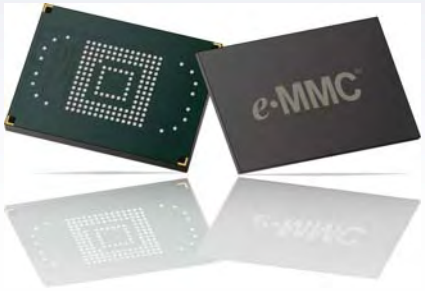
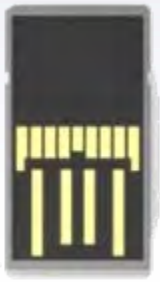
Embedded and Removable Flash Memory Storage Solutions for Mobile Handsets and Consumer Electronics

Ed Beeman
President, 2010 Tech, Inc.
MMCA Marketing co-chair

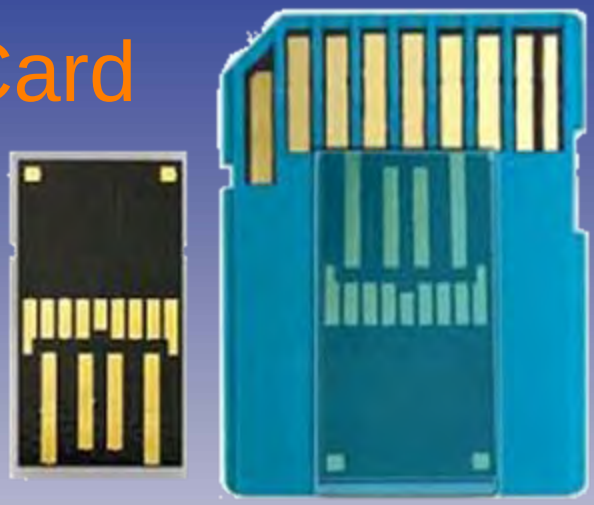




Agenda

- *mi*CARD
- *e*-MMC (embedded MMC)

*mi*CARD™
The Multiple Interface Card



- Full Std-A USB compatibility
  - No ASIC or S/W changes for PCs and other USB hosts
  - Thickness and width driven by USB Std-A slot
- Full MMC electrical compatibility
  - No ASIC or F/W changes for embedded systems
- Compelling removable form factor for DSC and phones
  - Ideal size: 12mm x 21mm x 1.95mm
- Using a mechanical adapter, *mi*CARD is backward compatible with many existing CE products that offer SD/MMC slots

*mi*CARD™ Applications

External Memory & I/O Interface:


PC

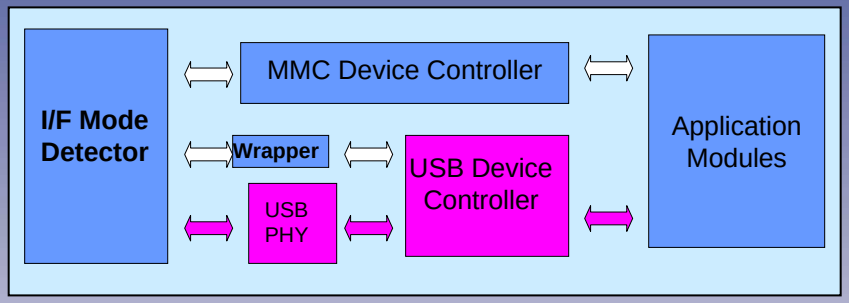

Notebook


TV


Car Stereo


DVD Player

USB Mode



Internal Memory Interface:


Phone

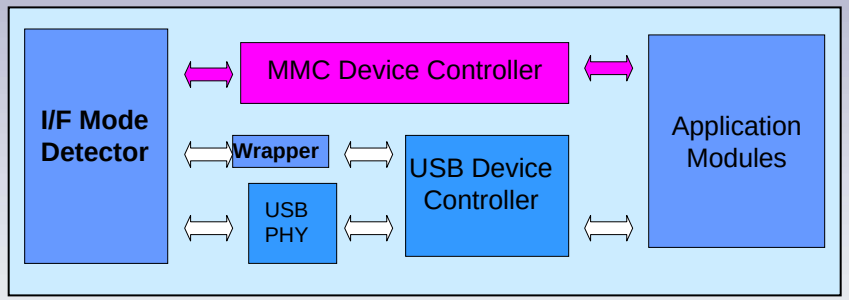

PDA


DSC


Video

MMC Mode

4-bit or 8-bit



Internal I/O Interface (Future)


