



Flash Memory Summit



Efficiency and Fitness of Embedded Flash Storage

By Chanson Lin

Email: Chanson.Lin@embestor.com

EmBestor Technology Inc.

<http://www.embestor.com>

Flash Memory Summit 2017
Santa Clara, CA



Flash Memory Summit

Outline

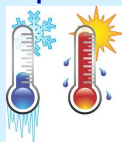


- Introductions: Embedded Systems and Applications
- Embedded Flash Storage (EFS) in Versatile Applications
- Versatile Embedded Flash Storage
- Customization Design Procedure
- Examples



Application Environment

Temperature



Moisture

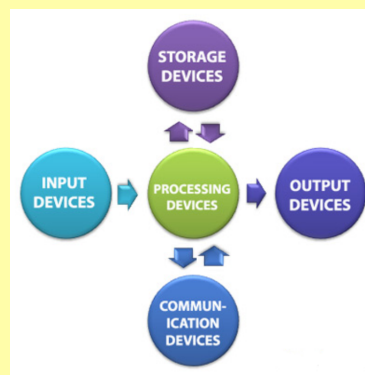


Dust

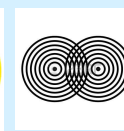


Embedded System

- Hardware
- RTOS
- Software
- User Interface
- Input Devices
- Output Devices
- Storage
- Communication



EMI & ESD



Workload



Data Security



Shock & Vibration



Performance



Power





Flash Memory Summit

Versatile Embedded Applications



- **Computer networking & peripherals:** image processing, networking systems, printers, network devices, monitors and displays.



- **Digital consumer electronics:** set-top boxes, DVDs, high definition TVs, digital signage and digital cameras.





Flash Memory Summit

Versatile Embedded Applications



- **Industrial:** Equipment, Instrument, Factory Automation, etc.



- **Satellites and missiles:** defense, communication, and aerospace.





Flash Memory Summit

Versatile Embedded Applications



- **Automobiles:** motor control, cruise control, body safety, engine safety, car infotainment, Autonomous Driving, etc.



- **Telecoms:** telephone, mobile phone, walkie-talkie, etc.



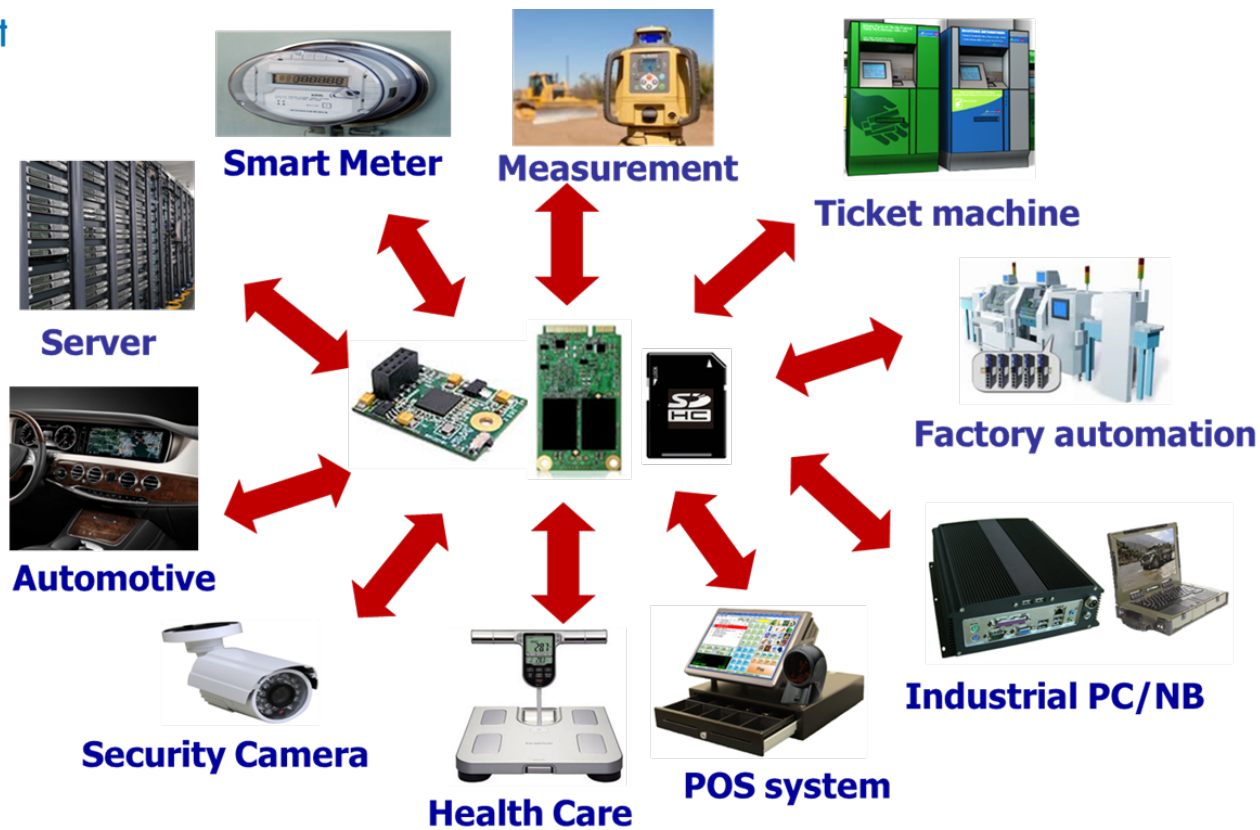
- **Smart cards:** banking, security systems.





