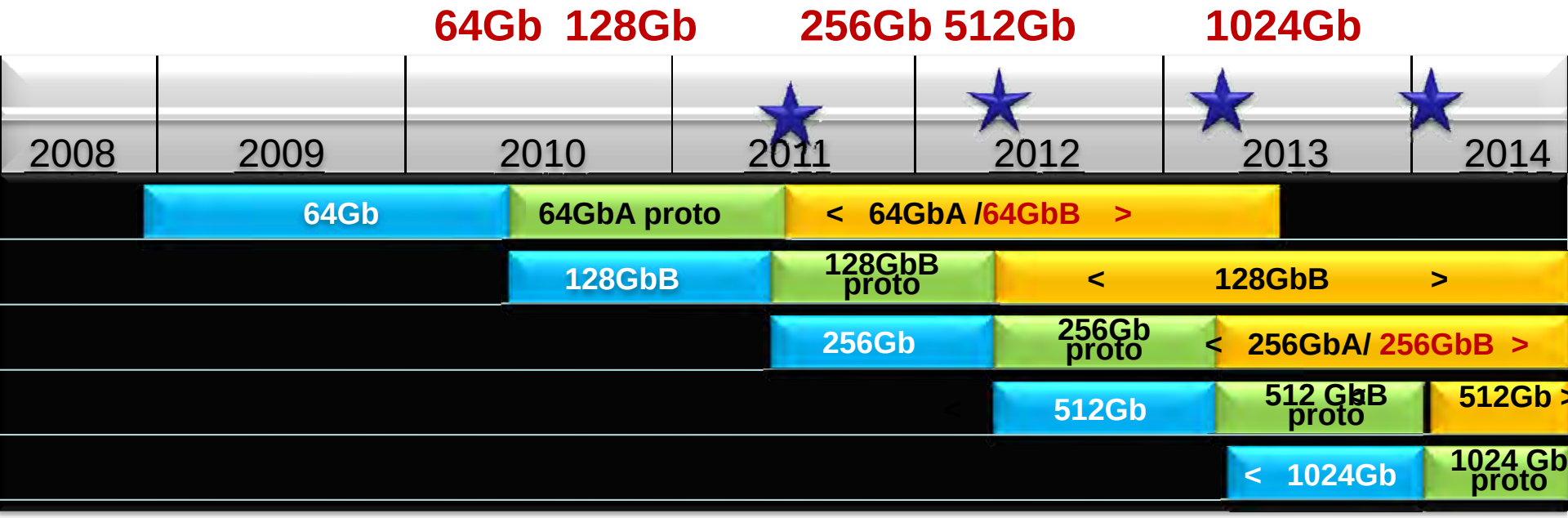
Ionic Charge Movement



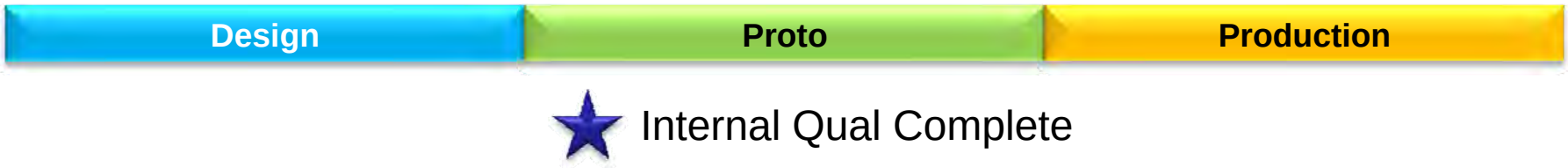
Unity CMOx™ memory technology works by the uniform movement of ionic charge under electric field control.

© 2009 Unity Semiconductor Corporation

2009-2014 Product Plan

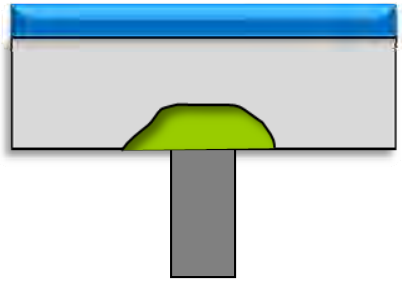
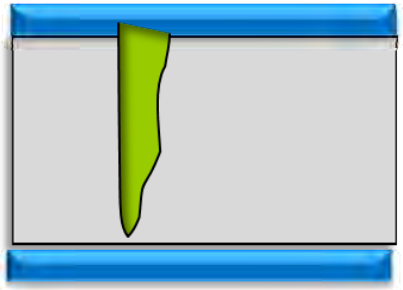
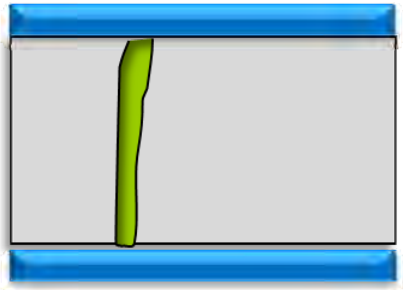
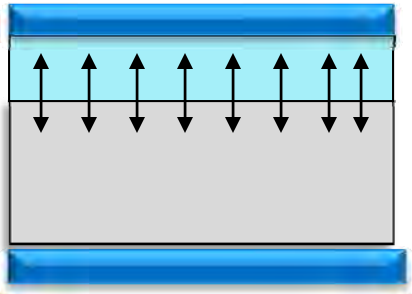


Note: “Version A” is un-shrunk product and “Version B” is a linear shrink.