Phone

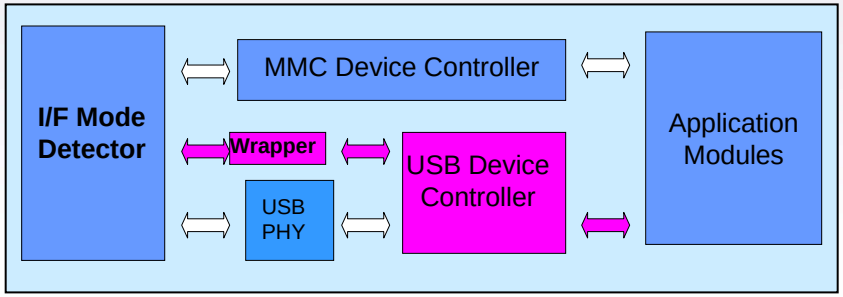

PDA


DSC


Video

USB HSIC

low-power



*mi*CARD adoption

- Host systems
  - ASUS Eee PC 901 & 1000
    - Dedicated slot for *mi*CARD
- Cards
  - Pretec, Transcend
- Connectors
  - Tyco, Lotes
- Passive adapters / Card readers
  - Kuang Ying, Adaptertek

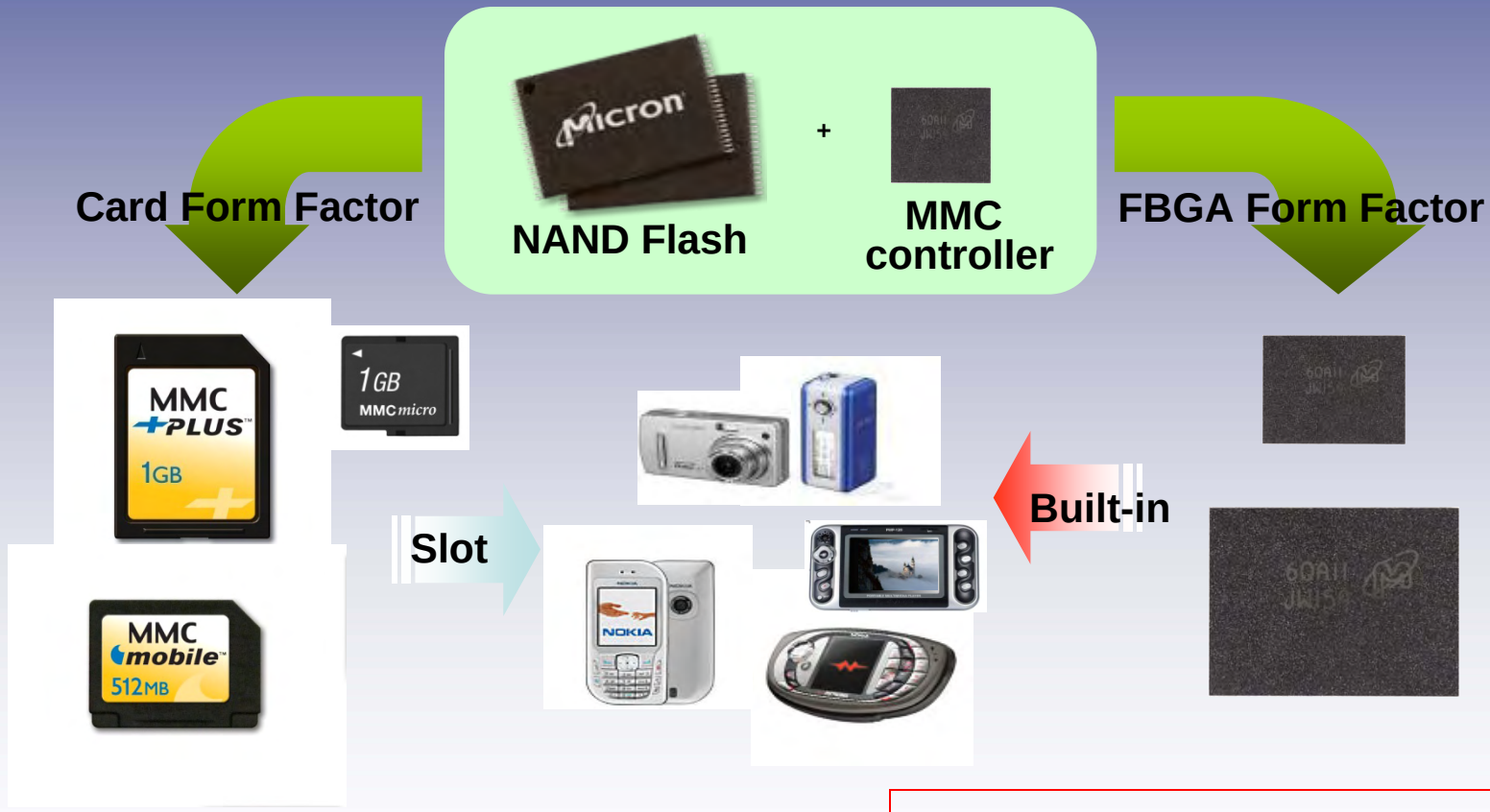
Looking forward

- HSIC digital USB interface
  - No expensive USB 2.0 PHY in host
  - Identical USB 2.0 bit timing
  - Lower power
- Higher performance
  - Follow USB developments (USB 3.0)

Agenda

- *mi*CARD
- *e*-MMC (embedded MMC)

