

SDA Overview and SD Standard Ver.8.00 SD Express / Ver.9.00 for semi embedded

Kazunori Nakano,
Board of Directors & Marketing Committee Chair
@ Computex & Global Workshop Taipei 2023 , Taiwan

Table of Contents

<https://www.youtube.com/watch?v=nOf750jcP7o>

- Introduction
- SD Association Overview
 - Organization
 - License Scheme & Compliance
 - Officers and Board of Directors
- SD Standard Specification and Ver.8.00 SD Express , Ver.9.00 Boot / TCG / RPMB Options
 - SD Card Market Update
 - SD Specification Evolution
 - SD Logos, SDA Pictographs and Card Types
 - Bus Mode , Speed and Backward Compatibility
 - Client SSD & PCIe SSD Technology Trend
 - PCIe & NVMe Interface Test Advantages
 - SD Ver.8.00 SD Express Card and Applications
 - SD Express / UHS-II Verification Program (SVP)
 - SDA Website
 - SD Ver.9.00 (Boot / TCG / RPMB Options)

Introduction



- **Kazunori (Kaz) Nakano**
 - Senior Expert, Memory Application & Marketing Engineering Dept. KIOXIA Corporation
 - Board of Directors & Marketing Committee Chair SD Association
- Starting his global electronic components marketing jobs from 1986 at Toshiba Corporation after graduation of Sophia University in Tokyo, he has been engaging in flash memory business @KIOXIA (former Toshiba Memory) from 2002 focused on SD Memory Card market & application development. Kaz has been dedicating his life with SD Card Association as Marketing Committee Chair from 2009 and Board of Directors from 2015. His global activity is endless, challenging and borderless to try to create new SD Card specifications and market for better IT interactions on a removable memory devices.

Forward-Looking Statements

During our session today we may provide forward-looking statements. Any statement that refers to expectations, projections or other characterizations of future events or circumstances is a forward-looking statement, including those relating to industry trends, standardization plans and any SD Association's related plans. Actual results may differ materially from those expressed in these forward-looking statements due to various factors. We undertake no obligation to realize these forward-looking statements, which speak only as of the date hereof.



SD Association Overview

SD Association Organization



SD Association: SDA (www.sdcard.org)

Mission: SD Card Standardization with Promotion and Adaption of SD Standard Worldwide



- Organization Established in 2000
- Member Company :About 785 Companies Worldwide as of May 2023 .
- Member Fee: Executive Member \$4,500/year General Member \$2,500/year

License Scheme & Compliance

Specification	SD Association	SD-3C LLC
	SDA Specification	SD Group Specification
	SDA Pictographs	SD Logos
		Essential Patents
License	Contract with SDA	Contract with SD-3C LLC
Card 	SDA Membership Agreement (SDAMA)	Card License Agreement (CLA)
Host 	SDA License Agreement (SDALA)	Host Ancillary Product License Agreement (HALA)

Licensee should comply with SD/SDA Specifications and SD/SDA Logo Guideline (As Normative Document)

□ **President: Hiroyuki Sakamoto**

Hiroyuki.sakamoto@t-net.ne.jp



□ **Chairman: Yosi Pinto**

Yosi.pinto@sandisk.com



□ **Treasurer: Bo Li**

Bo.Li@sandisk.com



□ **Executive Director*: Stan Moyer**

sdcard_ed@inventures.com



□ **Secretary: Thom Denholm**

Thom Denholm thom@tuxera.com



* Stan is not an official SDA officer per the bylaws definition. Though he is considered as a team member in the Officers Team as being the Executive Director of the association. A service provided by our SDA Office contractor – Global Inventures

SDA Board of Directors – 11 Companies

(in alphabetical order)