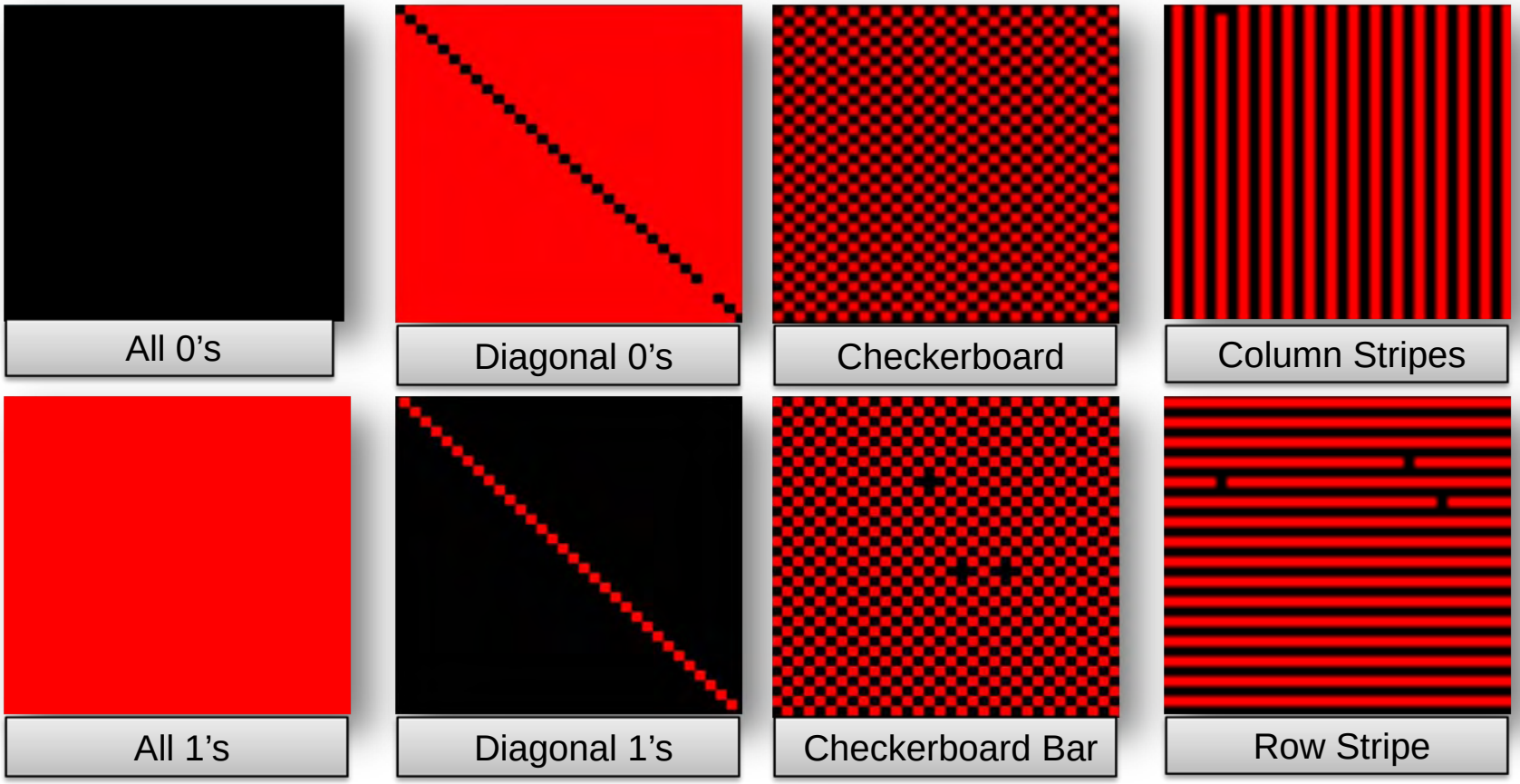
© 2009 Unity Semiconductor Corporation

Competing Next Generation NVM Technologies: Scaling

Write current >100ua	Write current >5ua	Write current >50ua	Write current <500na
Phase Change	Kozicki	RRAM	CMOx
			
Ovonyx, Intel	Adesto, Qimonda, Micron	Sandisk/Toshiba Samsung	Unity
Melting	Metal / Ion Movement	Melting	Oxygen Vacancy Re-distribution

© 2009 Unity Semiconductor Corporation

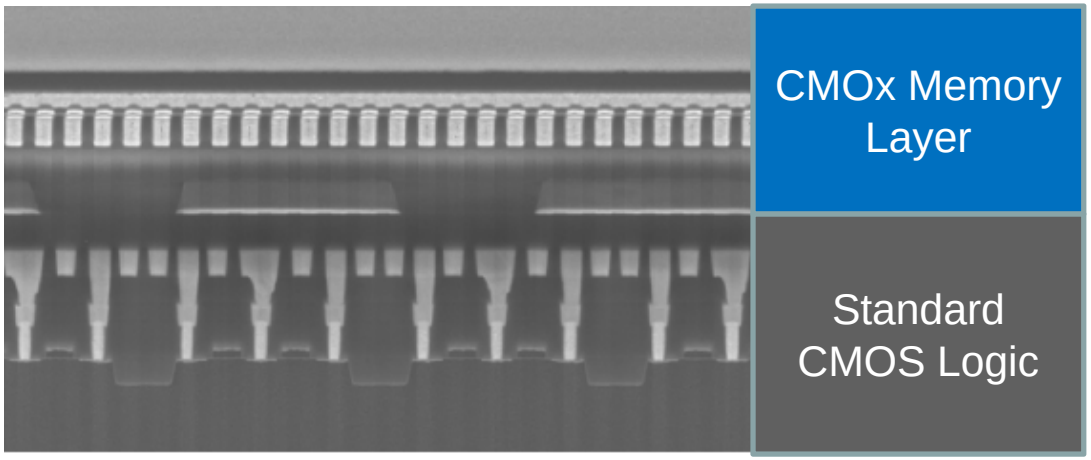
Write & Read Data Patterns



Only Unity has achieved successful data pattern writes and reads on a passive cross-point memory array. Each data pattern represents 1024 bits.