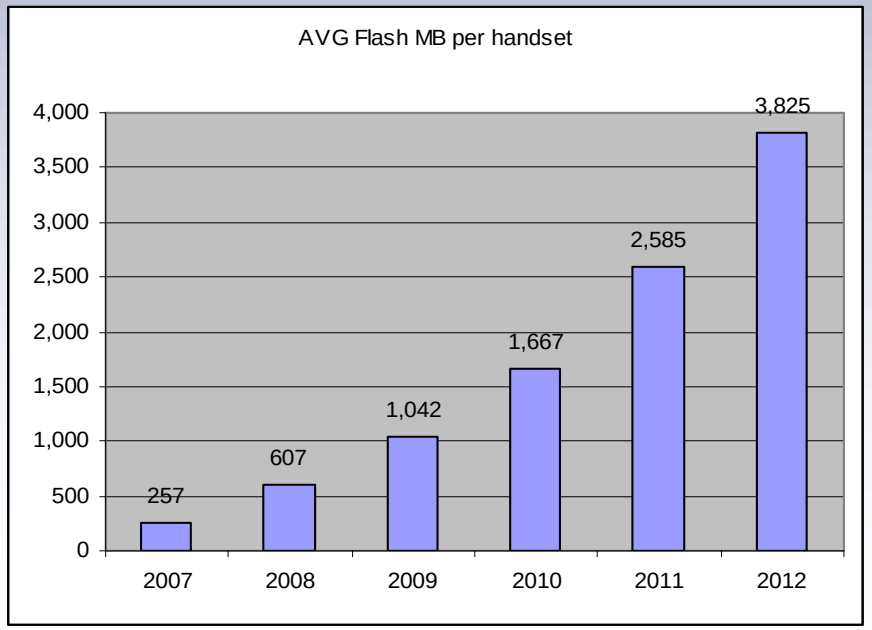
Embedded MMC Concept

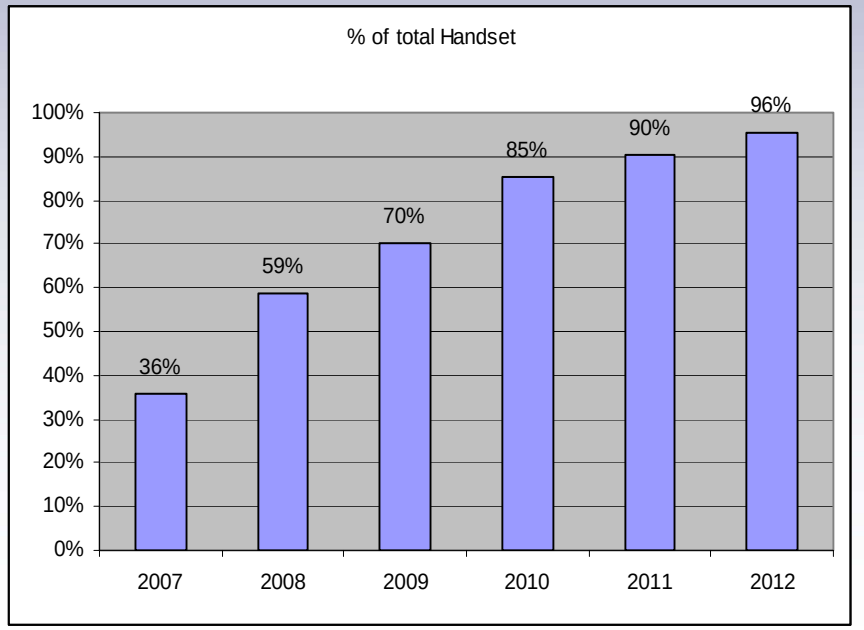


Embedded MMC

NAND Usage in Handsets

	2007	2008	2009	2010	2011	2012
Digital Handset Factory Units (M)	1,150	1,290	1,395	1,470	1,540	1,600
Mobile Handsets with Embedded NAND Flash Units (M)	411	760	980	1,254	1,390	1,530
% of total Handset	36%	59%	70%	85%	90%	96%
AVG Flash MB per handset	257	607	1,042	1,667	2,585	3,825
AVG Flash MB per handset (denominator: all handsets)	92	357	732	1,422	2,333	3,658
Total 1GB equiv (Millions unit)	103	450	997	2,042	3,508	5,715

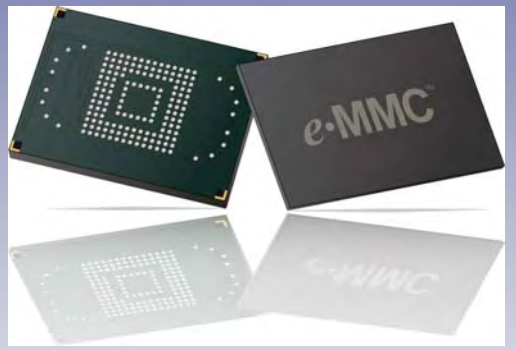




Source iSuppli Q1 2008

e-MMC™ (Embedded MMC)

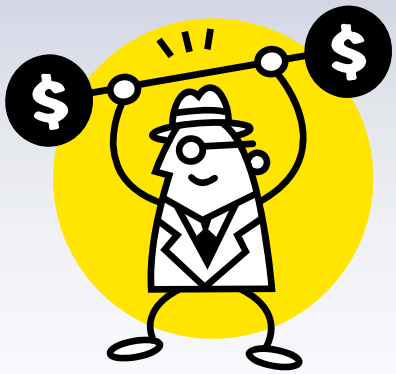
- *e*-MMC is high-speed MMC in BGA package
  - Based on MMCA and JEDEC joint standards
  - Interface speeds of up to 52 MB per second
  - Supports x1, x4 or x8 bus width
  - Operating voltage: 1.8v or 3.3v
  - JEDEC package options include:
    - 11.5 x 13 x 1.2mm
    - 12 x 16 x 1.3mm
    - 12 x 18 x 1.3mm



- *e*-MMC simplifies mass storage designs for portable consumer electronics products
  - A host system can now use a single memory bus architecture for both embedded and removable non-volatile mass storage
- Companies supply *e*-MMC under different brand names, all built to *e*-MMC standard
  - For example: Samsung MoviNAND, Micron e-MMC (Previously called ManagedNAND)

