

# *The Past, Present, and Future of SD Memory Cards*

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**TOSHIBA**  
Leading Innovation >>>

## Early Flash Memory Cards in the 90s

**PCMCIA  
ATA Card**



**CompactFlash**



**Miniature Card**



**SmartMedia**  
(aka SSFDC: solid state floppy disk card)

## SD Card Announcement

### **MATSUSHITA ELECTRIC, SANDISK AND TOSHIBA AGREE TO JOIN FORCES TO DEVELOP AND PROMOTE NEXT GENERATION SECURE MEMORY CARD**

SD (Secure Digital) Memory Card Expected To Unleash Wave  
Of New Digital AV (Audio/Video) Consumer Products And  
Enable Internet And Wireless E-Commerce.

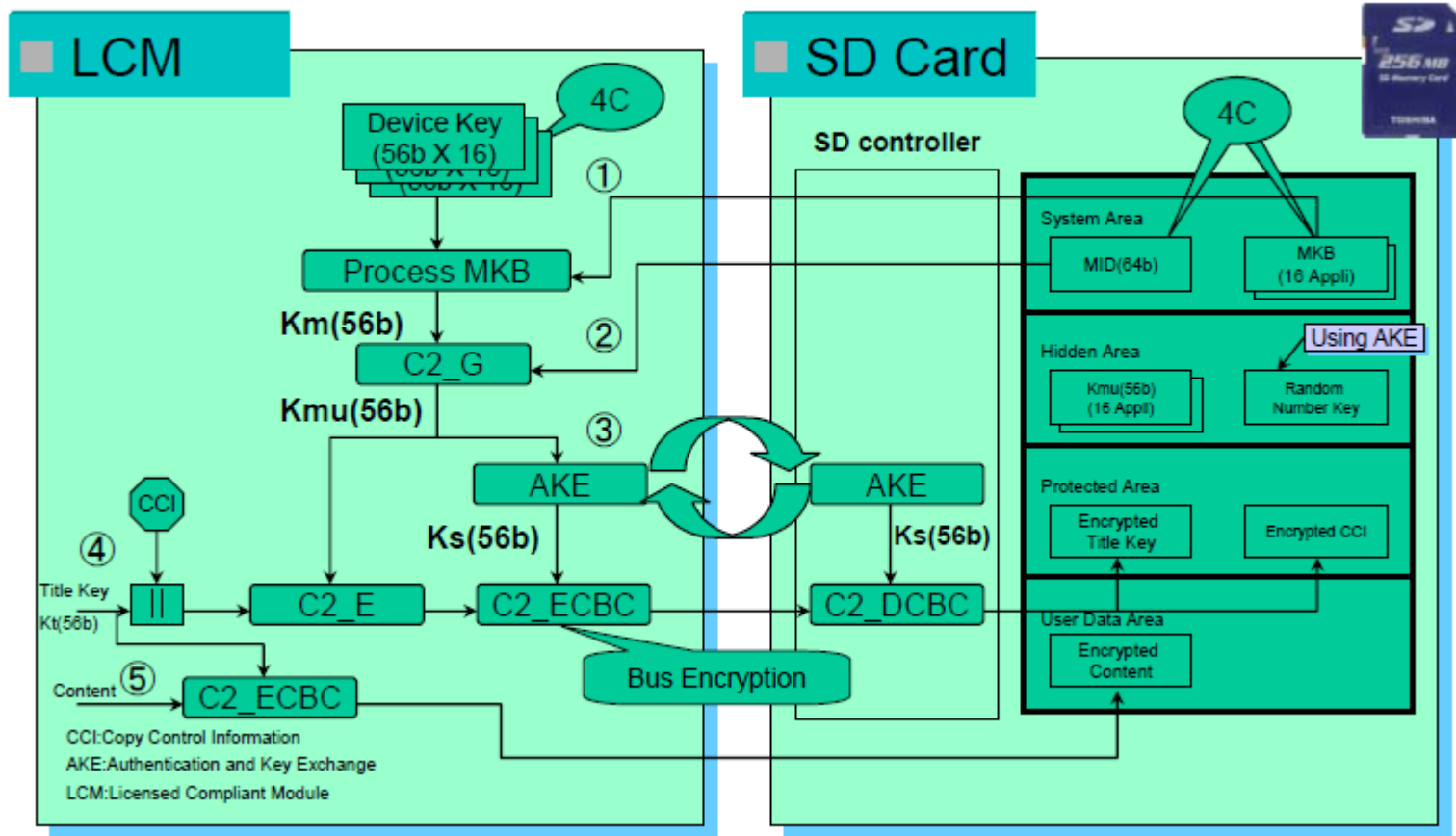
**REDWOOD CITY, CA, (Aug. 25, 1999)** - Matsushita Electric Industrial Co., Ltd. (NYSE:MC), best known by its Panasonic brand name, SanDisk Corporation (NASDAQ:SNDK) and Toshiba Corporation have reached an agreement on comprehensive collaboration to jointly develop, specify and widely promote a next generation secure memory card. The announcement was made today at joint press conferences in Tokyo, Japan, Osaka, Japan and Redwood City, CA.