Danny Lin



Jeff Hsieh



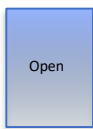
David Chen



Joel Tang



Kazunori Nakano



Open



Joseph Yuan



Jordan Zhong



Jyh Chau



Open



Shuichi Ohki



Takuji Maeda



T.H. Kuang



Andre Chen



HeeChang Cho



JiCheol Hong



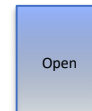
Yosi Pinto



Jeff Tsujimoto



Janice Chiu



Open



Joel Catala



Thom Denholm

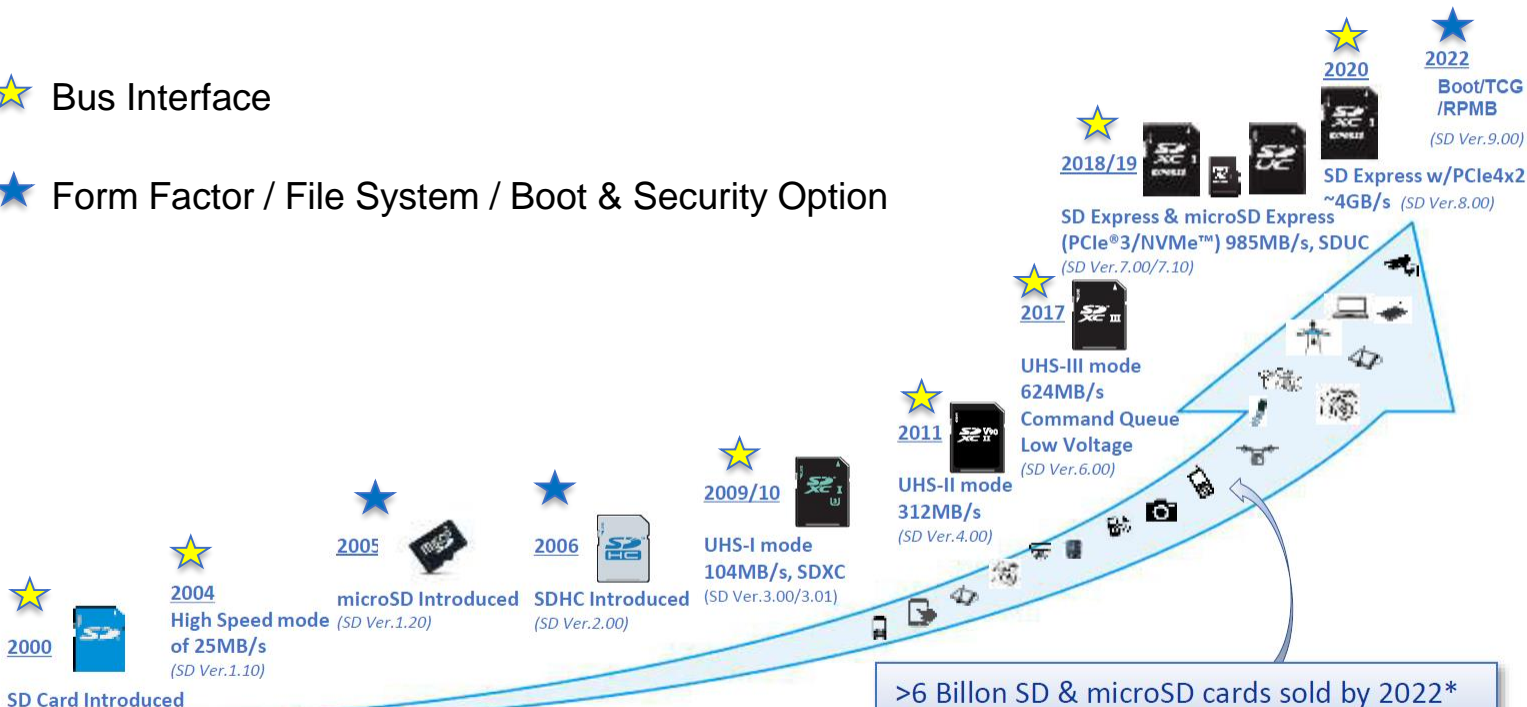


SD Standard Specification and Ver.8.00 SD Express Ver.9.00 Boot / TCG / RPMB Options

SD Card Specifications Evolution

★ Bus Interface

★ Form Factor / File System / Boot & Security Option



>6 Billion SD & microSD cards sold by 2022*
SD is the de-facto worldwide removable memory card standard

* Source: Estimation using news published by SanDisk in 2015 ("2 Billion microSD cards sold by 2015") + TrendForce's report from 2019 ("total of ~3 billion cards sold within 2016-2019") and report from Futuresource of total of ~1.1B sold between 2020-2022