© 2009 Unity Semiconductor Corporation

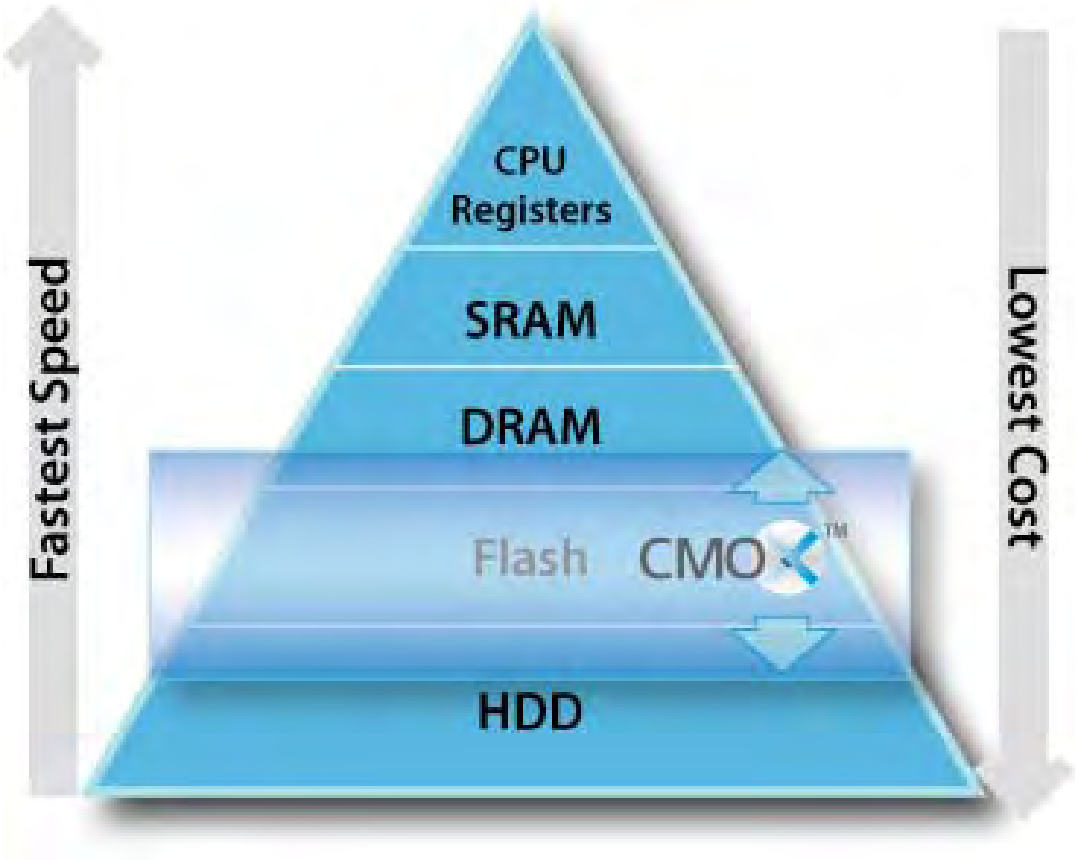
Manufacturing Model



Unity leverages existing standard CMOS logic foundries to reduce the capital required to build CMOx™ memory.