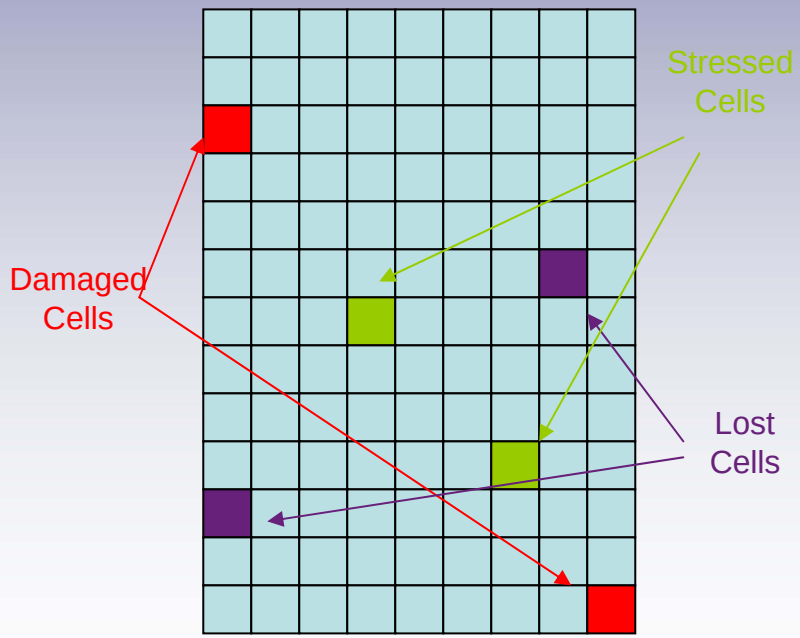
Why I Should Use *e*-MMC™?

- Because *e*-MMC saves you money and increases your competitiveness
  - In the near future
    - Increasing demand for storage means higher densities and larger arrays
    - Time-to-market demands require simplification of hardware design and hardware standards – *e*-MMC
    - Software complexity of flash management is taken care by the controller inside *e*-MMC