...

Powerful security and copy protection (SDMI compliant) ... The security level has been designed to comply with both current and future SDMI (Secure Digital Music Initiative) portable device requirements.

Sampling of the new SD Memory Card will begin in the first quarter of 2000. Production shipments are expected to commence in the second quarter of 2000. It is expected that application products that use the new card will be available in the first half of next year.

# SD Card Security Elements



## About the SD Association

The SD Association is a global ecosystem of technology companies charged with setting industry standards and encouraging the development of consumer electronics, wireless communication, and digital imaging and networking products that utilize the market-leading benefits of SD technology. Panasonic Corporation, SanDisk Corporation and Toshiba Corporation established the SD Association in January 2000 as a new industry-wide organization setting industry standards to promote SD product acceptance in a variety of applications. Today, the SD Association has approximately 1,000 members involved in the design, development, manufacture or sale of products using SD technology.



- Establish SD card specifications based on open discussion
- Promote SD card as the Global Standard

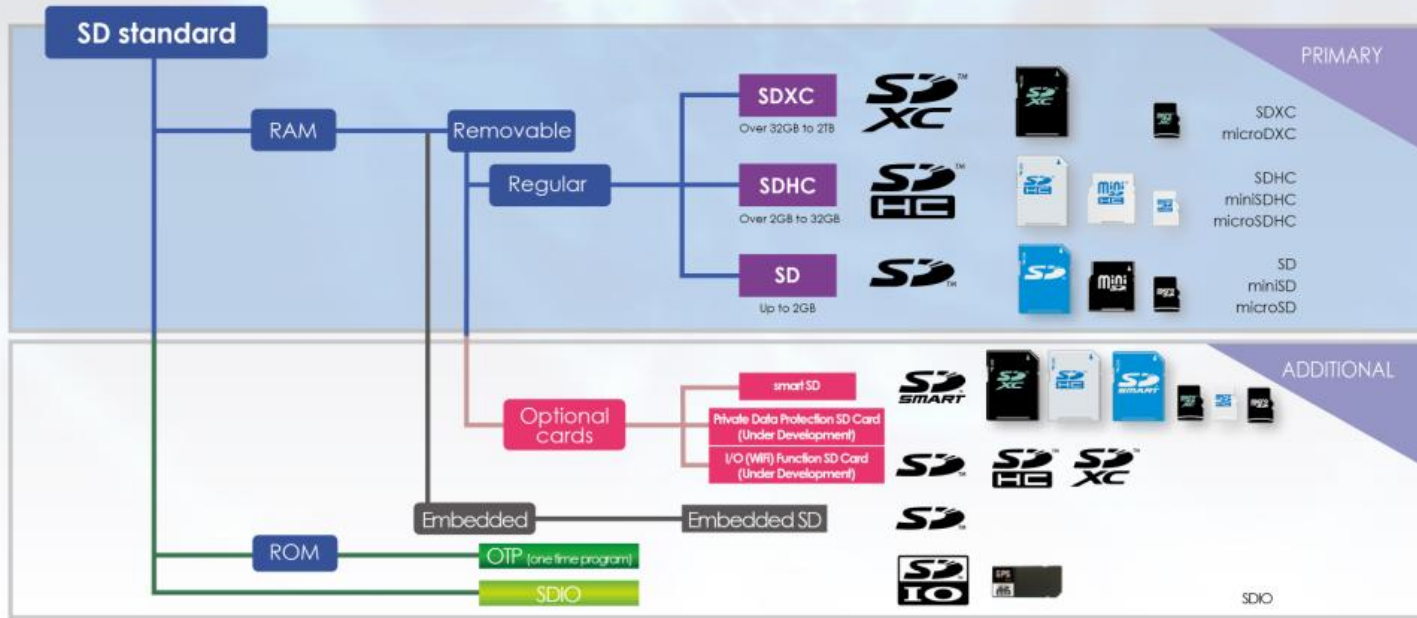


[www.sdcard.org](http://www.sdcard.org)