© 2009 Unity Semiconductor Corporation

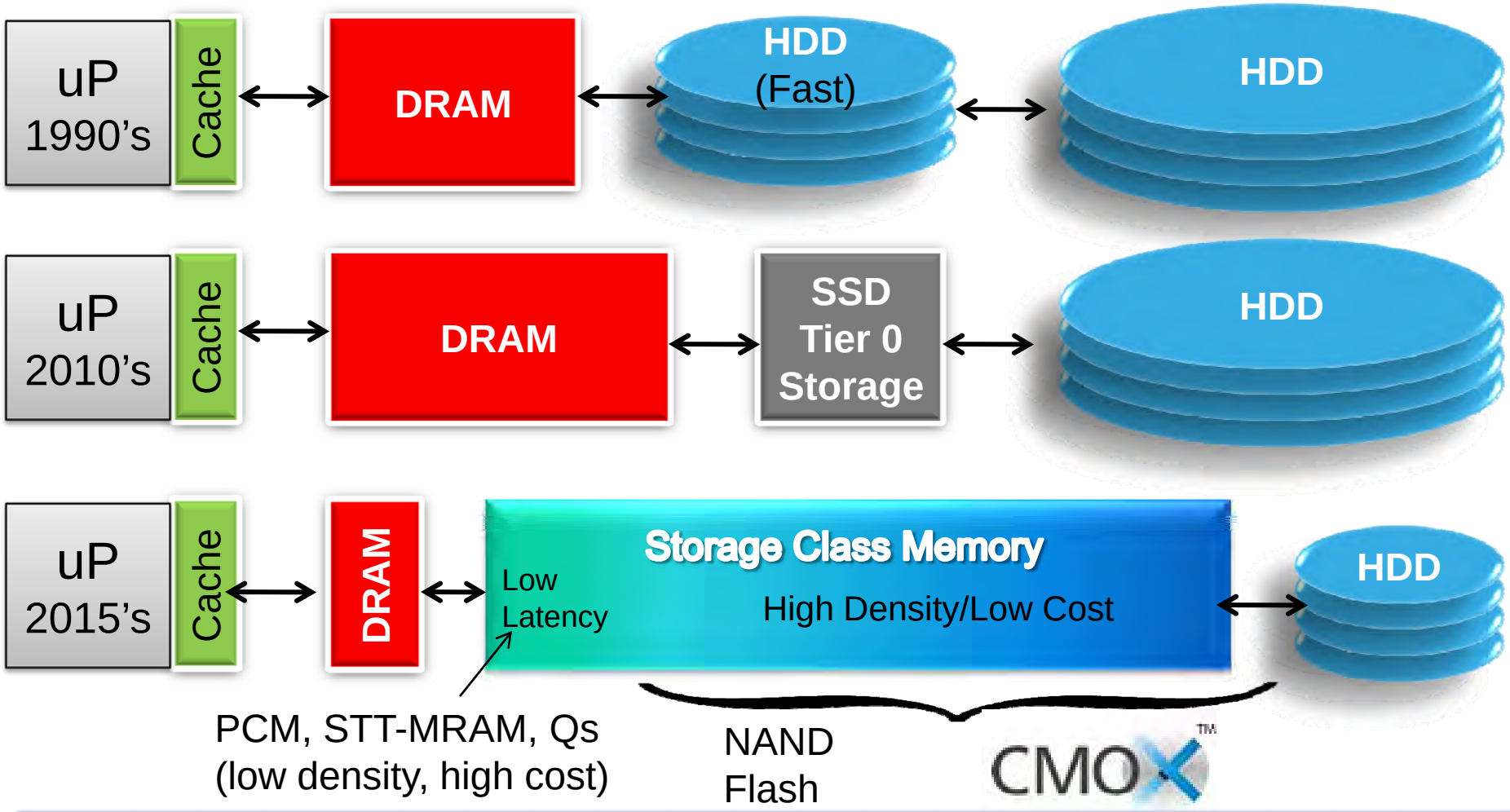
Memory Hierarchy



Unity CMOx™ stretches beyond Flash in the memory hierarchy with both lower cost and faster speed.

© 2009 Unity Semiconductor Corporation

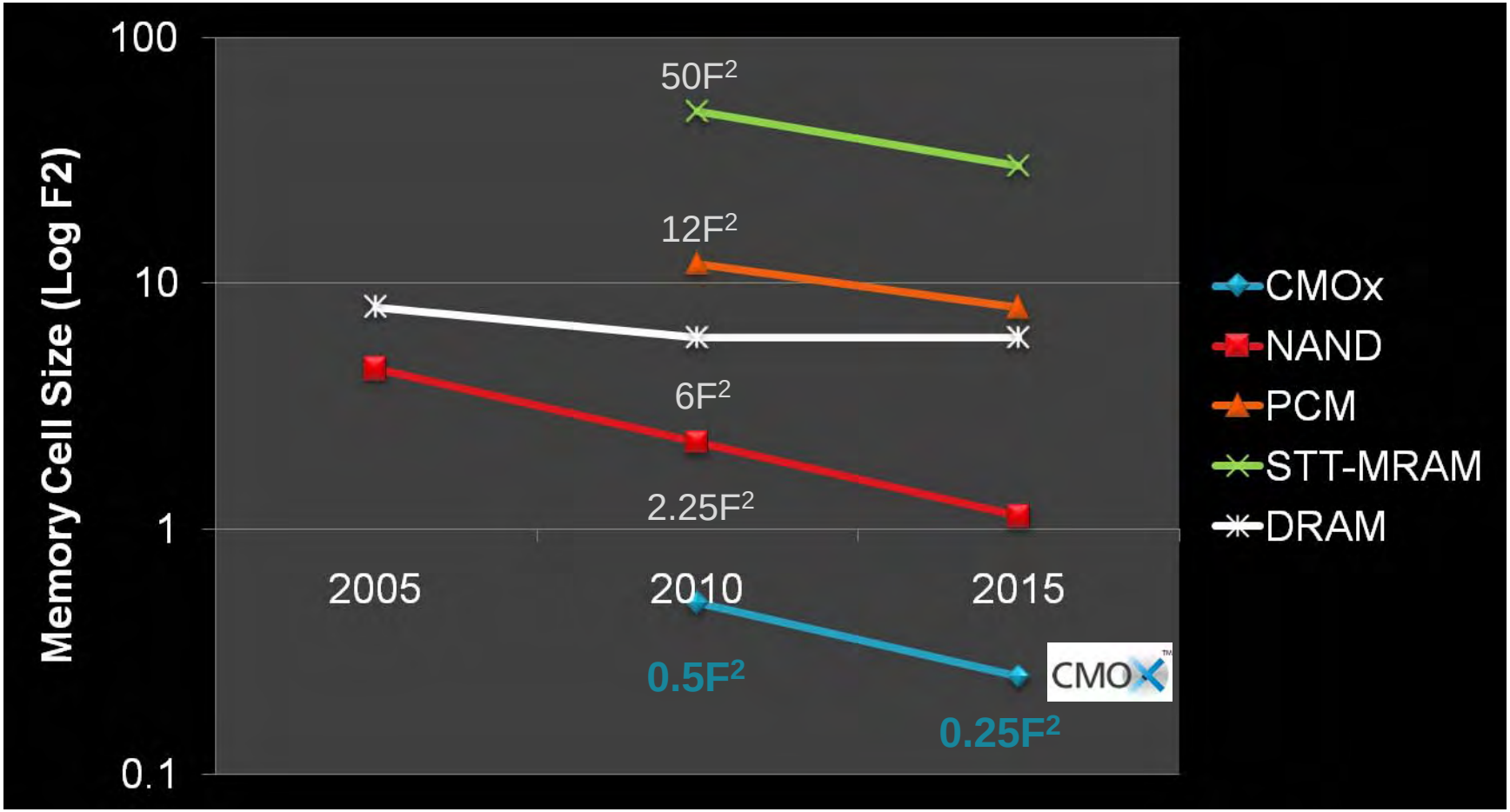
Enterprise Storage Evolution
IBM's Vision