SD Logos & SDA Pictographs

1. SD Logo :Capacity (4 Types)

2000



$\leq 2\text{GB}$
Standard
Capacity

2006



$2\text{GB} < - \leq 32\text{GB}$
High Capacity

2009



$32\text{GB} < - \leq 2\text{TB}$
eXtended Capacity

2018



$2\text{TB} < - \leq 128\text{TB}$
Ultra Capacity

2. Bus Mark :Data Transfer Performance

No Mark



High Speed

2004

UHS-I



Ultra High Speed

2010

UHS-II



2011

UHS-III



2017

SD Express



PCIe Gen.3
Gen.4

2018-2020

3. Speed Class Mark: Video Recording

Speed Class



2006

UHS Speed Class



2009

UHS Speed Class



2010

UHS Speed Class



2013

Video Speed Class



2016

SD Card Types

- **Form Factors**

- Standard SD Card

- **Functions**

- SD Memory Card
- SDIO Card
- SD Combo Card (SD Memory + SDIO Functions)
 - iSDIO Wireless LAN SD Card
 - iSDIO TransferJet SD Card
- smart microSD
 - microSD with Secure Element or with/without NFC interface



microSD Card

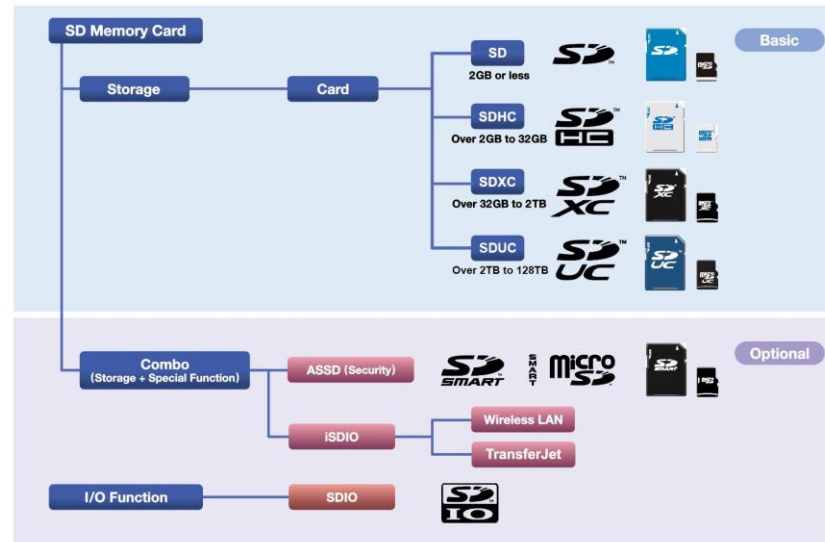


- **Memory Capacities**

- SDSC: Standard Capacity ($\leq 2\text{GB}$) / SDHC: High Capacity ($2\text{GB} < - \leq 32\text{GB}$)
- SDXC: eXtended Capacity ($32\text{GB} < - \leq 2\text{TB}$)
- **SDUC: Ultra Capacity ($2\text{TB} < - \leq 128\text{TB}$)**

- **Bus Interfaces**





- Non UHS (Non Ultra High Speed) Card
 - Default Speed : 12.5 MB/sec High Speed : 25 MB/sec
- UHS-I Card
 - UHS 50: SDR50 is mandatory (50MB/sec Max.) UHS104: SDR50 and SDR104 is mandatory (104MB/sec Max.)
- UHS-II Card
 - UHS156: FD156 is mandatory (Full Duplex 156MB/sec Max.) HD312 is optional (Half Duplex 312MB/sec Max.)
- UHS-III Card
 - UHS312: FD312 is mandatory (Full Duplex 312MB/sec Max.) UHS624: FD624 is mandatory (Full Duplex 624MB/sec Max.)
- **SD Express Card(New from SD Ver.7.00/8.00)**
 - PCIe Gen.3 x 1 Lane : (985MB/sec Max.) & NVMe protocol with legacy UHS-I interface (SD Ver.7.00)
 - PCIe Gen.3 x 2 Lane / Gen.4 x 1 Lane : (1,970MB/sec Max.) & NVMe protocol with legacy UHS-I interface (SD Ver.8.00)
 - PCIe Gen.4 x 2 Lane : (3,940MB/sec Max.) & NVMe protocol with legacy UHS-I interface (SD Ver. 8.00)