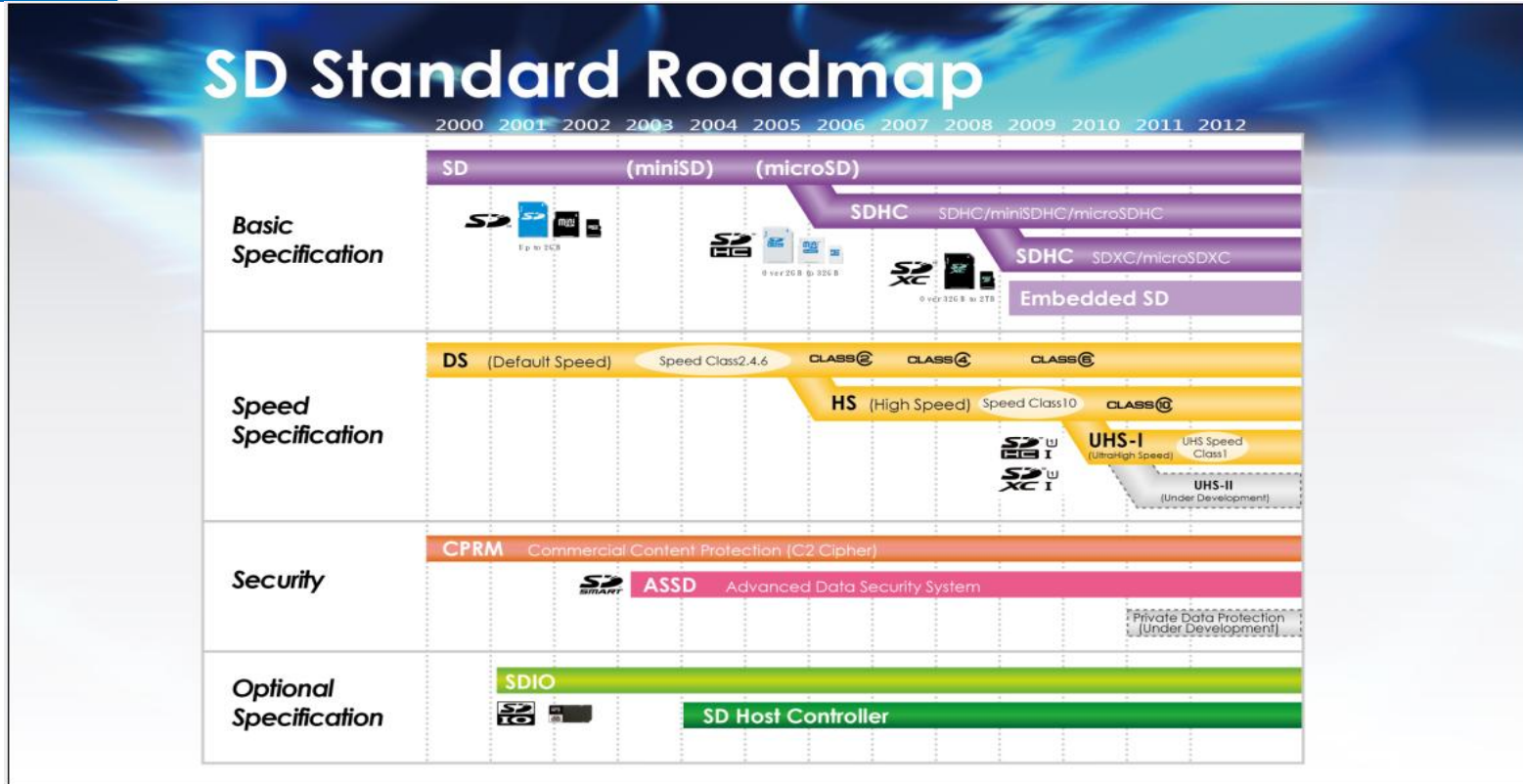
# SD Family Roadmap

## SD FAMILY

The success and pervasiveness of SD have given rise to countless devices, applications and services. To communicate usage and features for SD type and size, a convenient classification system is provided for a given host device. For instance, for the Removable RAM classification, SD FAMILY details three types of cards for capacity. For SMART SD/SDHC, the classification defines current and future security features. SD Association also defines SD I/O (input/output) and OTP (one-time program) as separate categories.

