



Flash Memory Summit Market Research

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Flash Memory Summit
5 – 7 August 2014

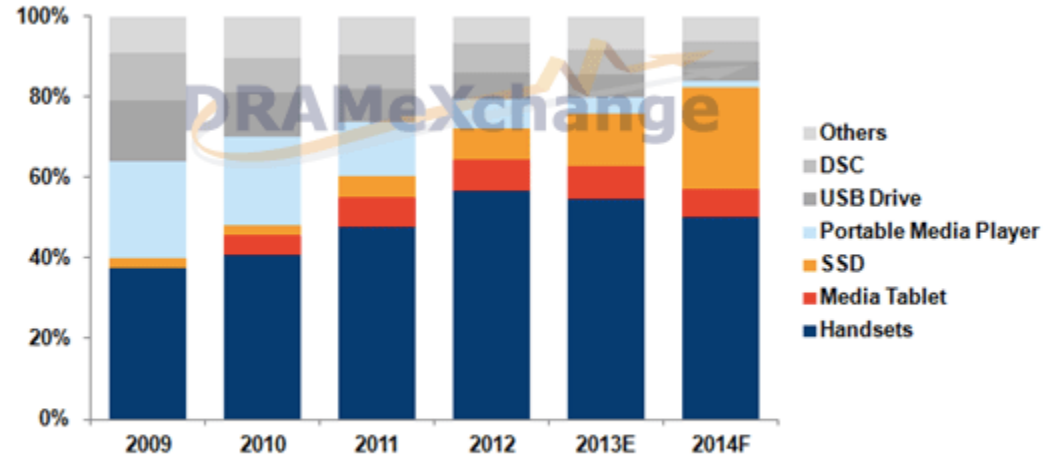
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Agenda