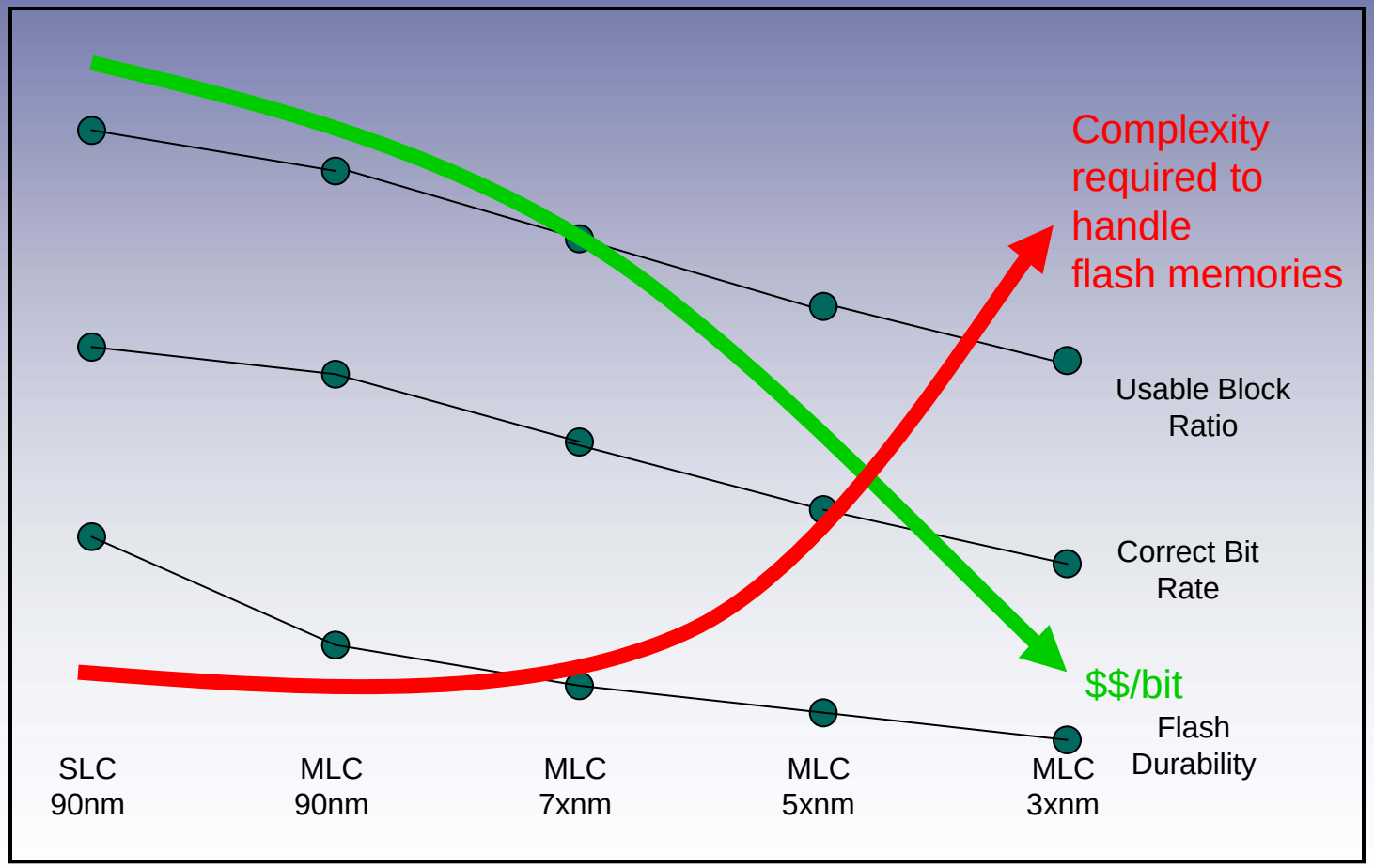
NAND Flash Trends

- Fabs are quickly moving to new processes and technologies
  - Endurance cycles
    - 1M - 100K - 10K - 1K and lower
  - Bad blocks
    - Percentage is increasing
  - Data retention
    - Reduced
  - EDC/ECC requirements
    - 1 - 4 – 6 - 8 bits and more…
- Power cycling complexity
  - Increased due to bit pairing



