Industrial Embedded Flash Storage Applications

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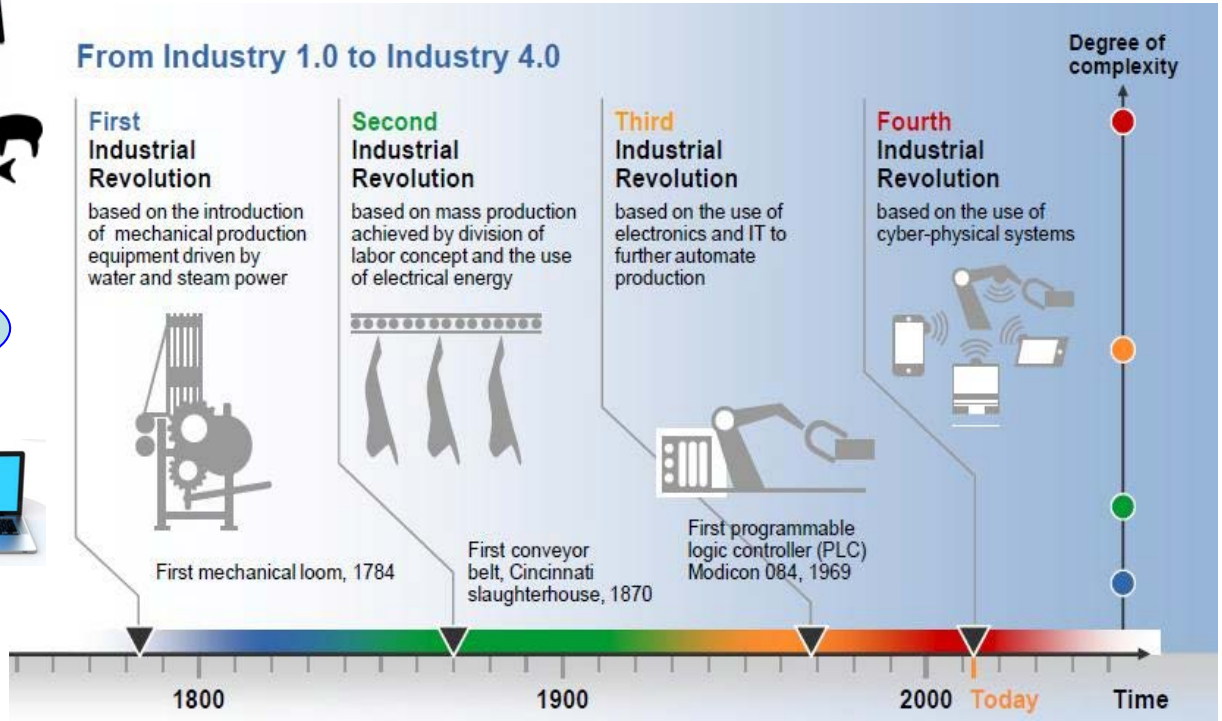
Outline

- Internet of Things and Industry 4.0
- The trend of Intelligent Machinery
- Illustration of uSD/SD card for Industrial Embedded Applications
- Customization Examples
- Industrial eMMC and eUSB for Industrial Embedded Applications.

IoT and Industry 4.0



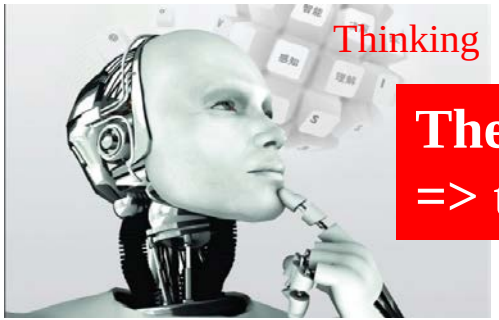
Source: DFKI (2011)