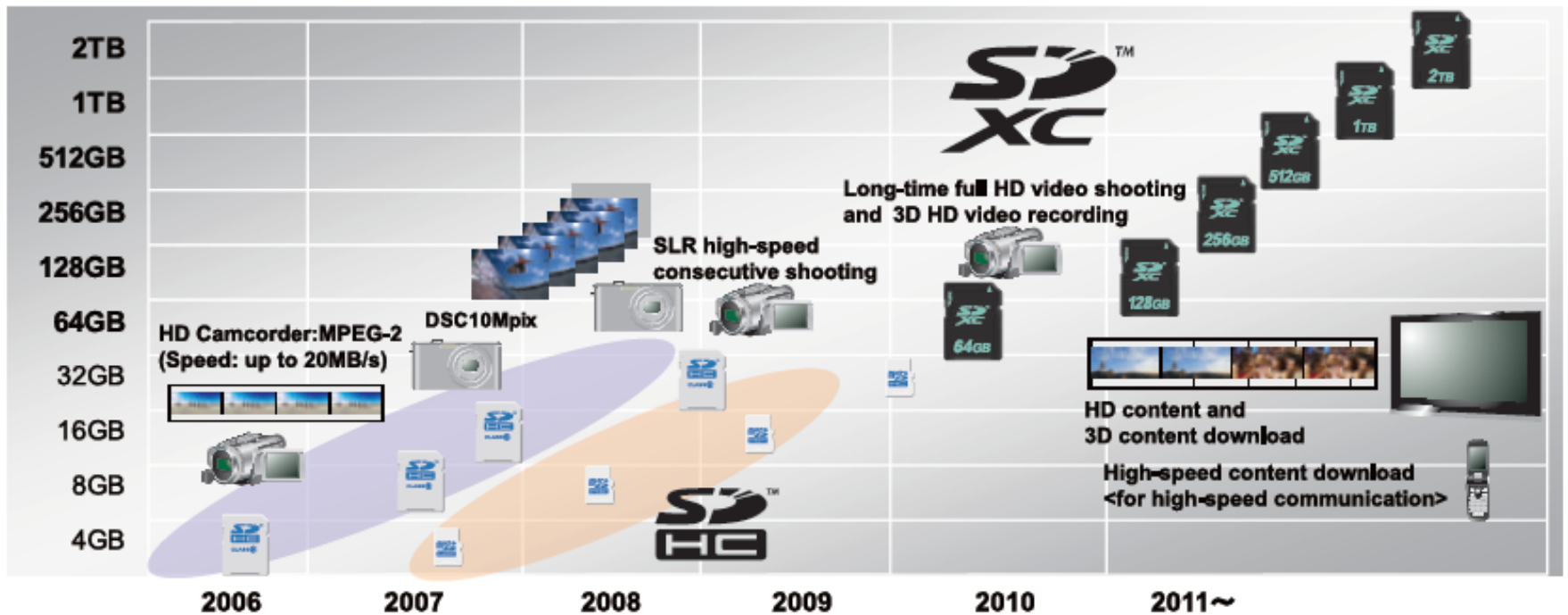


# SD Standard Roadmap



Yr	Ver.	Logo	File System	Capacity	Bus-IF Speed	Speed Class	Physical
2000	1.01	SD	FAT 12/16	~2GB	12.5MB/s (DS)	-	SD
2003	-	-	-	-	-	-	miniSD
2004	1.10	-	-	-	25MB/s (HS)	-	-
2005	-	-	-	-	-	-	microSD
2006	2.00	SDHC	FAT 32	Over 2GB~32GB	-	Class 2,4,6	-
2008	-	-	-	-	-	-	eSD
2009	3.00	SDXC	exFAT	Over 32GB~2TB	-	Class 10	-
2010	3.01	UHS-I	-	-	50MB/s (UHS50) 104MB/s (UHS104)	UHS Speed Class 1	-
2011	4.00	UHS-II	-	-	156MB/s (UHS156) 312MB/s (UHS312)	tbd	-