Flash Memory Array

NAND Flash Trends



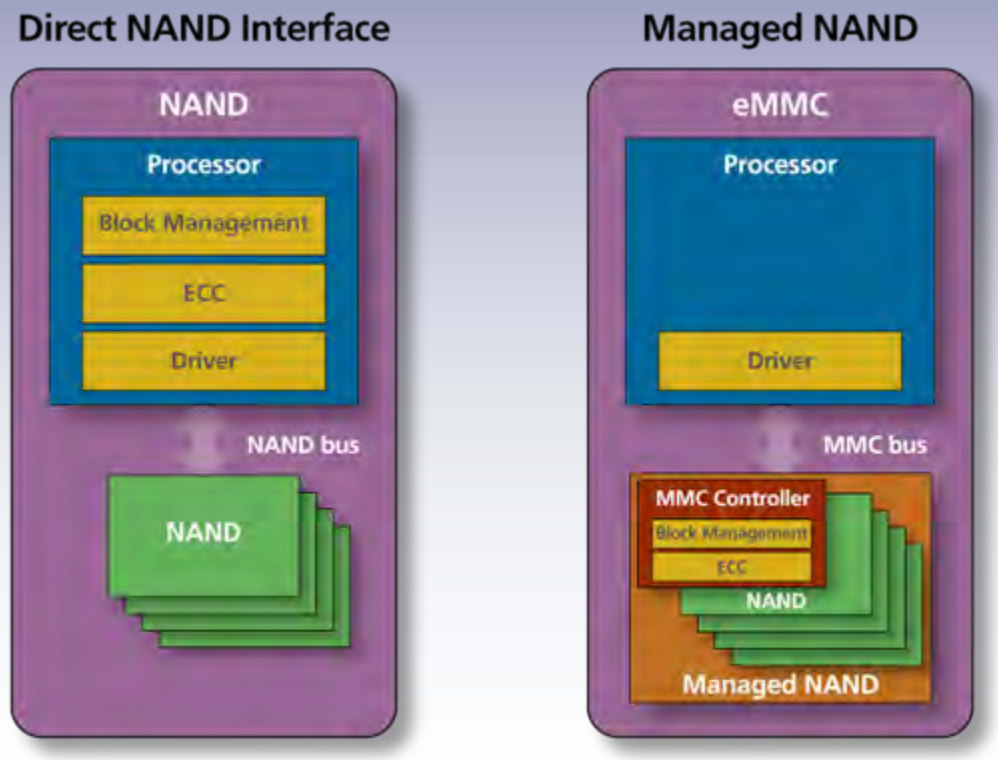
e-MMC™ vs. Standard NAND

- NAND requires ECC, bad block management and wear-leveling
- This represents added costs in the host application processor and requires extra development time and resources
- The controller in *e*-MMC handles the NAND management functions;
  - Overall lower costs