Intelligent Machinery

Motion

Sensing

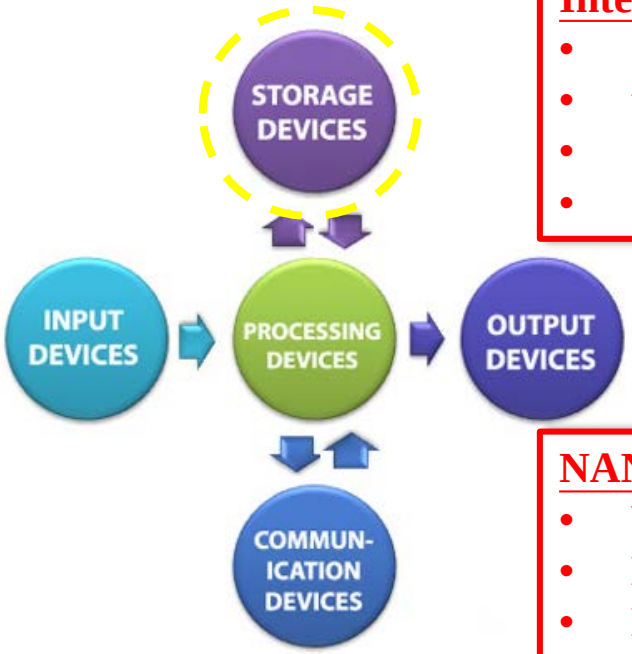
Thinking



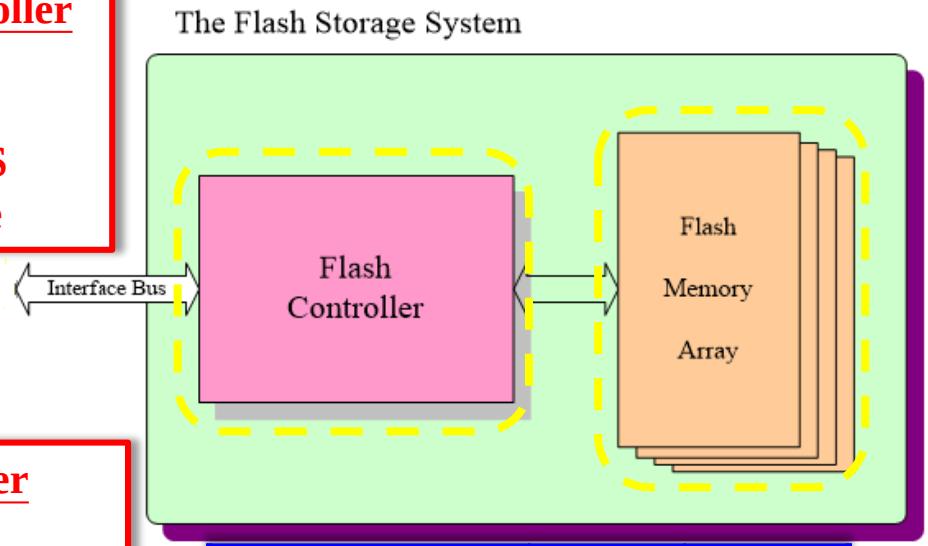
The Brain of Intelligent Machine
=> the Computer Systems

Connecting

EFS in Computer Systems



Interface Controller
- SD, UFD
- uSD, eSD
- eMMC, UFS
- SATA, PCIe



NAND Controller
- VLSI
- ECC
- DMA & Buffer
- Flash Sequencer
- Algorithms
- MCU & F/W

NAND Flash	SLC	MLC
WT (-40~85°C)	★★★	★★
CT (0~70°C)	★★	★

What is “For Industrial”?

	Industrial	Consumer
Users	Enterprise/Group	Personal
Customize	YES	NO
Life Cycle	> 5~20 years	[1~5] years
Quality	High	Just Enough
Design-In	Long-term	Timing, Cost
Environment	Versatile, Severe	With People
	… … … …	… … … …