Bus Mode & Speed

Bus Mode		Clock Frequency	Interface Method	Bus Maximum Performance	Spec. Version
Default Speed (DS)		25MHz	3.3V single-ended	12.5MB/sec	1.01
High Speed (HS)		50MHz	3.3V single-ended	25 MB/sec	1.10
UHS-I	SDR12	25MHz	1.8V single-ended	12.5MB/sec	3.01
	SDR25	50MHz	1.8V single-ended	25 MB/sec	
	SDR50	100MHz	1.8V single-ended	50 MB/sec	
	SDR104	208MHz	1.8V single-ended	104 MB/sec	
	DDR50	50MHz	1.8V single-ended	50 MB/sec	
UHS-II	FD156	52MHz x 30 (PLL)	UHS-II PHY	156 MB/sec	4.00
	HD312	52MHz x 30 (PLL)	UHS-II PHY	312 MB/sec	4.20
UHS-III	FD312	52MHz x 60 (PLL)	UHS-III PHY	312 MB/sec	6.00
	FD624	52MHz x 120 (PLL)	UHS-III PHY	624 MB/sec	
PCIe	Gen.3	100MHz x 40 (PLL)*	PCIe Gen3 PHY	1-Lane 1GB/sec	7.00
				2-Lane 2GB/sec	8.00
	Gen.4	100MHz x 80 (PLL)*	PCIe Gen4 PHY	1-Lane 2GB/sec 2-Lane 4GB/sec	

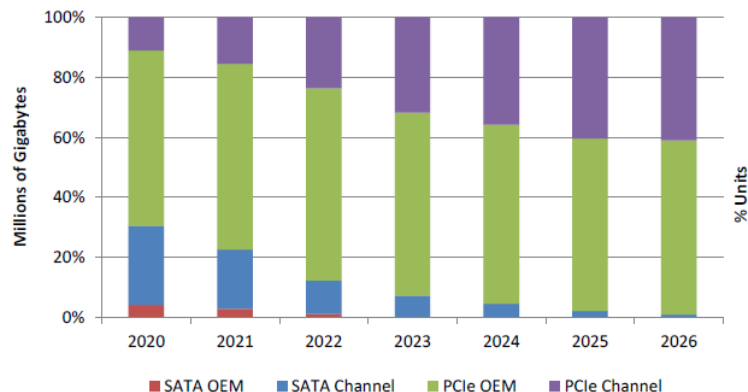
Bus Mode and Backward Compatibility

	SD Memory Card				SD Express Memory Card			
Pin Layout							 New	
PCIe Bus Interface					985MB/sec		3940MB/sec	
					New 1970MB/sec		PCIe Gen.4x1	
					PCIe Gen.4x1		PCIe Gen.4x1 / Gen.3x2	
SD Bus Interface					PCIe Gen.3x1		PCIe Gen.3x1	
					*microSD Express supports only PCIe Gen.3			
Capacity (file system)								
Capacity (file system)								
Capacity (file system)								

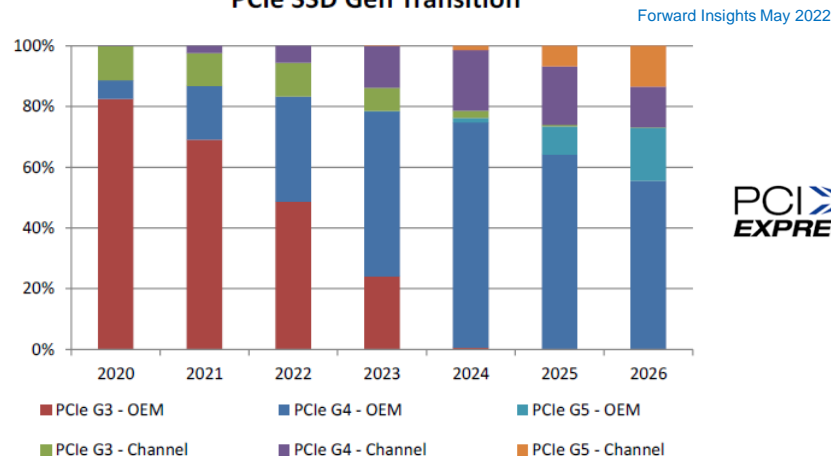
Client SSD & PCIe SSD Technology Trend for Higher Bus Speed and Memory Capacity

- NVMe™/PCIe is gaining popularity as the de-facto highly capable memory interface standard for the next generation computing, mobile computing, gaming and more