- NAND flash growth
- Verification challenges
- Alternatives
- Future

Demand forecast by application

Table-3 2009-2014F NAND Flash Demand Dynamics



Source: DRAMeXchange, Nov., 2013

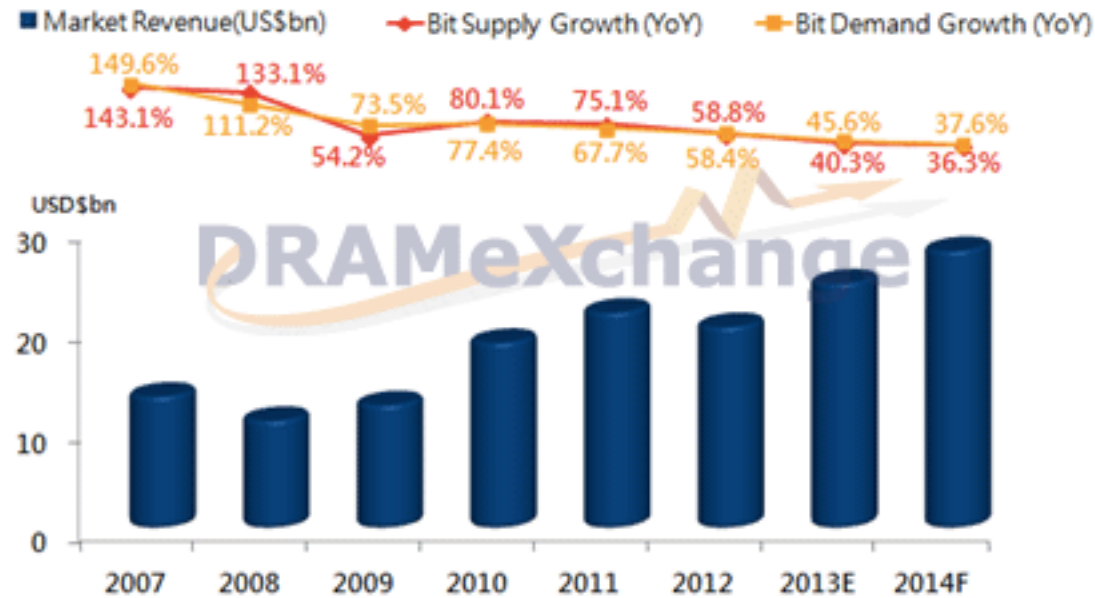


Source : DRAMeXchange, Dec., 2013

Growth in SSDs adding to the consumption growth of handsets and tablets

Demand forecast

Table-1 2007-2014F NAND Flash Market Value and Bit Growth

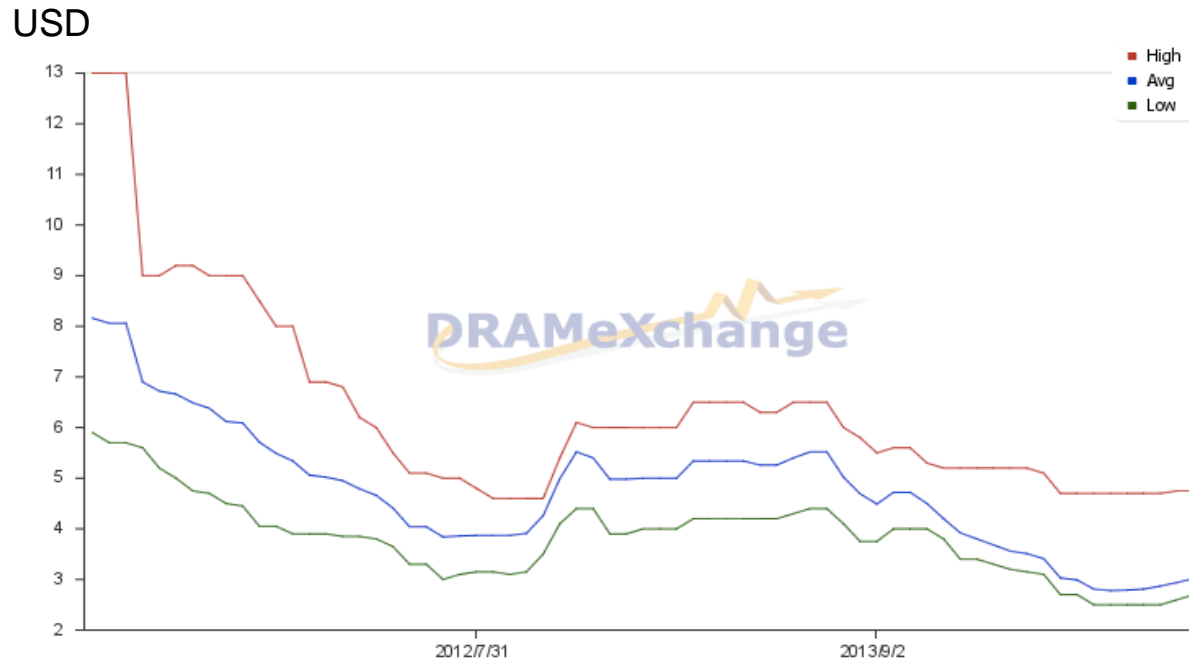


Source: DRAMeXchange, Nov., 2013

NAND flash growth trends are worldwide

Pricing pressure

64Gb MLC NAND Flash Contract Price

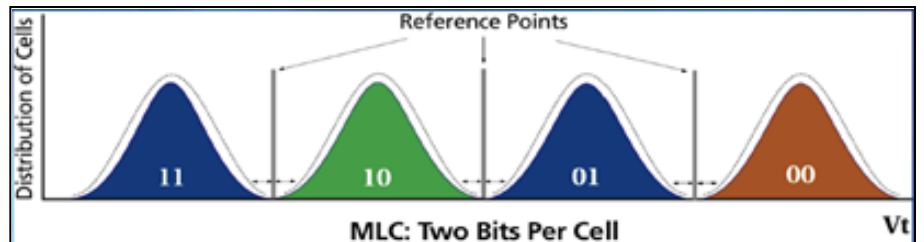
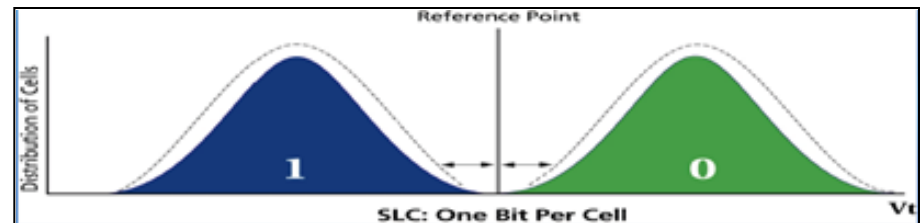