Industrial SD/uSD Features

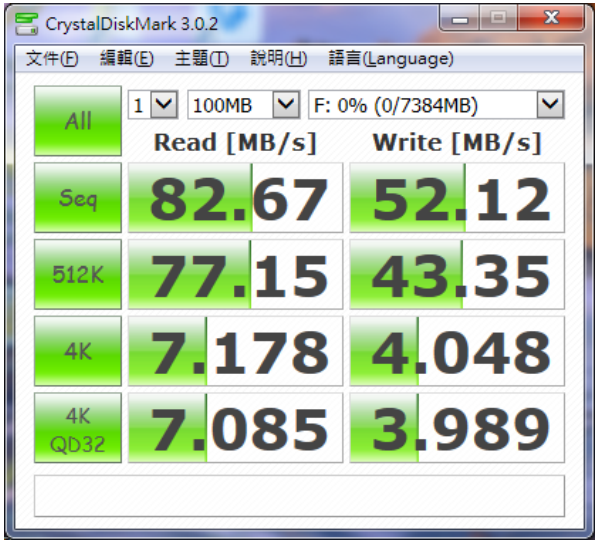
Features:

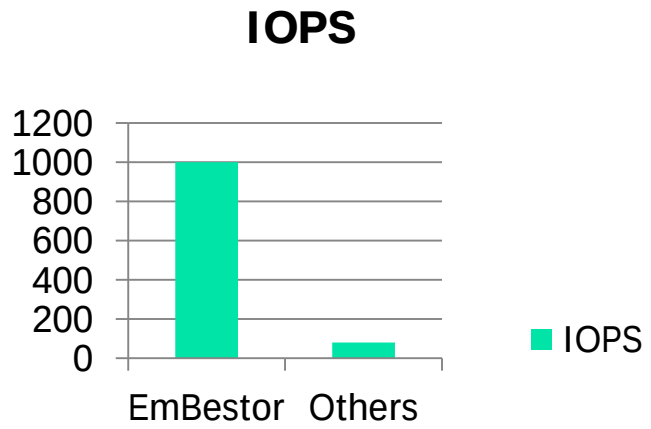
- Industrial Grade microSD / SD Card
- Density: 1GB ~ 32GB(SLC)
  8GB ~ 64GB(MLC)
- Support SD3.0 UHS-1 (SDR-104) Class10
- High IOPS performance as eMMC
- High Endurance (WAF = 1.5)
- Fixed BOM 3 years
- -40˚C ~ + 85˚C wide temp. support
- Complete SMART function
- Read Disturbance management
- Adaptive Wear Leveling
- Management of sudden power-fails

High Performance SD SLC

- SLC Flash Random Read/Write performance

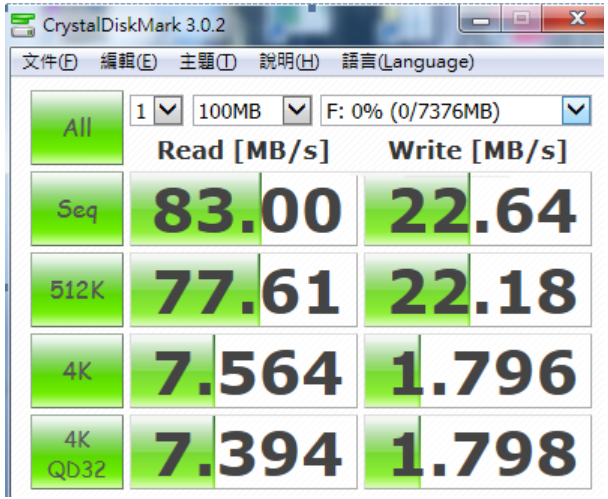
(Read IOPS >1500, Write IOPS >1000)

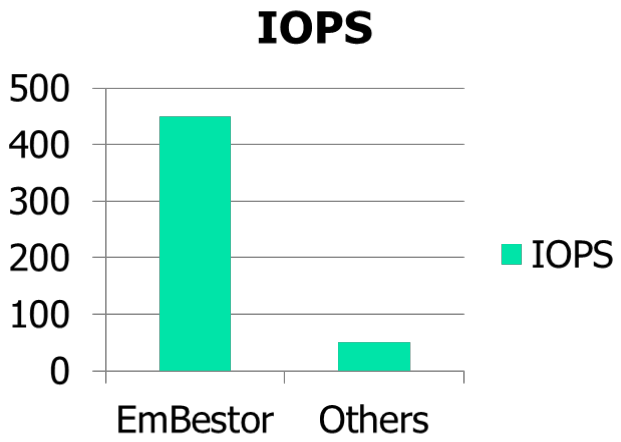




High Performance SD MLC

- MLC Flash Random Read/Write performance
  (Read IOPS >1500, Write IOPS >400)