## SD ROAD MAP & APPLICATIONS

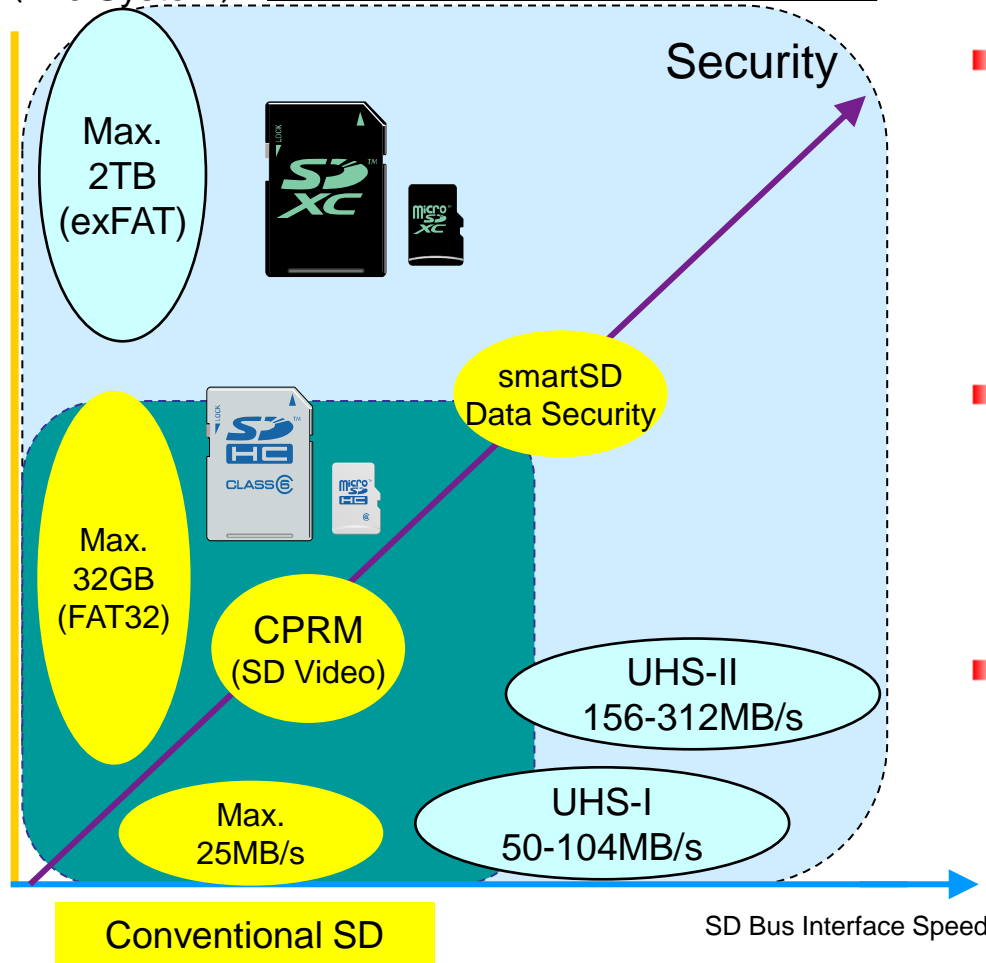




# Flash Memory **New Generation SD Standard (ver.3.00/3.01/4.00)**

**SUMMIT**  
Capacity  
(File System)

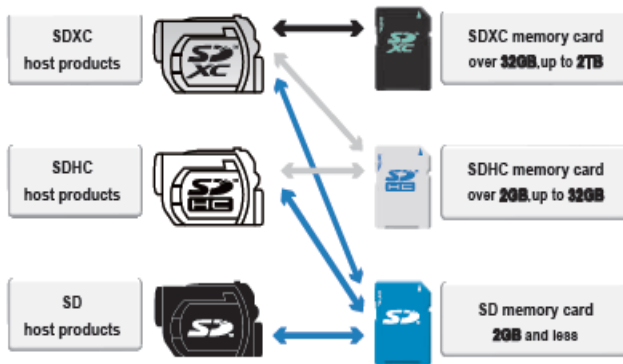
New Gen. SD Standard



- Massive Capacity (SDXC) ver.3.00
  - SDXC over 32GB up to 2TB for HD video recording/playback of huge file size data
  - File System : exFAT
  - Replacing from FAT32 Max. file size of 4GB (FAT: File Allocation Table)
  
- Ultra High Speed Bus ver.3.01/ver.4.00
  - UHS, incredible Bus Speed enhancement
  - 50MB/s - 104MB/s with UHS-I (Ultra High Speed) Standard on ver.3.01
  - 312MB/s with UHS-II Standard on ver.4.00
  
- New Functions ver.4.xx
  - Personal Data Protection, Enterprise Data Security and Encryption System is coming
  - Further Bus-IF Speed integration on UHS-II

# SD Host & Card Interoperability

## SDXC - Compatibility



### Understanding Backwards Compatibility

- SDXC memory cards can be used only with SDXC host products.
- SDXC host products can use SD, SDHC and SDXC memory cards.
- SDHC memory cards can be used with SDHC and SDXC host products.
- SDHC host products can use both SD and SDHC memory cards.


If an SDXC memory card is inserted into a PC or a host product that does not support SDXC memory cards, a message may prompt you to format the card. Do not format the SDXC memory card in a non-compatible host product; it will erase the data on the SDXC memory card and format the card for a different file system that will no longer work with SDXC host products.

### Overview: SDXC support on Windows OS

	Windows.7	Windows.Vista (SP1 or later)	Windows.XP (SP2 or later) [with exFAT update]
SDXC Compatible USB Reader	Yes	Yes	Yes
SD Slot on PC	Yes [needs SDXC driver patch]	Yes [needs SDXC driver patch]	NO

# UHS (Ultra High Speed) Bus Interface

- For the sheer variety of high-performing, feature-rich devices, higher speed Bus I/F and its minimum writing speed specifications for SDHC and SDXC have been introduced.

