Choose the Right NAND Flash Solution for Your Embedded Application

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Agenda

• Embedded Market Overview
• Key Applications
• NAND Solutions
• Feature Comparison
• Conclusion
Embedded Market Trends

Automotive
- Transition to a mobile living space; fully connected with autonomous driving
- V2V/V2I communications
- Accelerated adoption of new technologies

Industrial Multi-Market
- Internet of Things (IoT) driving smarter connected devices
- Distributed data analytics and storage
- Adoption of mobile and PC derived platforms

Consumer
- Adoption of UHD/4K expands across applications
- Wearable applications are booming
- Increased mobility and smaller form factors

Connected Home
- Smarter homes for entertainment, security, and energy management
- Traditional set-top box (STB) market faces competition from over the top (OTT) and cloud-based networks
- Rapid growth into developing countries
Discrete vs. Managed NAND

**Discrete NAND**
- SLC, MLC, TLC
- Wear Leveling
- Command/Block Management
- ECC
- Driver

**Managed NAND**
- SSD, e.MMC, eUSB, CF
- Wear leveling, CMD/Block mgmt, NAND error mgmt

**ECC FREE**
- Serial NAND, EC²NAND
- Wear Leveling
- Command/Block Management
- ECC
- Driver
Managed NAND easy to design but more expensive

- uC and package adders (MCP, caps) large portion of BOM cost vs. discrete NAND at low densities

Discrete NAND can achieve similar/higher performance vs. e.MMC with optimized software
Discrete NAND Software Options

NAND FS

Application
Flash File System (e.g. JFFS, YAFFS, UBIFS)

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Flash wear leveling, bad block management, power loss managed by file system

Block FS

Application
Block File System (e.g. EXT4)

Flash Translation Layer
Flash Low-Level Driver

NAND

Requires FTL and LLD
Same software stack for managed and discrete NAND
Performance

- Comparable performance between discrete NAND and eMMC if software is optimized and host can manage ECC.

Based on Amlogic M8 Platform; 50 MHz async mode
Sequential Performance @ 128K chunk size and Random Performance @ 4K chunk size
## Power Consumption

### Active (W)

- PCIe: 4 W
- SATA: 3 W
- UFS: 1.2 W
- eMMC: 0.8 W
- NAND: 0.2 W

### Seq Write (nj/bit)

- PCIe: 2.5
- SATA: 2.75
- UFS: 2
- eMMC: 2
- NAND: 1

### Standby (mW)

- PCIe: 60 mW
- SATA: 60 mW
- UFS: 3 mW
- eMMC: 1 mW
- NAND: 0.5 mW

### Random Write (mj/KIOPS)

- PCIe: 28 mj/KIOPS
- SATA: 40 mj/KIOPS
- UFS: 50 mj/KIOPS
- eMMC: 60 mj/KIOPS
- NAND: 60 mj/KIOPS
Reliability Considerations

- Power Loss Recovery

- SLC mode

- Reflow Data retention
Summary

• Discrete NAND is a good option for cost-sensitive applications
• Managed NAND is better for ease of design/time to market
• Discrete NAND performance is equal to managed NAND if software is optimized
  • Robust power-loss protection, SLC mode, and reflow capability needed to use discrete NAND