

# TABLET AND SMARTPHONE DEMAND DRIVES NEW TRENDS IN

# MOBILE

MARKET REQUIREMENTS AND JEDEC  
STANDARDS LEAD TO INNOVATION,  
PERFORMANCE, AND NEW TECHNOLOGIES.

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**A**s the number of mobile devices worldwide surges, the need for better, cheaper memory for these devices soars. Numerous alternatives are available for mobile memory. Industry standards abound, and others are still in development. By all accounts, this market is on the upswing, so where do all of the memory technologies and form factors fit in, and what's on the horizon for mobile memory?

According to estimates from IHS iSuppli Research, the growth of sales for smartphones and tablets will increase revenue in the mobile-memory market by 26% in 2011 to \$16.4 billion, compared with \$13 billion in 2010 and, iSuppli projects, \$19.3 billion in 2012 (**Reference 1**). Gregory Wong, principal analyst at Forward Insights, agrees that consumer devices, particularly smartphones and tablets, are driving memory demands. He observes two basic types

MEMORY

IMAGE: GORDON STUEBER



of memory available for these devices: e•MMC (embedded multimedia card), a low-power JEDEC (Joint Electron Device Engineering Council) Solid State Technology Association standard, and solid-state drives. Solid-state drives offer better IOPS (input/output operations per second) for tablets than does the JEDEC standard but at a higher cost and power consumption (Figure 1).

Increasing performance and maintaining low power are the major challenges for memory designers, and many see universal flash storage, which accomplishes these goals, as the next big thing. Vendor support is weaker than it was when JEDEC first proposed the standard, according to Wong. As such, a solid-state drive with a low-power SATA (serial-advanced-technology-attachment) interface could be an alternative. “For example, the idle power of the SATA PHY [physical layer] is quite large,” he says. “You could make it ‘low power’ by turning off the PHY when [it is] idle.”

### SETTING THE STANDARDS

JEDEC, a volunteer organization, sets open standards for the microelectronics industry and recently hosted a standardization meeting in Vancouver, BC, Canada, focusing primarily on memory-related topics. “The ongoing standards-development work within the JEDEC committees, focused on mobile memory, has significant strategic value to the industry and will help make possible a wide range of innovative new products,” says Desi Rhoden, chairman of the JC-42 Committee for Solid State

### AT A GLANCE

Mobile devices create a bottomless market for memory ICs.

Standards, particularly from the JEDEC (Joint Electron Device Council) Solid State Technology Association, are vital to evolution in mobile memory.

Solid-state drives are starting to change the level of integration for mobile memory, especially in tablets.

Memories. Published JEDEC standards that relate to mobile memory include LPDDR2 (low-power double data rate 2), universal flash storage, and e•MMC.

JEDEC designed the LPDDR2 JESD209-2E standard to enhance the design of mobile devices, such as smartphones, cell phones, PDAs (personal digital assistants), GPS (global-positioning-system) units, and handheld gaming consoles, by enabling increased memory density, improved performance, greater compactness, overall reduction in power consumption, and longer battery life. As a result, it offers advanced power-management features, a shared interface for nonvolatile and volatile memory, and a range of densities and speeds. The JC-42.6 Subcommittee for Low Power Memories published the standard in April 2009 and updated it in April 2011.

The JEDEC JESD220 universal-flash-storage standard targets both embedded and removable flash-memory-based storage in mobile devices

that require high performance and low power consumption, such as smartphones and tablets. The standard uses the MIPI (Mobile Industry Processor Interface) Alliance’s M-PHY (MIPI-physical-layer) and UniPro (Unified Protocol) specifications to form its interconnect layer. Because it combines this advanced interface with low active-power level and a near-zero idle-power level, universal flash storage shows promise in achieving significant reductions in device power consumption. JEDEC first published the standard in February 2011.

In June, JEDEC announced the publication of the JESD84-B45 Embedded Multimedia Card Electrical Standard

## LPDDR3 EXTENDS THE LPDDR2 STANDARD’S BANDWIDTH, REACHING 6.4 GBYTES/SEC, OR 12.8 GBYTES/SEC FOR DUAL CHANNELS.

Version 4.5, a low-cost data-storage and communication standard that targets applications such as smartphones, cameras, organizers, PDAs, digital recorders, MP3 players, pagers, and electronic toys. The latest version of the standard increases interface bandwidth from 104 Mbytes to 200 Mbytes to achieve high mobility, high performance, low power consumption, and high data throughput. This free standard helps to improve the interaction between the host processor and the memory device at the interface, configuration, and protocol levels to gain system performance and reliability (Reference 2).