Bus Interface	Card Type	Bus Mark	Bus Speed	Speed Class
Normal Speed	SD, SDHC and SDXC	—	12.5MB/s	Class2, 4, 6
High Speed	SD, SDHC and SDXC	—	25MB/s	Class10
UHS-I	SDHC and SDXC		50MB/s (SDR50, DDR50) 104MB/s (SDR104)	UHS Speed Class 1
UHS-II <span style="background-color: orange; color: white; padding: 2px;">New</span>	SDHC and SDXC	TBD	156MB/s 312MB/s	TBD





\* Maximum speed differs from the bus I/F speed. It varies depending upon the card performance. The average speed that your device writes to an SD memory card may vary depending upon the device and the operation it is performing. The speed may also depend how on other data is stored on the SD memory card



Normal and High Speed Cards can also be used with UHS-I host devices. High performance required by UHS-I host device can be achieved by the combination with UHS-I card.

# Speed Classes and UHS Speed Class

- Speed Class designates minimum writing performance.\* It was designed for streaming data recording. The “Speed Class”, Class2, 4, 6 and 10 for the current Bus I/F and the “UHS Speed Class” Class1 works under UHS-I Bus I/F. (The Speed Class and the UHS Speed Class are not compatible.)

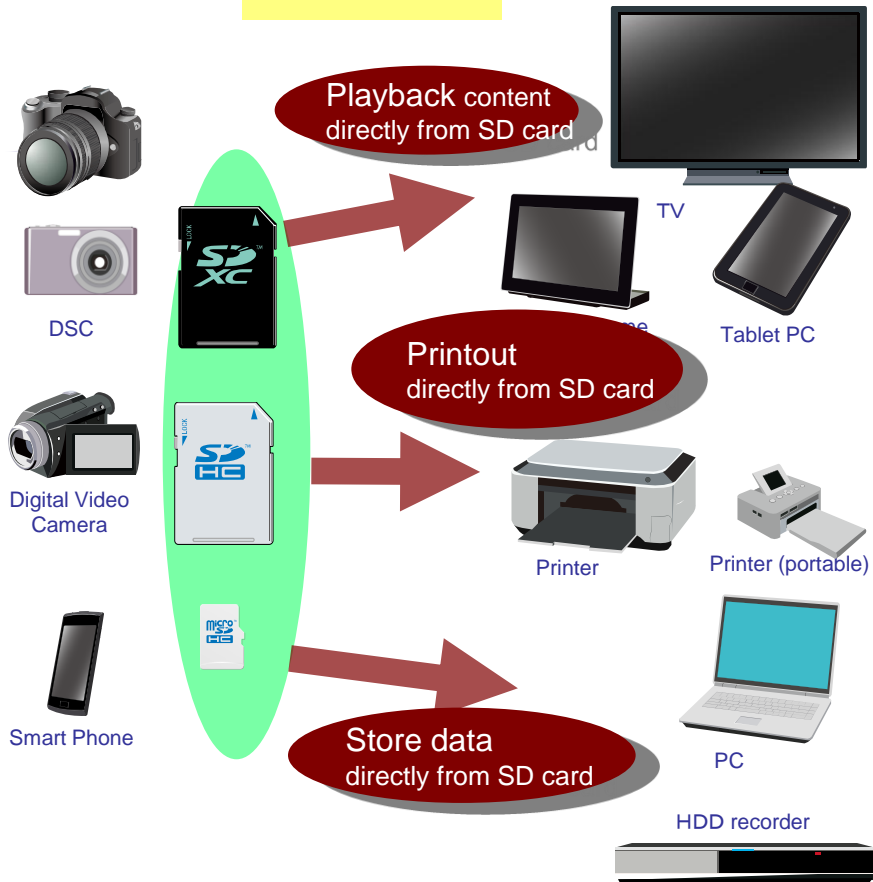
	Speed Class Mark	Applications
Speed Class		SD video recording
		HD~Full HD video recording
		Full HD video recording HD still consecutive shooting
UHS Speed Class		For higher potential of recording real-time broadcasts and capturing large size HD videos