Flash Memory Summit

EFS in Industrial Applications





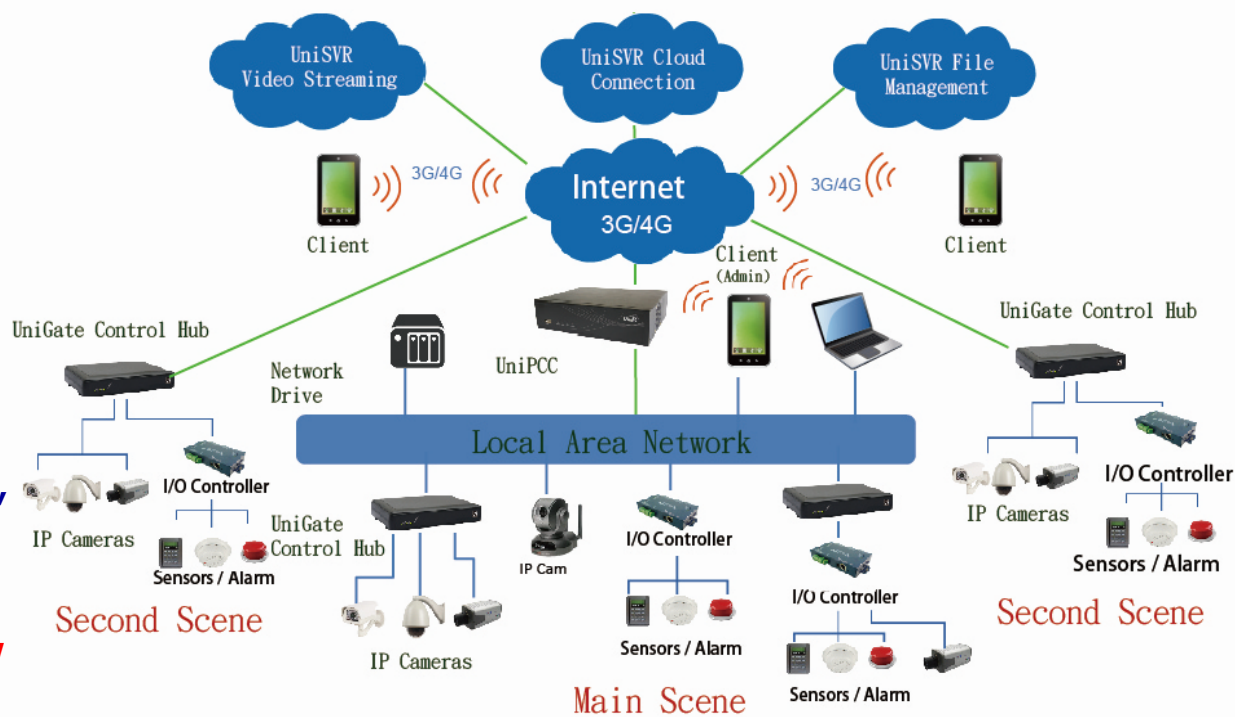
Flash Memory Summit

EFS in IoT Applications



Embedded Flash Storage:

- For the "Things": Sensors, Actuators, IP Cams, I/O Controllers. (**Low density**)
- For the Gateway: Controller Hub, Network Gateway. (**Mid Density**)
- For the Server: the Cloud, Data Center. (**Large/ Super Density**)
- Data Logger for All: (**Low Density**)



Source: UNISVR



Flash Memory Summit

Versatile Embedded Flash Storage



Interface Types:

- SD:
- USB:
- PATA:
- **SATA:**
- eMMC:
- UFS:
- PCIe/NVMe:

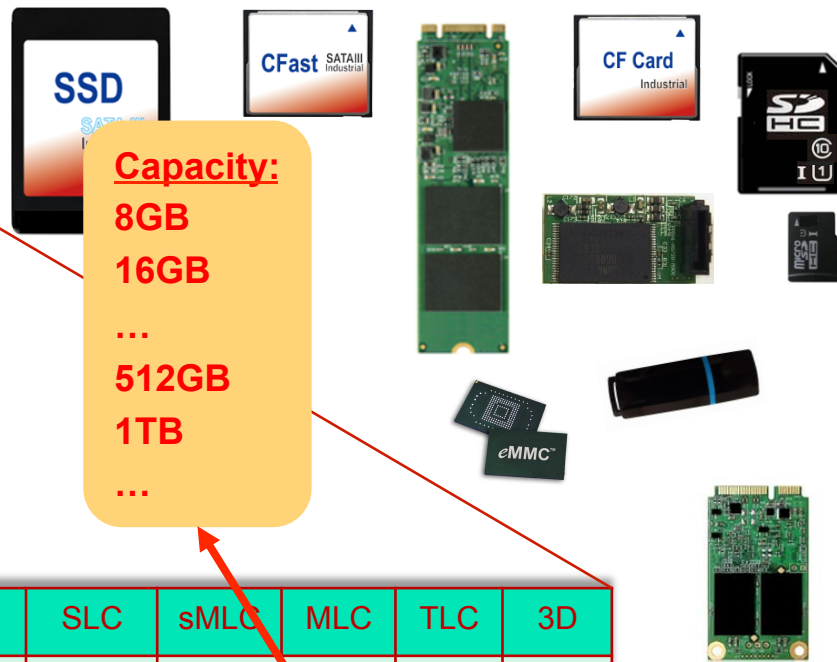
SATA Form-factor:

- 2.5" SSD:
- Half-slim:
- mSATA:
- M.2:
- U.2:
- DOM:
- CFast:

Capacity:

- 8GB
- 16GB
- ...
- 512GB
- 1TB
- ...

NAND Flash	SLC	sMLC	MLC	TLC	3D
WT (-40~85°C)					
ET (-25~85°C)					
CT (0~70°C)					





Typical Customization Procedure

Project Start

Application Case Discussion Phase

Custom RFI Form:
Application Scenario & Platform:
System Goal & Target Performance:

Specification Discussion Phase

RFI => System Specification Form:
Application Scenario => Features:
Goal & Target => Performance Spec.:
Design Spec.: H/W, F/W, S/W, Test Plan, ...
Project Schedule Plan:

Design & Verification Phase

Design & Verification Iterations:
Schedule Control:
Design Review: H/W, F/W, S/W, Test Plan, ...

Qualification & Preparing for MP Phase

Engineering Samples:
Engineering Verification Test:
Design Verification Test:
Pilot Production:

Mass Production



Flash Memory Summit

EFS Design-In Check List



Basic Functions:

- Interface:
- Form-factor:
- Memory Type:
- Capacity:
- Performance:
- Data Read/Write behavior:
- Power Consumption:

Additional Functions:

- Workload & product lifecycle.
- Data Integrity: Data Retention, Power-fails, Data Robustness.
- Data Security.

Environmental:

- Operation Temperature Range.
- Dusty, Humid, Chemical.
- Electro-Magnetic: EMI, EMC.
- Mechanical: Vibration, Shock.



Select the Best Fit EFS

- **Must be Satisfied:** Items by Check-list Table.

Item Specification	CHK	Item Specification	CHK
Form-factor, MO297	✓	S.M.A.R.T. items	✓
Interface, SATA 3	✓	Customized items	✓
Temperature, -40~85	✓	✓

- **Selectable Items:** by optimizing the Performance Index.

$$\text{Performance Index} = f(\text{Capacity, Data Rate, Power, ...})$$

- **Configurable:** Flexible, Extensible, Adaptive, ...



Flash Memory Summit

EX: Edge Storage with Security



■ Application Scenario:

- Edge Storage for Security Camera, 24/7 video recording.
- With Remote Monitoring & Control function.
- With Video & Image Data Privacy function.
- High endurance & Sustainable Write for Full HD Video buffer.

■ Main Specifications:

- uSD Card Form-factor; SLC 2GB/4GB (PE cycle: 60K);
- WAF < 1.5; TBW > 80; Non-stop write;
- Support Remote Real-time S.M.A.R.T. feature.
- Support Privacy Data security.