Only Unity CMOx™ memory competes with HDD via high density and low cost.
Other next-generation SCM technologies are targeted at low latency (DRAM).

© 2009 Unity Semiconductor Corporation

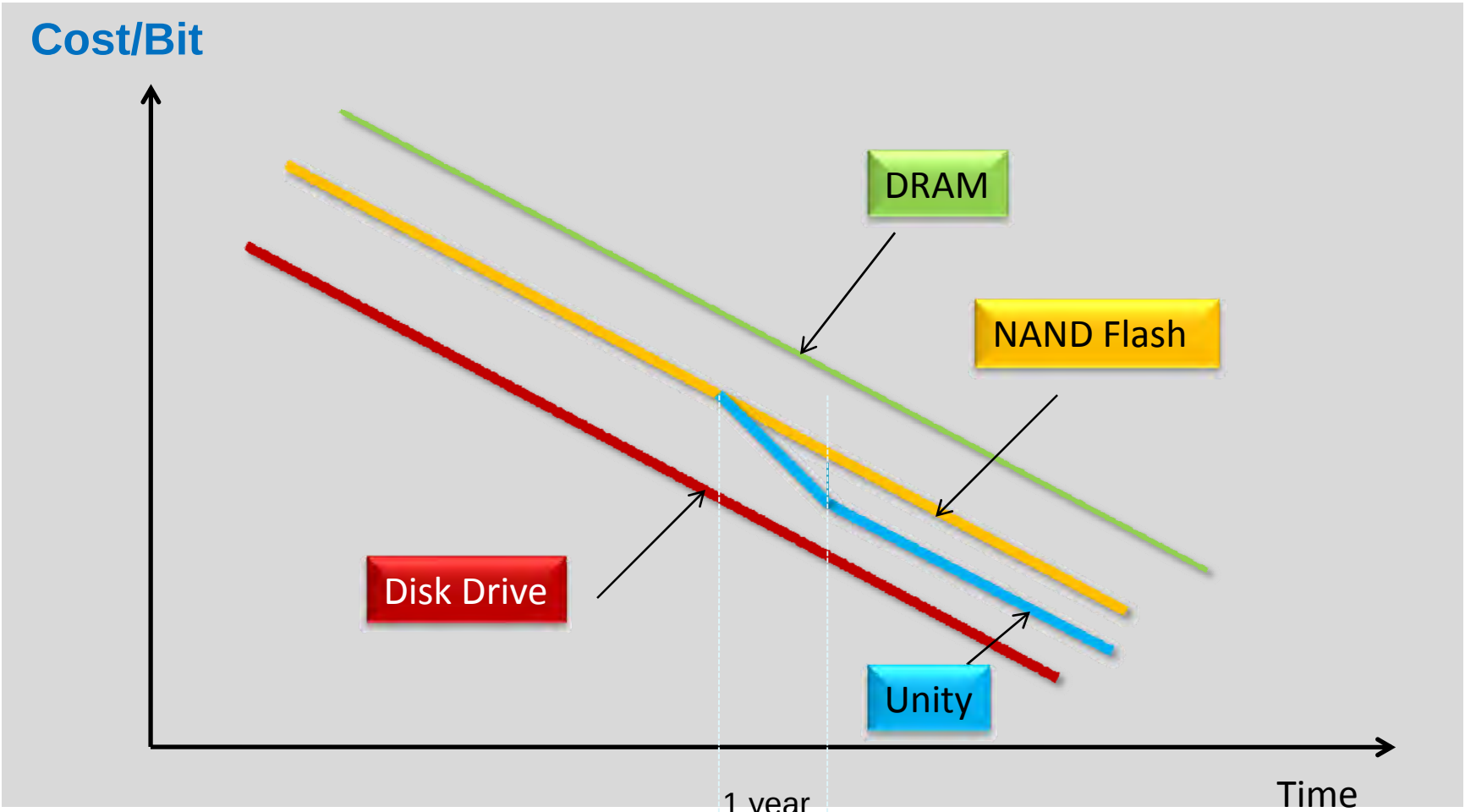
Memory Cell Scaling Trends



Unity CMOx™ memory cell size starts smaller than NAND & stays smaller.
Other next-gen SCM cell sizes start bigger than NAND & stay bigger.