Source: DRAMeXchange, July 2014

At the same time that demand is increasing, prices are stabilizing

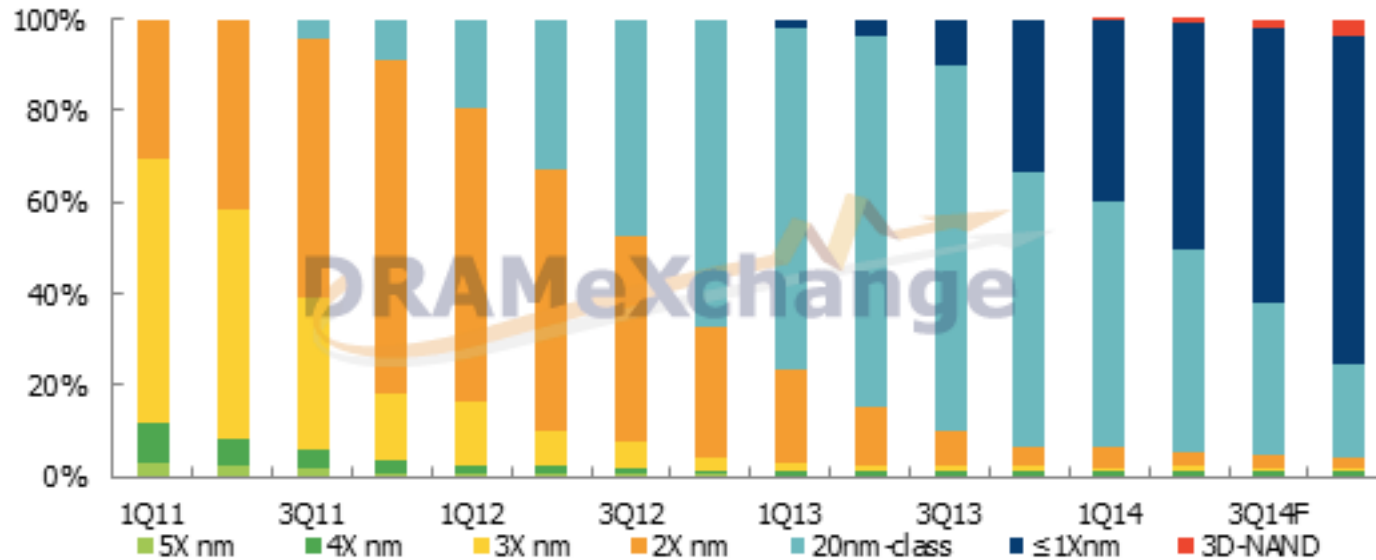
MLC vs. SLC

- Growth pressures for higher density and higher performance has driven the transition from SLC to MLC
- This transition does not come at no cost, increased capacity also increases sensitivity to errors



Technology scaling and 3D NAND

Figure-1 NAND Flash output by node



Source: DRAMeXchange, May, 2014

Scaling limitations driving development—Expected to peak in 2H 2015

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Verification challenges

- To effectively verify ECC performance in simulation, one needs to be able to:
 - Inject errors into memories during simulation
 - Set assertions
 - Memory
 - Data
 - Parity checking
 - Explore memory space
 - Width expansion
 - Depth expansion
 - Interleaving
 - Address scrambling
 - Internal memory register access

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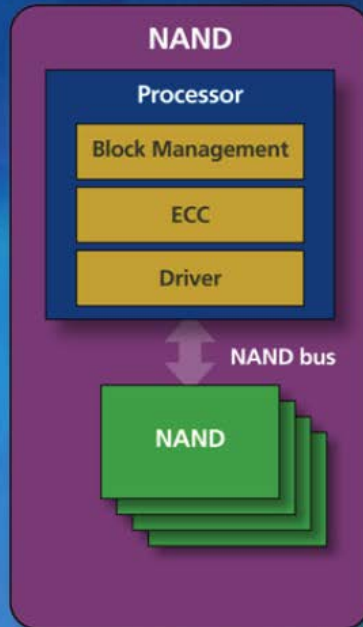
What's next?