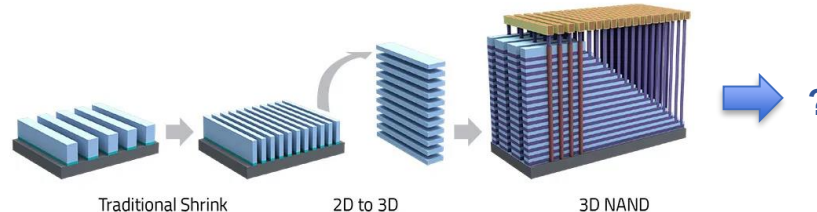
Client SSD OEM/Channel Trend



PCIe SSD Gen Transition



- The flash memory technology continues to evolve allowing higher performance access and higher capacities in small devices



PCIe and NVMe Interfaces – Test Advantages

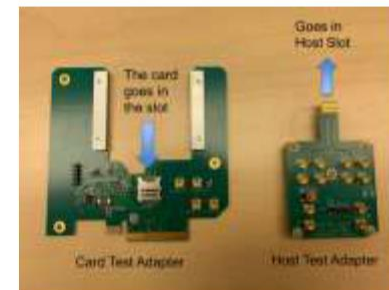
Many Bus Analyzers, Protocol Analyzers, Test Suites are in the market...*



- ☐ SD Express Test Fixtures – for SD7.x & SD8.0
- ☐ Enables Host and Card vendors to test their SD Express's PCIe interface using standard test equipment
- ☐ The set is available for borrow by our members at our approved labs (GRL and Allion)



In parallel, there are new lower-cost SD Express card dedicated testers available or under development



** May not be a complete list of available solutions*

SD Express Card – What is it?



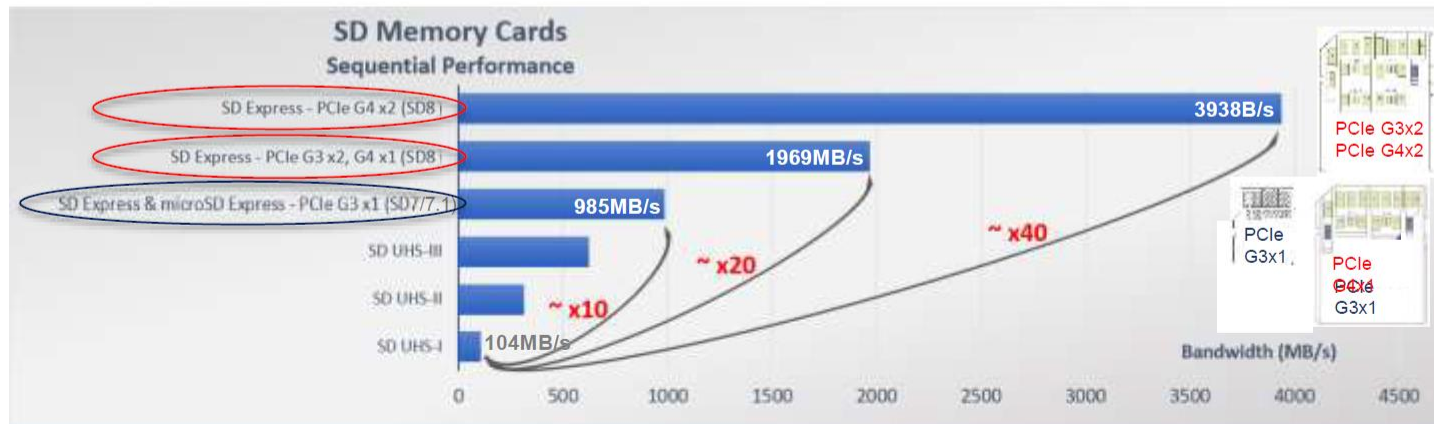
- The fastest SD™ and microSD™ memory cards with backward compatibility
- Supporting the following interfaces:
 - NVMe™ + PCIe® interface – up to PCIe 4.0 x2
 - SD interface (UHS-I up to 105MB/s)



Uses the same, well known form-factors

32.0 × 24.0 × 2.1 mm

15.0 × 11.0 × 1.0 mm



SD Express Memory Card (SD 8.00 w/PCIe Gen4) Applications



Multi Channel Video Capturing → requires multi-stream high speed recording and captures large amount of data



4K cameras are everywhere
Plus growing 8K, 12K and 8k 360° VR cameras
→ Huge data/speed requirements
(8K/24fps uncompressed requires 6GB per minute or 360GB per hour!)

