Understanding the New UHS-III

In February 2017 the SD Association (SDA) released the SD 6.0 specification, which adds a new level of Ultra High Speed III (UHS-III) bus interface, providing up to 624 megabytes per second (MB/s) transfer rates.

UHS-III answers the demand for bus speed enhancement for 8K videos and 360-degree/3D cameras/drones, and data-intense high-speed wireless communication such as 5G mobile networks, or IEEE802.11.ax, recorded on higher capacity SD memory cards. UHS-III includes all UHS-II functionalities plus 3.12/6.24Gpbs FD modes and Quick Recovery function. The major modification in UHS-III is the adoption of high-performance PHY. If the host device implements 6.24Gbps UHS-III PHY, UHS-II devices are relatively easy to upgrade to UHS-III.

Key Features of UHS-III

Enhancement of Lane Bitrate

UHS-III interface, which is compatible with UHS-II, consists of the following three differential signaling lanes: RCLK, D0 and D1 (see Figure 1). Command, data and other packets or symbols are transmitted by D0 (basically from host to SD memory card) and D1 (basically from SD memory card to host) lanes.

There are four available bitrate segments, called ranges, in UHS-III, as described in Table 1. Range A and B were introduced in UHS-II. By 8b/10b coding and half-duplex mode, setting D0 and D1 lanes to the same direction for data rate enhancement yields maximum transmission speeds for Range A and B of 156MB/s and 312MB/s, respectively.

Range C and D are added in UHS-III, achieving the doubled maximum speeds assured by UHS-III. Maximum transmission speeds for Range C and D are 312MB/s and 624MB/s, respectively, by 8b/10b coding and full-duplex mode (bus direction switch is not needed). Moreover, "emphasis" technology can be adopted in Range C and D to improve signal integrity.

Note that a UHS-III memory card must support all ranges from Range A to Range D.

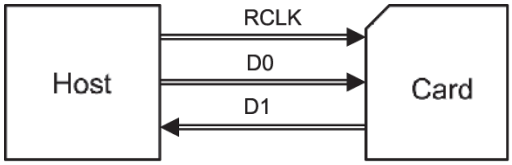

Figure 1: Interface Structure of UHS-III (Full-duplex Mode)

Range	RCLK Frequency	Available Bitrate / Lane	Max Transmission Speed	Note
Range A	26 – 52MHz	0.39 – 0.78Gbps	156MB/s (Half-duplex)	Available in UHS-II/III
Range B		0.78 – 1.56Gbps	312MB/s (Half-duplex)	
Range C	48 – 52MHz	2.88 – 3.12Gbps	312MB/s (Full-duplex)	Available in UHS-III
Range D		5.76 – 6.24Gbps	624MB/s (Full-duplex)	

Table 1: Max Bitrate and Transmission Speed for Each Range

SD memory cards have been progressing in two aspects: greater storage capacity and faster bus speed. Figure 2 shows the progress of SD bus interface throughput. As SDA propels higher storage capacity and faster bus speed specifications, it enables applications to manage big data with an SD memory card.

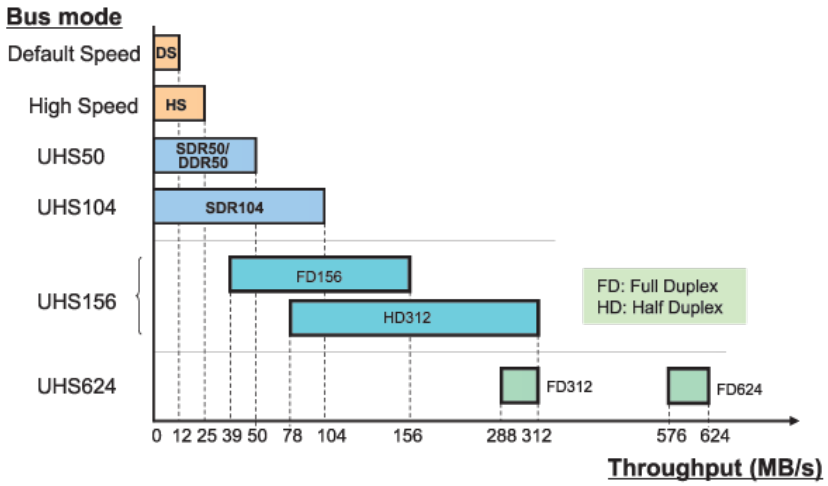

Figure 2: Progress of Bus Interface Throughput

QR Dormant

In UHS-II, once the memory card enters Dormant (power-saving) state, it goes through Wakeup and Config states to get back to Active state (working). In UHS-III, on the other hand, QR (Quick Recovery) Dormant function is added to make the transition time from Dormant to Active state shorter. For example, the host device can use a UHS-III card in lower power consumption by implementing efficient power management using QR Dormant if the UHS-III card supports QR Dormant, which can enter deep sleep and return to Active state quickly.

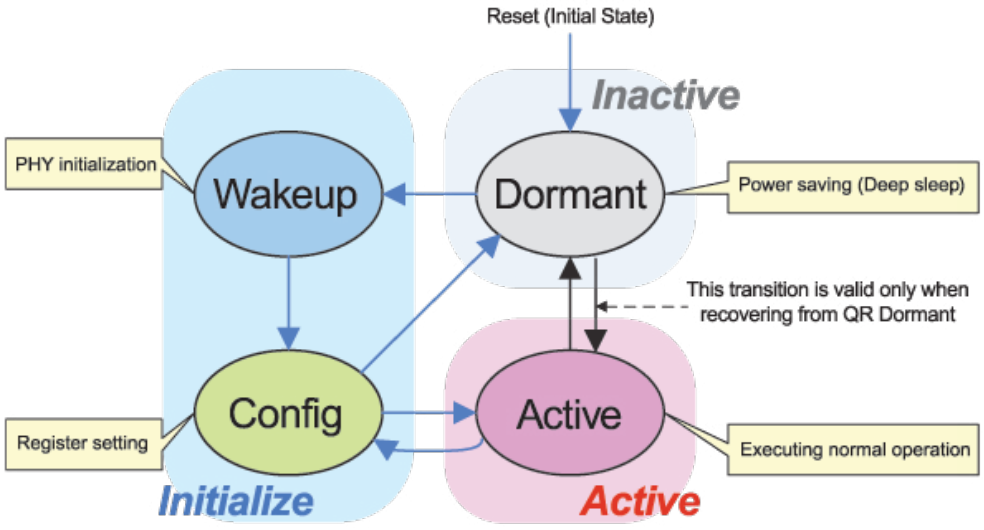

Figure 3: State Machine for UHS-III