Benefits of Adopting *e*-MMC™

e-MMC Saves Money

- *e*-MMC hides all NAND technology details behind a high level interface



e-MMC™ – The Bridge to Low Cost NAND Technologies

System Design

e-MMC

Advanced Flash Technologies
5Xnm, 4Xnm, 3Xnm

Changing ECC Requirements

Garbage Collection

Wear Leveling

Different Software Drivers

Vendor Specific Commands

Multi-Sourced Packaging

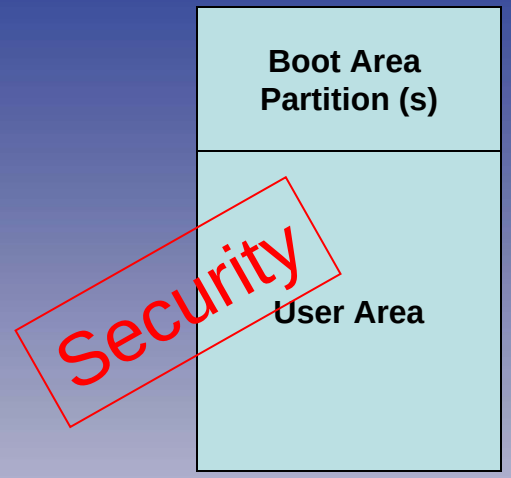
Which Interface to Select?

Controller F/W Update

Changing NAND Block Size

Changing NAND Page Size

e-MMC™ Features



- *e*-MMC v4.3 spec. includes:
  - *e*-MMC features with boot function
    - Protect boot data from hacker
      - Improve system reliability to save RMA and maintenance costs
    - Store code in *e*-MMC to save overall system cost
  - Host initiated explicit sleep mode for power saving
  - Separate power supply definitions for interface I/O and Flash operating voltages to better match host controller interface and Flash memory component requirements

e-MMC™ Futures

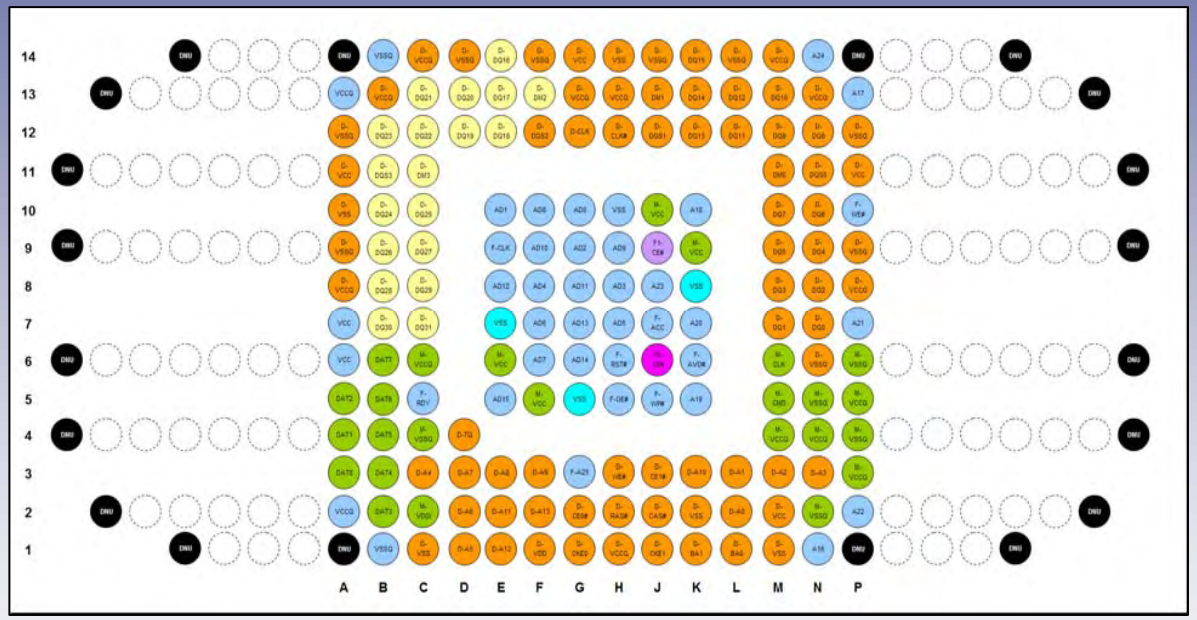
- *e*-MMC v4.4 specification is planning:
  - *Higher Performance*
    - DDR interface (up to 104MB/s)
  - ***Security Features***
    - Secure Erase
      - The US government outlines their requirements in the following documents:
        - » DoD 5220.22M
        - » NIST SP 800-88
      - These documents require clean and purge operations
    - Write Protection
    - Multiple Partitions
    - Secure Memory Block
  - ***Lower I/O Voltage***
    - For Compatible with future Microprocessors

