How to Maximize i.MX RT Performance with GigaDevice High-Speed Serial Flash

NXP FTF Connects **June 13, 2019**

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GigaDevice Semiconductor (Beijing), Inc.

GigaDevice

10,000,000,000

GigaDevice has shipped more than 10 Billion SPI Flash in 10 years

23 Product Series

14 Densities

4 Voltage Ranges

7 Temp. Grades

25 Packages

GigaDevice has shipped more than 10 Billion SPI Flash in 10 years

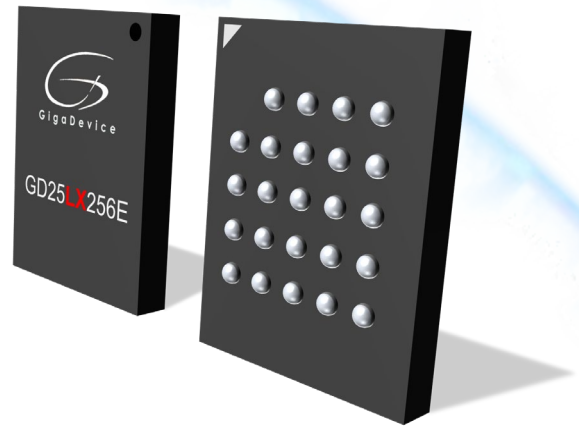
High Speed SPI Flash Family

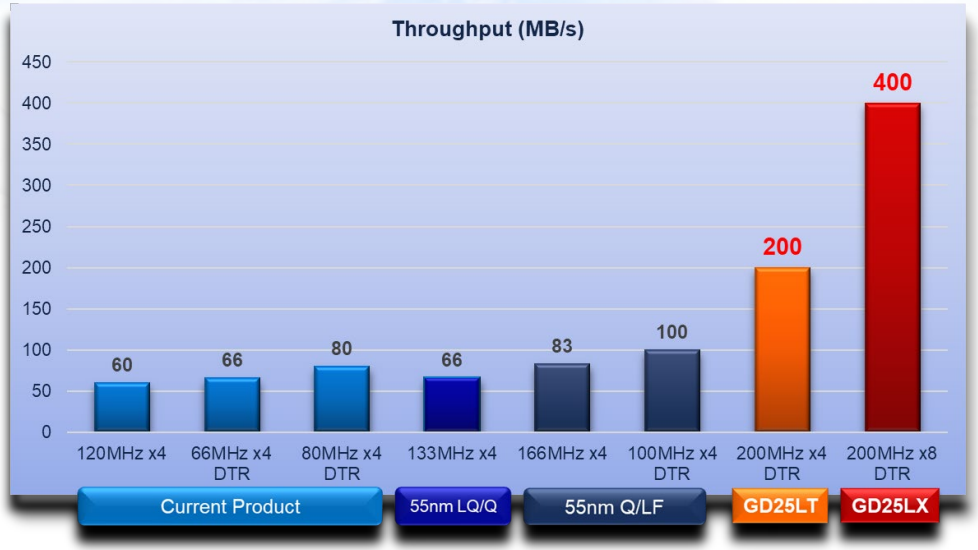
GD25LT

- **GD25LT256E**:
  1.8V 256Mb **Quad** DTR SPI NOR Flash
- **200MB/s** Data Throughput
- Ideal Solution for XiP Operation
- High Reliability with internal ECC
- Standard 8x6mm TFBGA package

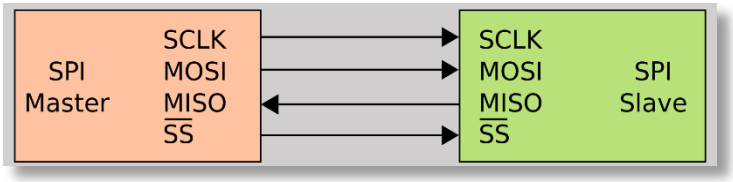
GD25LX

- **GD25LX256E**:
  1.8V 256Mb **Octal** DTR SPI NOR Flash
- **400MB/s** Data Throughput
- Ideal Solution for XiP Operation
- High Reliability with internal ECC
- Standard 8x6mm TFBGA package



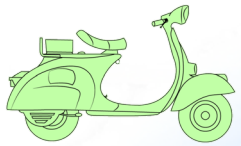


SPI Flash Memory Evolution

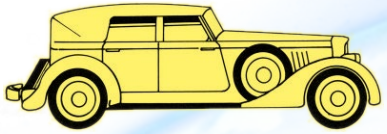


Year: Mid – 1980s	Inventor: Motorola	A.K.A: 4-wire Serial Bus

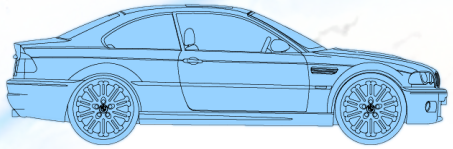
Year: 2000	Frequency: 20 MHz x1	Throughput: **2.5** MB/s