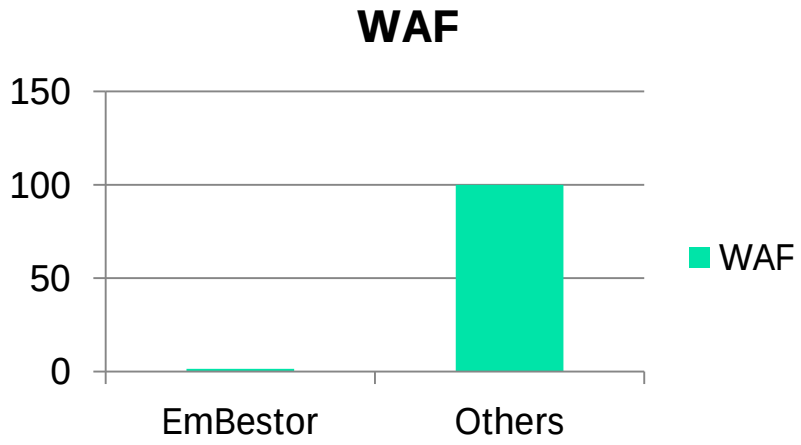


High Endurance SD Card

- High Endurance: TBW(Tera-Bytes Written) and WAF(Write Amplification Factor) value