- **Managed NAND solutions**
 - Vendor and technology independence
 - ECC
 - Partial page program operations
 - Commands and interfaces
 - eMMC 4.5
 - UFS

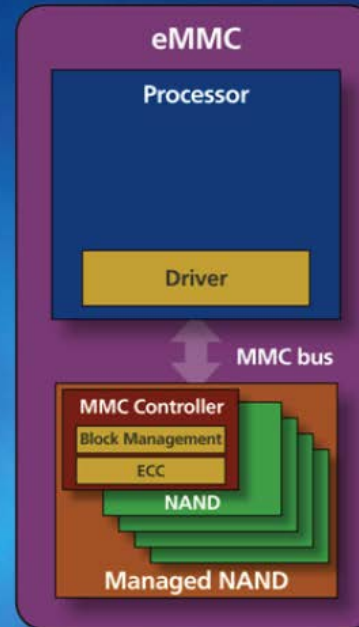
eMMC

What is eMMC?

Direct NAND Interface

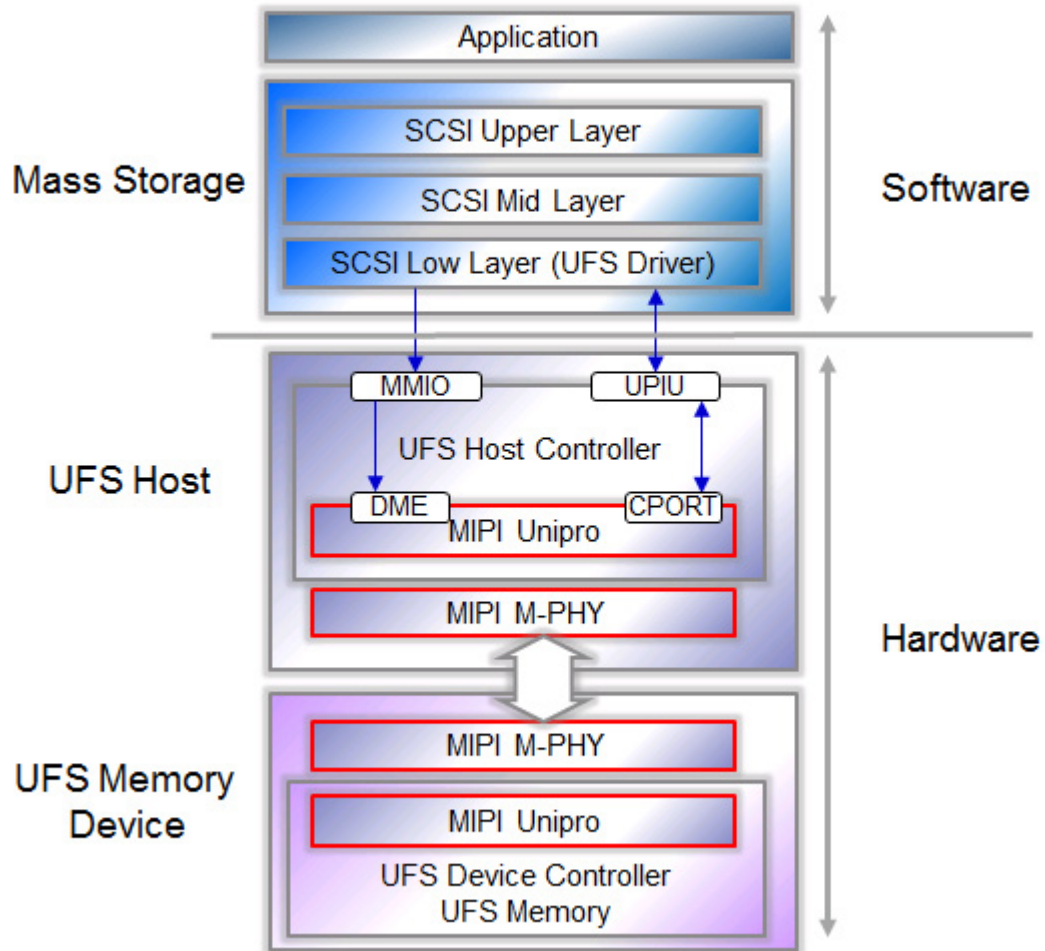


Managed NAND



UFS..

■ Universal Flash Storage (UFS) System Architecture



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Trends

- ECC approaches continue to be more complex and must be used judiciously based on application targets
- High IOPS application requirements continue the drive for higher transfer rates
- Managed NAND solutions becoming more complex in implementation but more standardized in approaches
- 3D NAND

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