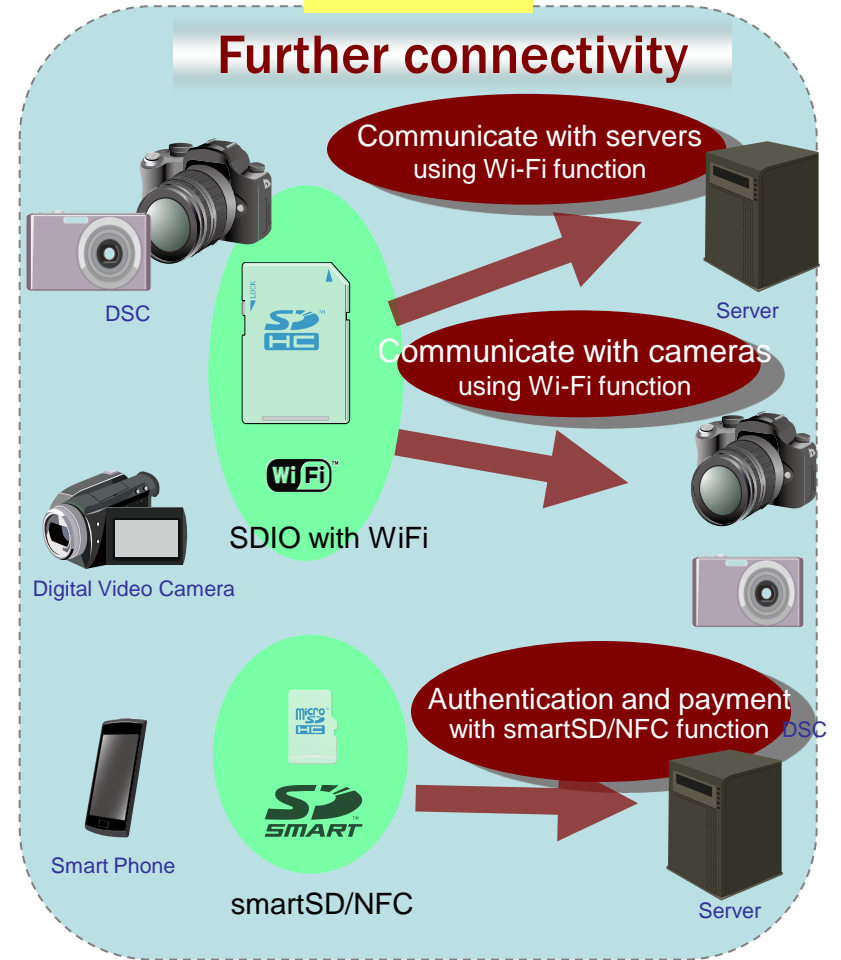
\* minimum writing performance under SD Card compliance test conditions.

# SD Standard Integration for Network Application

## Current



## Future



## Summary

- SD Standard is continuing to evolve in capacity and speed along with the requirements from enhanced digital market
- Standardized “SD” with capacity up to 2GB, “SDHC” with capacity up to 32GB and “SDXC” with capacity up to 2TB
- Ultra High Speed “UHS” SD bus realizes incredible read/write performance both in host and card products
- New SD Standards will be coming like SD cards with WiFi for wireless connectivity and smartSD/ NFC for authentication/payment in mobile cloud market
- See SD Card website (<https://www.sdcard.org>) for more information and the SD Formatter 3.0 for SD/SDHC/SDXC.