JEDEC is also developing LPDDR3 to meet the higher bandwidth requirements of next-generation smartphones and tablets. JEDEC LPDDR3 effectively extends the LPDDR2 standard’s bandwidth, reaching 6.4 Gbytes/sec and allowing 12.8 Gbytes/sec for a dual-channel configuration. It will support both POP (package-on-package) and discrete packaging types and preserve the power-efficient features and signaling interface of LPDDR2.

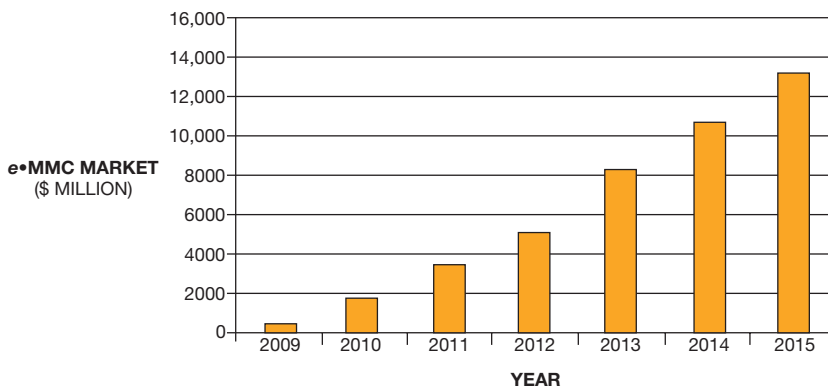
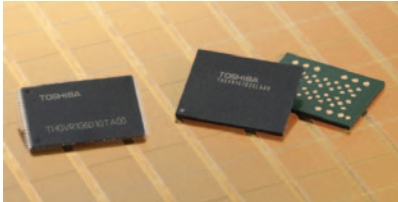


Figure 1 The e•MMC market, which includes smartphones and tablets, will continue to grow through 2015.



**Figure 2** Toshiba's SmartNAND series integrates robust ECC and targets consumer mobile devices that require high-density, nonvolatile memory.

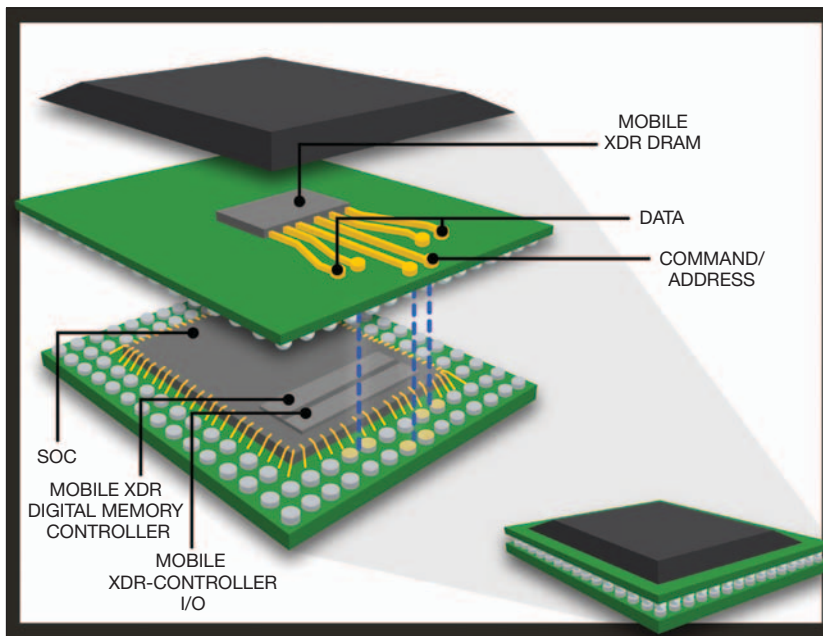
The JEDEC WideIO (wide-input/output) standard aims to satisfy industry demands for increased levels of integration and improved bandwidth, higher latency, lower power consumption, lower weight, and smaller form factor. JEDEC expects WideIO to provide performance, energy efficiency, and compactness for smartphones, tablets, handheld gaming consoles, and other high-performance mobile devices. WideIO mobile DRAM uses chip-level 3-D stacking with TSV (through-silicon-via) interconnects and memory chips on SOCs (systems on chips). WideIO will suit use in systems that require memory bandwidth as high as 12.8 Gbytes, including 3-D gaming, 180p high-definition video, and similar applications.