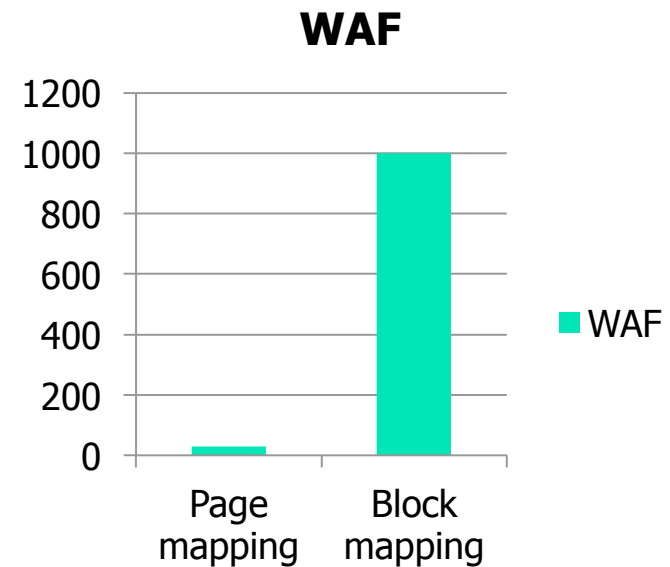
High Endurance (Low WAF)

- WAF: Write Amplification Factor. The low WAF value means high endurance

$$\text{WAF} = \frac{\text{Bytes written to NAND}}{\text{Bytes written from Host}}$$

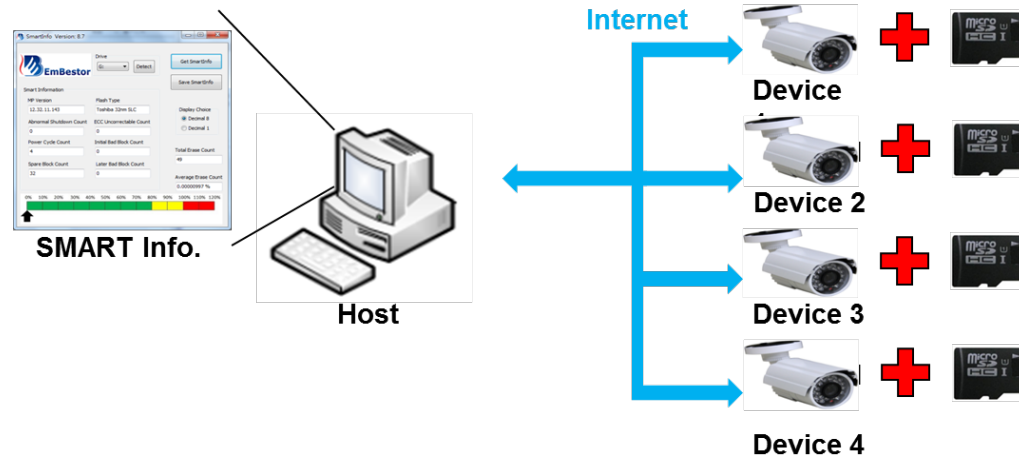
Item	EmBestor	Others
WAF1*	30	1000
WAF2*	1.1	1.6

***Testing condition:**
WAF1: JEDEC 218 & 219 standard
WAF2: Surveillance video recording



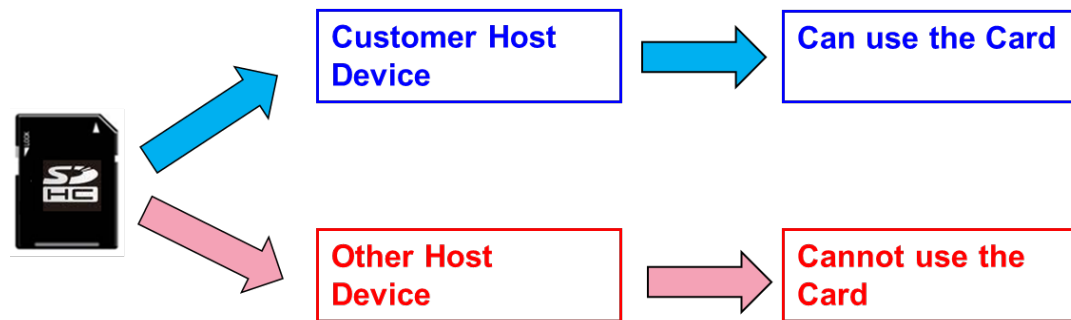
Real-time Remote S.M.A.R.T.

- Host can get more of device's SMART Information easily.
- Support Customized Windows AP, the normal reader could get the SMART Info.
- Support SDK for several Linux OS versions



Data Privacy: Proprietary Use

- The EmBestor EFS Devices provide Hidden Data mechanism. Customer Host device need follow the Hidden Data specifications.
- This mechanism can provide the data privacy and enhance the data security level.





Flash Memory Summit



Thank You !!

Enjoy Best Service !!

Flash Memory Summit 2017
Santa Clara, CA