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

$$TBW = \frac{\text{(Capacity GB/1000) x PE Cycles}}{WAF}$$



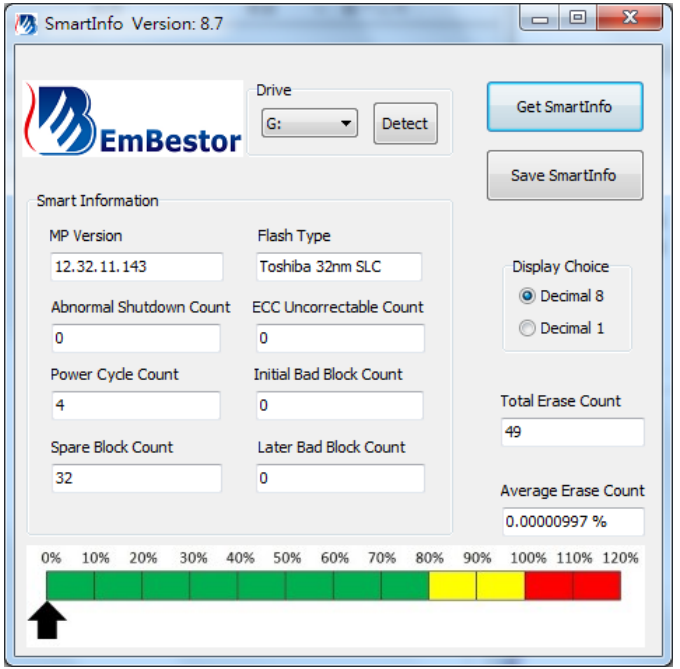
Item	EmBestor	Others
WAF	1.5	100

Capacity	16GB	32GB	64GB
TBW	32TB	64TB	128TB

S.M.A.R.T. for SD card

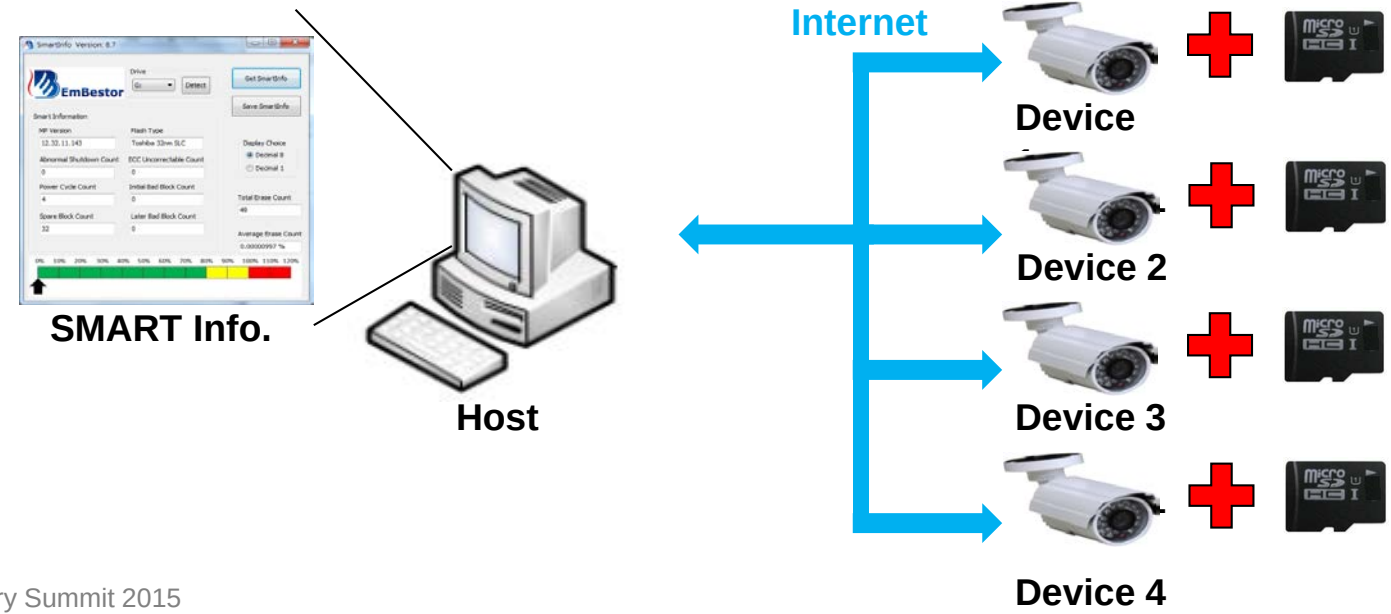
- Support Customized Windows AP, the normal reader could get the SMART Info.
- Support different Linux OS version SDK

Item	EmBestor	Others
Life Monitor	O	O
Total Erase Count	O	O
Average Erase Count	O	O
MP Version	O	O
Flash Type	O	O
Abnormal Shutdown Count	O	X
Power Cycle Count	O	X
Spare Block Count	O	X
ECC Uncorrectable Count	O	X
Initial Bad Block Count	O	X
Later Bad Block Count	O	X



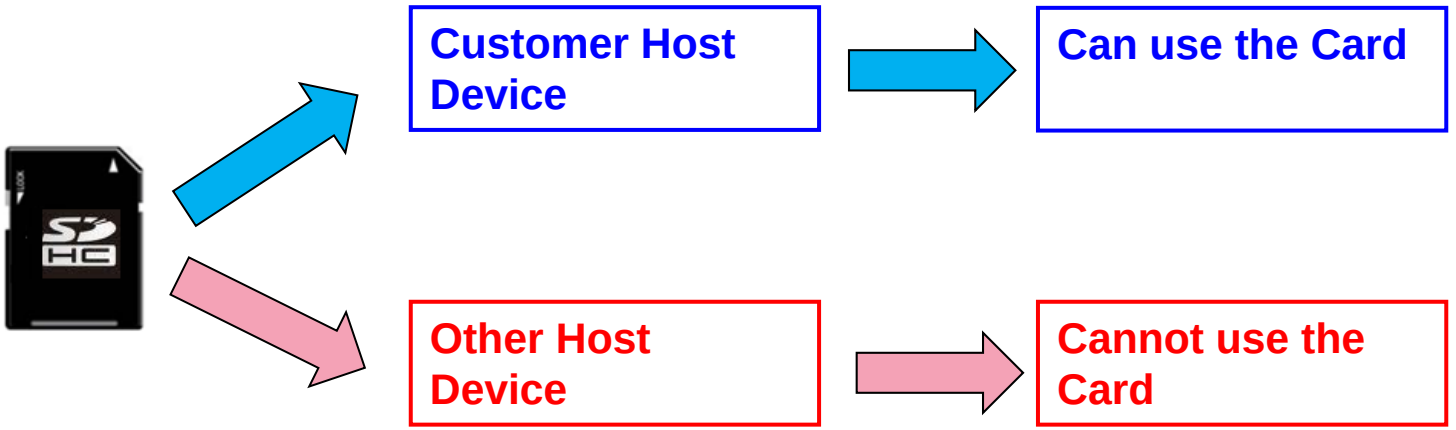
Real-time Remote S.M.A.R.T.