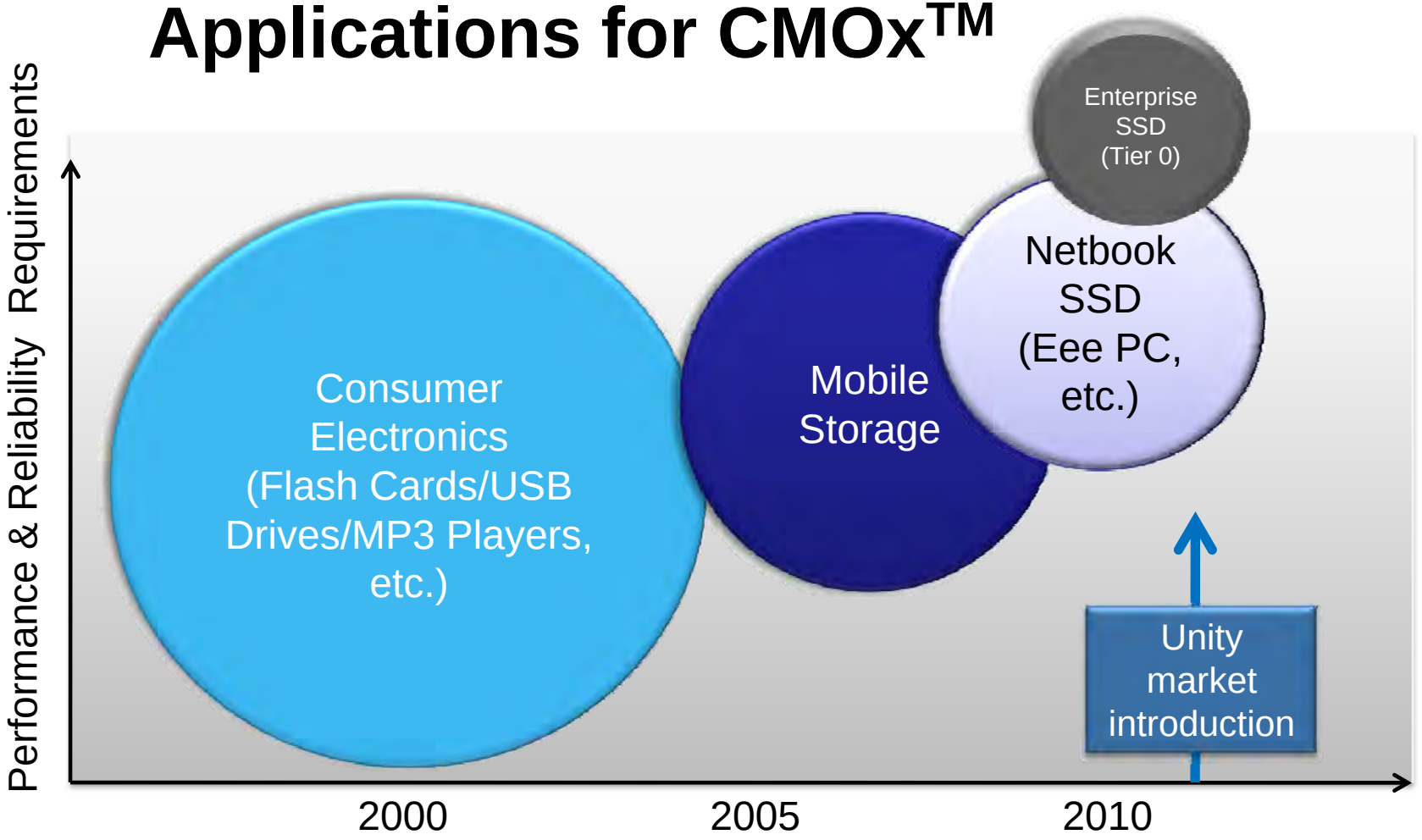
© 2009 Unity Semiconductor Corporation

Learning Curves: 30%/year



© 2009 Unity Semiconductor Corporation

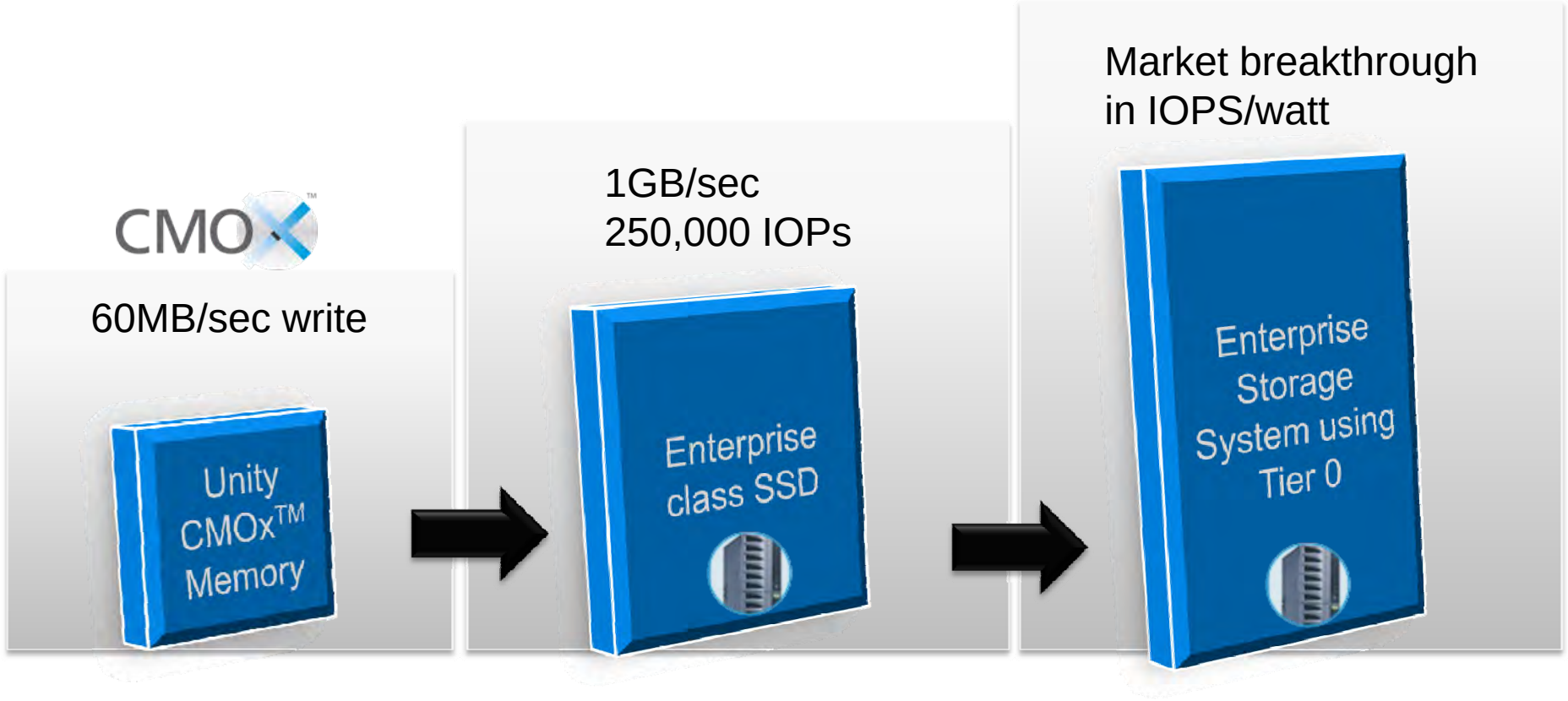
Applications for CMOx™



Performance & reliability requirements are increasing with each new application. CMOx™ is designed to address even the most demanding requirements.

© 2009 Unity Semiconductor Corporation

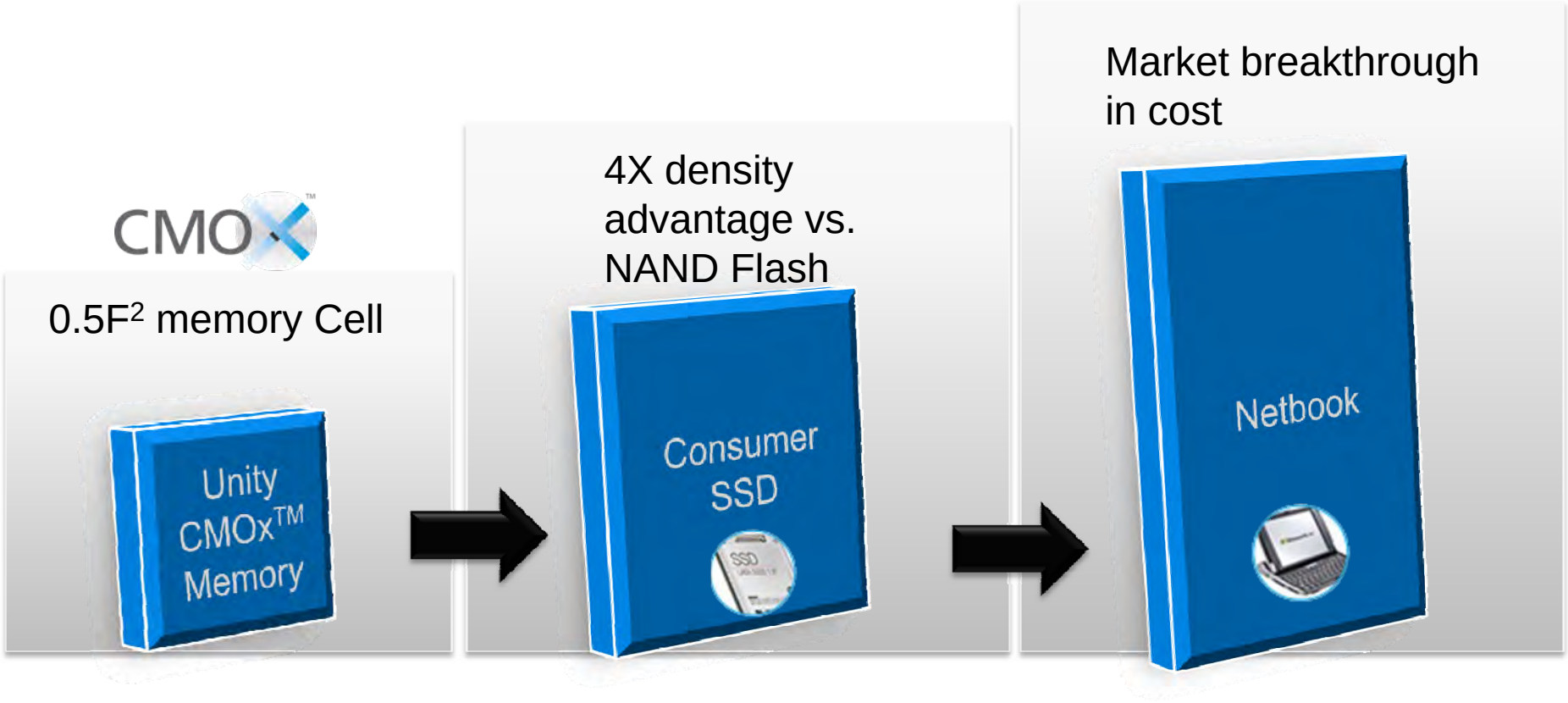
Unity Enables High Performance Storage



Unity's 5x-10x write speed advantage maximizes the performance and leads to dramatically improved IOPS/watt.