## IN THE FIELD

Designers selecting mobile memory care about performance, form factor, and supply availability. According to Scott Nelson, vice president of Toshiba's memory business unit, NAND is the de facto storage medium for mobile memory because of density and low cost. He sees designers of mobile devices selecting NAND memory across a range of formats—from raw NAND, embedded memory with an embedded multimedia-card interface, to removable memory, such as SD (secure digital) and microSD.

One of the challenges for memory providers is the continuing need for improved error correction in next-generation NAND. In response, Toshiba offers an approach that addresses increasing needs for better ECC (error-correction code) and flash management. The company also offers the SmartNAND MLC (multilevel-cell) NAND product, which is essentially NAND with an ECC-controller chip (**Figure 2**).

Tetsuya Yamamoto, a Toshiba memory-engineer manager, observes that performance needs increase with each generation of JEDEC specification, which is an additional challenge. For instance, the most recent Embedded Multimedia Card specification raises performance



**Figure 3** Rambus' Mobile XDR targets smartphones, netbooks, mobile gaming, and multimedia products.

## FOR MORE INFORMATION

**Forward Insights**  
www.forward-insights.com

**IHS iSuppli Research**  
www.isuppli.com

**Joint Electron Device Council Solid State Technology Association**  
www.jedec.org

**Mobile Industry Processor Interface Alliance**  
www.mipi.org

**Rambus**  
www.rambus.com

**SanDisk**  
www.sandisk.com

**Toshiba**  
www.toshiba.com

to 200 Mbytes/sec. Yamamoto expects the universal-flash-storage standard to include a maximum speed of 2.9 Gbytes/sec. To address the performance issue, Toshiba plans to support a universal-flash-storage interface in addition to the one for the Embedded Multimedia Card.

According to Kendra De Berti, senior marketing manager for Rambus, the memory needs of smartphones and tablets represent a challenging mix, including low active and standby power, fast power-state transitions to increase battery life, small footprint, high bandwidth, multiple memory channels for high throughput, and the ability to support more powerful multicore processors. She notes that engineers must now create low-risk memory that uses and maintains backward compatibility with the infrastructure.

To address these challenges, Rambus has been building a patent portfolio for mobile memory with several proprietary technologies in the Mobile XDR (extreme-data-rate) memory architecture (Figure 3). For example, the company's low-swing differential-signaling technique delivers high data-rate performance at low voltage. Rambus has heavily invested in JEDEC's LPDDR2/3 standards, which use single-ended signaling, in which data and command/address signals are referenced to ground.

Rambus is closely following the emerging WideIO specification. "The promise of WideIO DRAM with TSV-interconnect technology is high bandwidth at low power in a compact footprint, and it would address the major shortcomings of the LPDDR, but it does so by introducing major issues of its own," says De Berti. She sees the need for significant development work before Rambus can supply WideIO with TSV technology with high yields and low costs. Further, she adds, significant changes to supply chains and business



**Figure 4** SanDisk's integrated solid-state drive offers fast, lightweight, and affordable storage for smartbooks, ultrathin PCs, and tablets.

models will be necessary for broad adoption in mixed-IC, processor-plus-memory, implementations.

The industry is also showing a lot of interest in solid-state drives for tablets (Figure 4). All of the major memory suppliers are also delivering new solid-state drives. "The real challenge is to provide increased performance and capacities at prices consumers want," notes Mike Wong, director of public relations for SanDisk Corp. "New mobile devices [are always] entering the market, and the sheer volume of products can be a challenge if developers are not prepared," he adds. **EDN**

## REFERENCES

- 1 Yang, Michael, "Mobile Memory to Proliferate to \$16.4 Billion Market in 2011, Up 26 Percent," IHS iSuppli, April 28, 2011, <http://bit.ly/lo1KpO>.
- 2 "e•MMC Electrical Standard," Joint Electron Device Council Solid State Technology Association, <http://bit.ly/ljkHdq>.



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