- Host can get easily more of device's SD SMART Info.
- Support Customized Windows AP, the normal reader could get the SMART Info.
- Support different Linux OS version SDK



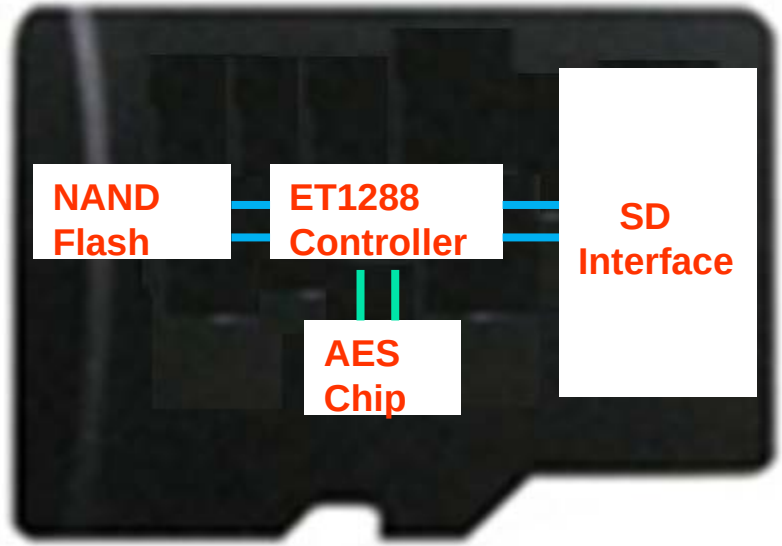
Customization: Proprietary Use

- The EmBestor i-TF & i-SD card provide Hidden Card mechanism. Customer Host device need follow the Hidden Card spec. rule.
- This mechanism can enhance the data security level.



Customization: e-Commerce

- Support data encryption function, according to communicate with AES chip
- EmBestor support security customization based on customer requirement.



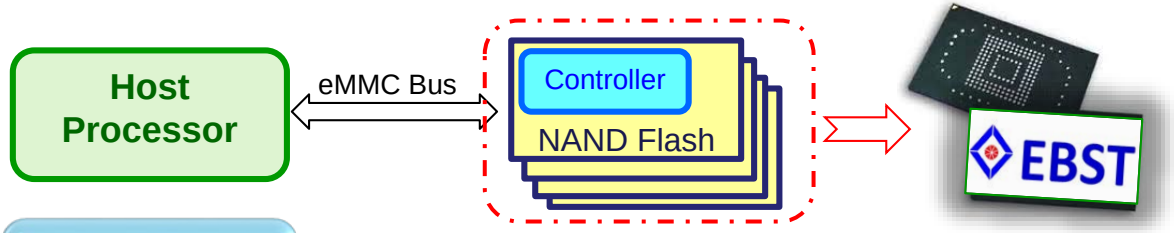
Mobile Payment

Mobile Identity

Cloud Security

Key Protect

Industrial eMMC Device



Design	• Complete Solution, Full Integration. • World-Class Solutions with System Expertise
Quality	• Industrial Temperature Range: -40C to 85C • High Endurance
Life Cycle	• Extended Life Cycles with BOM Control • Product Change Notification (PCN)
Support	• FAE and Customer Quality Support • Qualification and Failure Analysis Reports

Industrial eMMC Device

Features:

- Compliant with v4.51 + HS200
- High Endurance
- High Random IOPS
- Design for Industrial application
- Management of sudden power-fails
- High Reliability

Operating System:

- Windows family
- Linux family
- DOS or embedded system

Flash support:

- MLC: 4GB ~ 64GB

Temperature:

- Industrial Grade: -40℃ ~ 85 ℃
- Extended Grade: -25℃ ~ 85 ℃

Performance:

- Max. Sequential Read: 120 MB/s
- Max. Sequential Write: 35 MB/s
- Max. Random 4KB Read IOPS: 4500
- Max. Random 4KB Write IOPS: 1200

