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electronic design

design FAQs

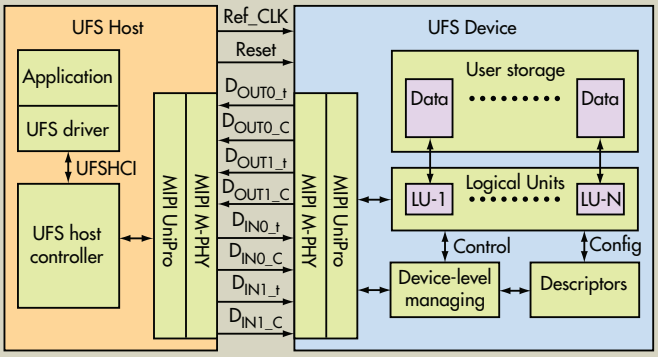
Universal Flash Storage On the Rise

FREQUENTLY ASKED QUESTIONS

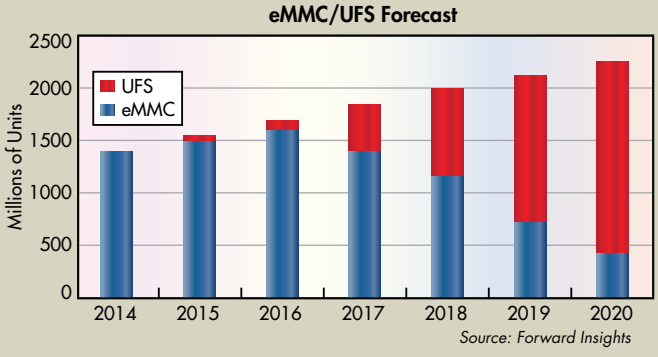
Q: What is Universal Flash Storage (UFS)?

A: Universal Flash Storage (UFS) is a JEDEC standard storage technology for high-speed memory. There has been growing interest in UFS because it can be used to connect the latest high-speed flash-memory technology to high-performance SoCs such as those used in smartphones and other mobile devices.

The JESD220B UFS 2.0 standard updates the UFS v1.1 standard with increased link bandwidth for better performance, security features extensions, and additional power-saving features. It uses the M-PHY physical interface developed by the MIPI Alliance. It also uses the MIPI Alliance MIPI UniPro for the link layer.



1. UFS utilizes high-speed serial lanes for full duplex operation. The standard supports two lanes. Each lane operates at 5.8 Gbits/s.



2. The forecast shows a significant rise in the use of UFS storage.

Q: What is the difference between UFS and eMMC?

A: The JEDEC eMMC standard is an 8-bit bus, flash-memory interface. It operates in half-duplex mode and it is easy to implement across a full range of SoCs in numerous applications. The latest version, 5.1, tops out at 400 Mbytes/s.

UFS uses two high-speed serial links (*Fig. 1*). The differential pairs can operate in full-duplex mode to enable transmit and receive at the same time. Each M-PHY lane supports 5.8 Gbits/s, enabling a maximum interface speed of 11.6 Gbits/s when transmitting over two lanes.

Q: What advantages does UFS have?

A: Enabling higher performance is the main advantages of UFS over eMMC. The ability to support half- and full-duplex modes provides better performance or better flexibility compared to eMMC. The use of the SCSI Architecture Model allows better support in multithreaded applications. Other flash-memory systems, like eMMC, are designed for single-threaded operation.

Power efficiency varies depending upon applications. The typical eMMC implementation sometimes provides better power efficiency in idle mode, but UFS provides better efficiency when larger transfers are involved. Its faster transfer rate can also minimize the time for a transfer.

Q: Will UFS replace eMMC as an embedded memory-storage solution?

A: The parallel bus architecture interface of eMMC consumes more power as the frequency has increased with successive JEDEC standard versions of eMMC. And more precise timing control among 8 I/O is needed at higher frequencies. UFS, with its serial interface, was created as the next-generation embedded memory solution to replace eMMC, and to enable increasing levels of performance in future generations. Therefore, UFS is intended to be a potential replacement for any applications that use eMMC today.

Currently, UFS is primarily targeted to support higher densities such as 32 GBytes to 128 GBytes, and is first being adopted by high-end smartphones and tablets, and soon after migrating to mid-range smartphones and many other applications. eMMC will continue to support the low density requirements of many applications, especially those that will continue to need under 32 GBytes.

Q: What is the market adoption of UFS?

A: UFS was first introduced in February 2013 with UFS ver1.1. This was provided to SoC vendors to enable the development of the UFS interface for their

SoCs. Since then, the UFS ver2.0 standard was developed, and the first smartphones to use UFS were introduced to the market in 2015. It is expected that a wide range of high-end smartphones will be introduced using UFS in the second half of this year, driving significant growth in UFS demand heading into 2017. This trend will continue as UFS pricing approaches parity with eMMC, and is adopted by mid-range smartphones and many other applications (*Fig 2*).

Q: What interface features does UFS support?

A: UFS employs the SCSI architectural model that supports features like Native Command Queuing. The more advanced protocol provides more flexibility and features not found in more basic interfaces such as eMMC. This means that the UFS controller design is very important to performance and efficiency.

Q: What considerations should design engineers take into account when using UFS?

A: Compliance, interoperability, and backward compatibility are some of the major considerations designers will have to contend with when dealing with UFS and other storage technologies. Since UFS controller design is critical to performance and quality, design engineers should consider utilizing memory vendors who develop their own UFS controller to harness the best performance and quality out of their own NAND. As we have seen for eMMC, the market-share leaders have been those suppliers who develop their own eMMC controllers. This is expected to be the case for UFS memory as well.

Q: What other applications are adopting UFS beyond smartphones?

A: Smartphones are the primary application currently, but others such as video cameras, augmented reality, 2-in-1 tablets, and notebooks are also adopting UFS to take advantage of the higher throughput and capacity of UFS storage devices. Automotive is also adopting UFS for infotainment and driver-assist memory requirements, though due to the long development and certification process, it will take more time before cars reach the market that incorporates UFS memory. ■