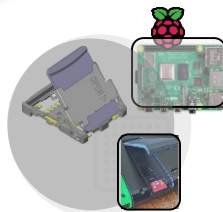


Gaming with 3D high-resolution graphics → requires more memory and high-speed capability for real-time usage



VR & AR video

increasing in quality → requires a high-speed real-time view of 360°



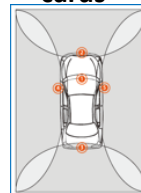
Semi-embedded applications (IoT, Mobile-Compute etc)



Multi-sensor Data Collection
And/or
Multimedia Apps running from cards



Right To Repair



SVP Verified Product

SD Express / UHS-II Verification Program (SVP)



Supported by
Granite River Labs
A Designated Lab of SDA

SD Express

SVP Verified Product List --- SD Express

	Model	Company	Product Type	Listed Date
1	BH770GG7	Bayhub Technology	Card & Host Interface Controller	2023/1/10
2	RTS5261	Realtek Semiconductor Corp.	Card & Host Interface Controller	2022/4/26
3	GL9767	Genesys Logic Inc.	Card & Host Interface Controller	2021/12/1
4	PS5017	Phison Electronics Corps.	SD Card	2021/12/1
5	ASD512GEX3L1-C	ADATA Technology Co., Ltd	SD Card	2022/1/27
6	ASD256GEX3L1-C	ADATA Technology Co., Ltd	SD Card	2022/1/27
7	SDSQXFN-256G	SanDisk, a Western Digital Brand	SD Card	2022/12/13
8	SDSQXFN-256G	SanDisk, a Western Digital Brand	microSD Card	2022/12/13

SD Express Card & Host Interface Controller

BayHub



BH770GG7



GL9767

REALTEK

RTS5261
For PC Application

SD Express Memory Card

ASD512GEX3L1-C
ASD256GEX3L1-C

PHISON



PS5017

SanDisk



SDSDQXFN-256G SDSDQXFN-256G

The SDA Compliance Committee has developed the SD Express/UHS-II Verification Program (SVP). This new verification program checks the electronic interface of UHS-II and SD Express cards/products, giving consumers and businesses higher confidence that devices passing SVP meets the interface standards, while ensuring compatibility based on the Physical Test Guideline.

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SD Association

Introducing
**New SD Ver.9.00
& SD Express**
(PCIe Gen.4)



SEE THE SD EXPRESS VIRTUAL TRADE SHOW ►

SD Express

microSD EXPRESS

SD Express Solutions

SD Express Next Implementation Video

SD Express White Paper

SD Express Simplified Specification

SD 9.0 For Embedded Applications

SD 9.0 Verified Products

Industrial Applications

Application Performance Class

What's New

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February 08, 2023

Solutions for Implementing SD Express into Your Products[On-Demand Video](#) | [Presentation](#)

**Watch SD Express
Implementation Video**



How to Impleme...





SD Association

Industrial Applications



Application Performance Class



SD Express & UHS-II Verified Products



SD Express Host Implementation Video



SD Express White Papers



Host Implementation Guideline



SD Express Solutions



SD 9.0 Video



SD 9.0 For Embedded Applications



SD 9.0 Simplified Specification



Executive Members



- New Optional Functions for semi-embedded Higher Security Applications

<https://www.sdcard.org/cms/wp-content/uploads/2022/05/Boot-TCG-and-RPMB-The-New-Security-Features-Introduced-in-SD-9.0.pdf>

☐ **SD9.0 features provide enhanced features that may open new opportunities for SD cards usually tightly bound to a specific host product as:**

- ☐ Semi-embedded devices replacing the soldered embedded memory (IoT, Chromebooks etc)
- ☐ As a secured memory for OEM applications (ie Gaming, Automotive, VR etc)

1. Boot

- ◆ Fast Boot and Secure Boot features give cards the ability to serve as a device's boot code memory by using a simple and easy fast boot code uploading process, along with secured methods of providing boot code updates

2. TCG Storage

- ◆ A secured storage method defined by the **Trusted Computing Group** adding a self-encrypted drive capability

3. Replay Protected Memory Block (RPMB)

- ◆ Offers a secured hidden memory accessible only through a secured authentication process and provides a secured write-protect mechanism, secured boot code update and replay protection security mechanism



Thank You
www.sdcard.org