Industrial i-UFD/eUSB Module

Features:

- Compliant with USB 2.0 Mass Storage
- Operating as Boot Disk
- Adaptive Wear Leveling
- Management of sudden power-fails
- Complete S.M.A.R.T. function
- High Random 4KB IOPS
- Fixed BOM: SLC(5), MLC(3) years

Operating System:

- Windows family
- Linux family
- DOS or embedded system

Flash support:

- SLC: 256MB ~ 32GB
- MLC: 8GB ~ 64GB

Temperature:

- Industrial Grade: -40 ℃ ~ 85 ℃
- Standard Grade: 0 ℃ ~ 70 ℃

Performance:

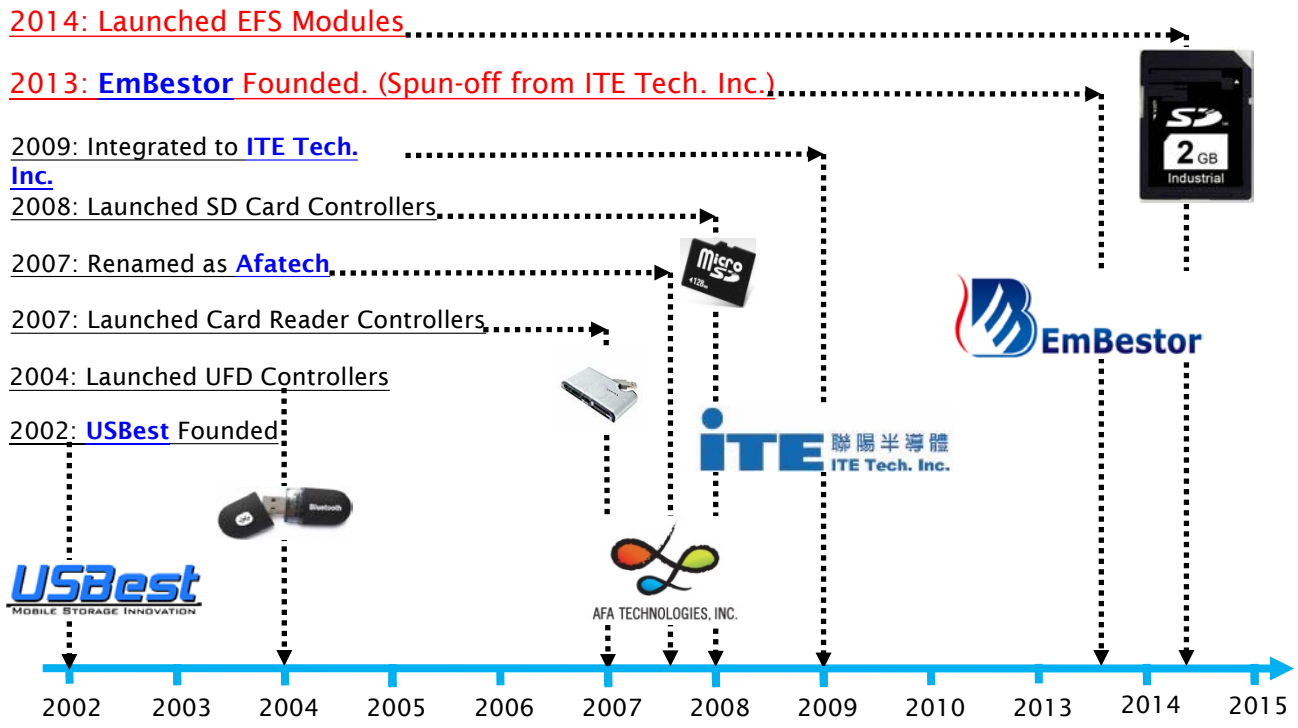
- Max. Sequential Read: 33 MB/s
- Max. Sequential Write: 20 MB/s
- Max. Random 4KB Read IOPS: 1500
- Max. Random 4KB Write IOPS: 800

Thank You!