Performance

Security

Low-power

Potential Integration with Other System Memory Types

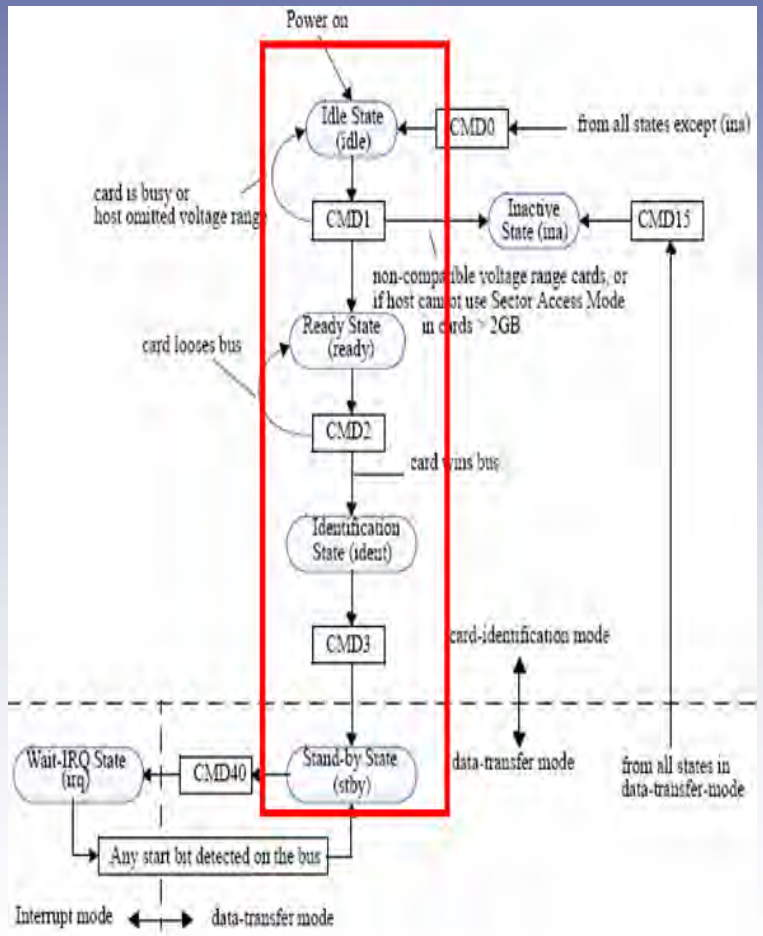


MUX NOR SHARED Only
X16 DRAM Only
MUX NOR1 Only
X32 DRAM Only
MUX NOR2 Only
High-Speed MMC Only
DO NOT USE
MUX NOR & MMC GND

- **Integration with other system memory types will make the system more cost effective**

Do I Need to Modify My Design to Accommodate *e*-MMC™?

- Probably Not
  - If your system supports MMC, then congratulations! *e*-MMC is identical to MMC electrically
  - If your system is using SD cards, then that's OK -- MMC is quite similar to SD
  - The initialization flows and command sets are similar



MMC Initialization Flow

e-MMC™ Summary of Benefits: Connecting you with

- Feature: Flash technology changes invisible to the host
  - Benefit: **Painless enjoy cutting edge NAND and enable faster product development and time to market**
- Feature: Fast and scalable performance
  - Benefit: Interface speeds up to 52MB/sec
- Feature: 1.8v or 3.3v interface voltage
  - Benefit: Supports a wide range of applications (i.e. consumer electronics, wireless, navigation, industrial, etc)
- Feature: MMCA/JEDEC industry standard
  - Benefit: Leading memory manufacturers serve as multiple sources
- Feature: Supported by key consumer electronic and cell phone OEMs
  - Benefit: Strong industry commitment