© 2009 Unity Semiconductor Corporation

Unity Enables Low Cost Storage



Unity's 0.5F² memory cell and 4x density advantage dramatically reduces $/GB vs. NAND.

© 2009 Unity Semiconductor Corporation

Unity Product Roadmap

64Gb

- **1st generation**
- Next-generation, JEDEC standardized, DDR NAND Flash interface and command set
- Full compatibility with memory controllers
- Unity proprietary features that accelerate the overall storage system performance *

128Gb/256Gb

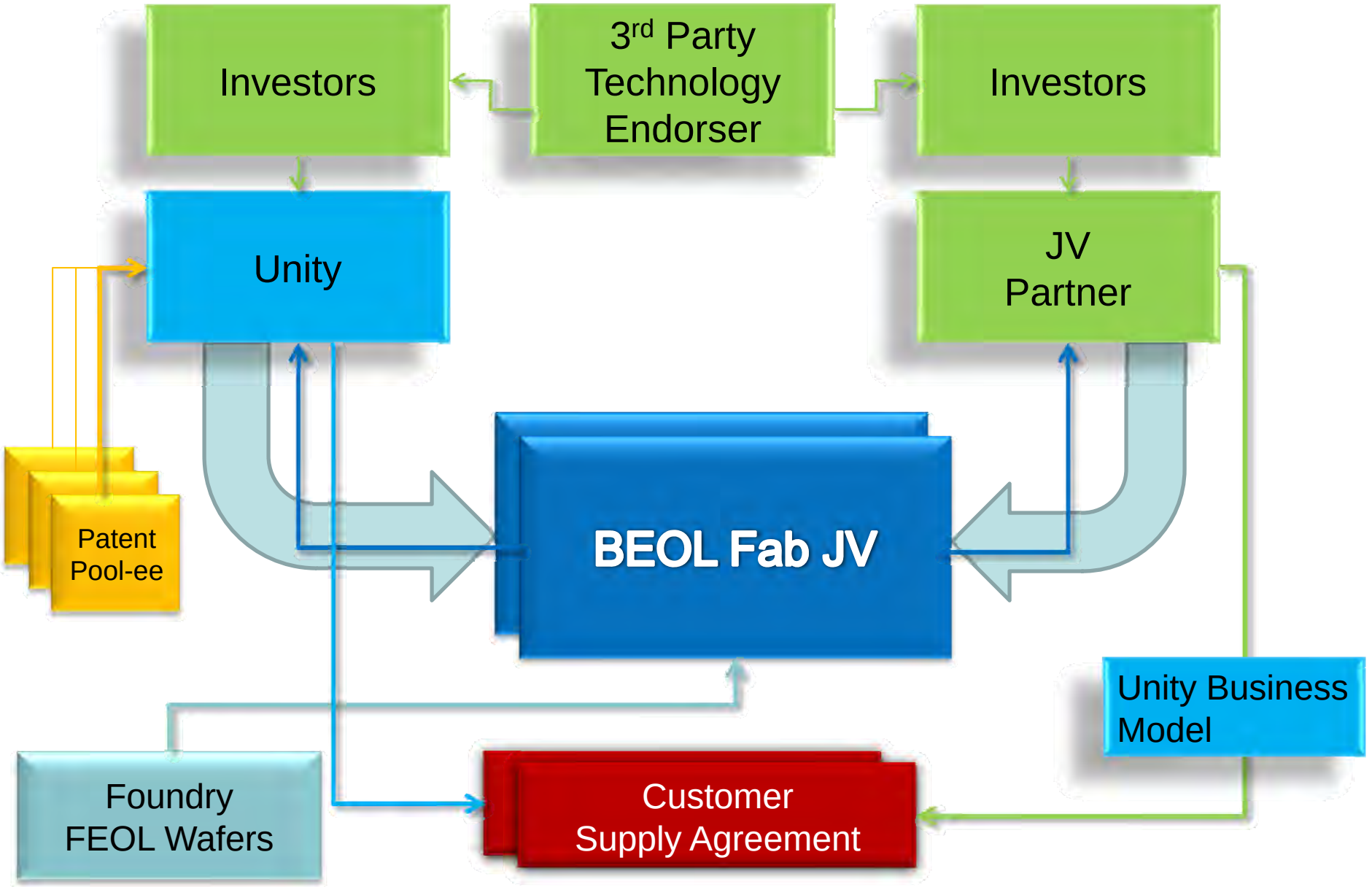
- **2nd generation**
- High capacity, high performance storage class memories
- Interface, command set and features tuned for state-of-the-art SSD's or mobile storage *

512Gb/1Tb

- **3rd generation**
- Achieve the historic milestone of a single chip 1 Tb (terabit) storage class memory
- 20nm process node
- 4 bits/cell MLC

* 1st generation Unity proprietary features, and 2nd generation product interface potentially co-developed with a system customer/investor.

© 2009 Unity Semiconductor Corporation



© 2009 Unity Semiconductor Corporation

UNITY SEMICONDUCTOR

“Every so often a truly different technology comes along that has the promise to change the industry. The Unity Semiconductor approach has all the hallmarks of such an event”

Jim Handy
Objective Analysis

Technology for Terabits

© 2009 Unity Semiconductor Corporation

UNITY SEMICONDUCTOR

Additional information located at:

http//:www.unitysemi.com

Technology for Terabits

© 2009 Unity Semiconductor Corporation