EmBestor Overview

Company	**EmBestor** => **Embe**dded **Stor**age
Establish	July 4, 2013
President	Chanson Lin
Capital	USD $4.8 million
Employee	45 staffs
Business	Embedded Flash Storage: SIP & Modules; Removable Commodity: SD, UFD Controllers.
Philosophy	Empower **Teamwork**; Enable **Passion**; Create **Value**.
Operation	Hsinchu – Headquarters, R&D, back-end & manufacturing support Shenzhen – Field application support

EmBestor Company History



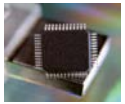
EmBestor Product Overview

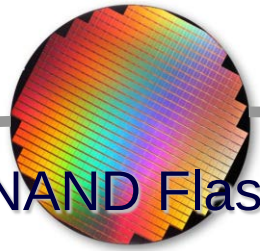
Removable Commodity
(Controllers)

USB Flash Disk:
USB2.0 & USB3.0

Memory Cards:
SD2.0 & SD3.0

eMMC Application:
eMMC to UFD



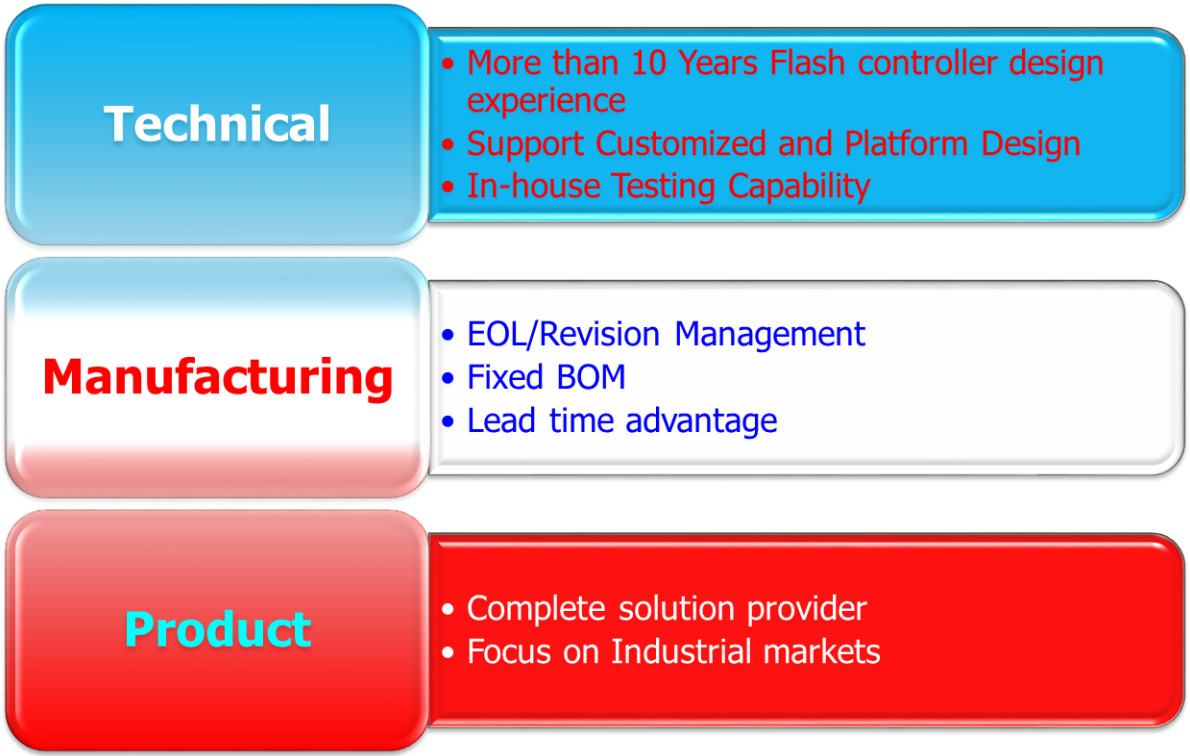


Industrial Applications
(Industrial Modules)

Industrial SD Cards:
i-TF & i-SD

CF/C-Fast Cards:
CF , CFast , i-CF

SATA/PATA Modules:
mSATA , SATA/PATA DOM

Industrial UFD Modules:
USB DOM & i-UFD

EmBestor Merits