Year: 2004	Frequency: 50 MHz x2	Throughput: **12.5** MB/s



Year: 2009	Frequency: 104 MHz x4	Throughput: **52** MB/s



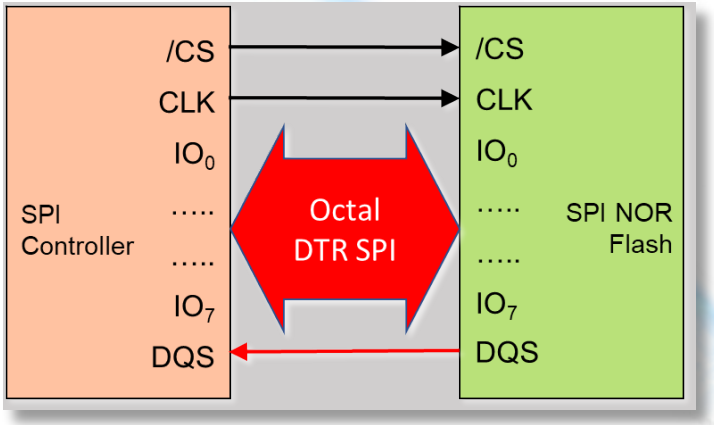
Year: 2016	Frequency: 80 MHz x4D	Throughput: **80** MB/s

Year: 2019	Frequency: **200 MHz x4D**	Throughput: **200 MB/s**

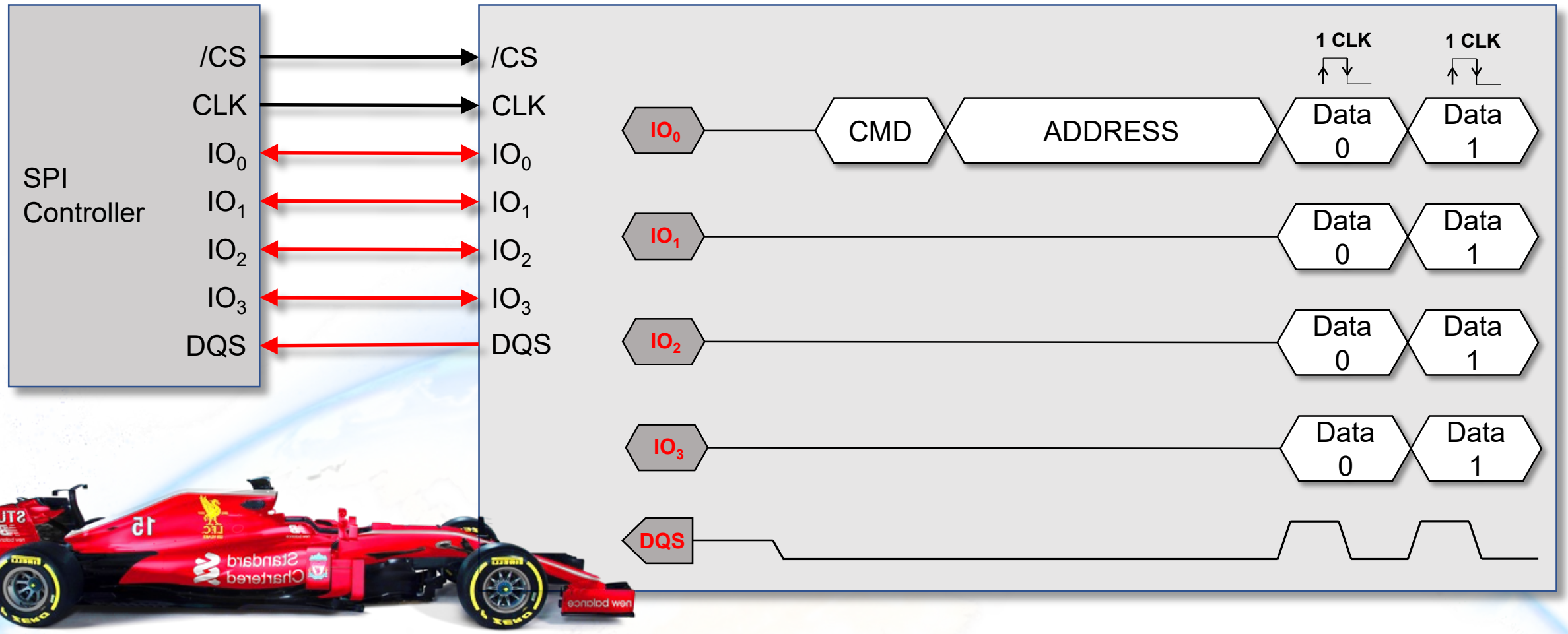
Year: 2019	Frequency: **200 MHz x8D**	Throughput: **400 MB/s**

GD25LT

GD25LX

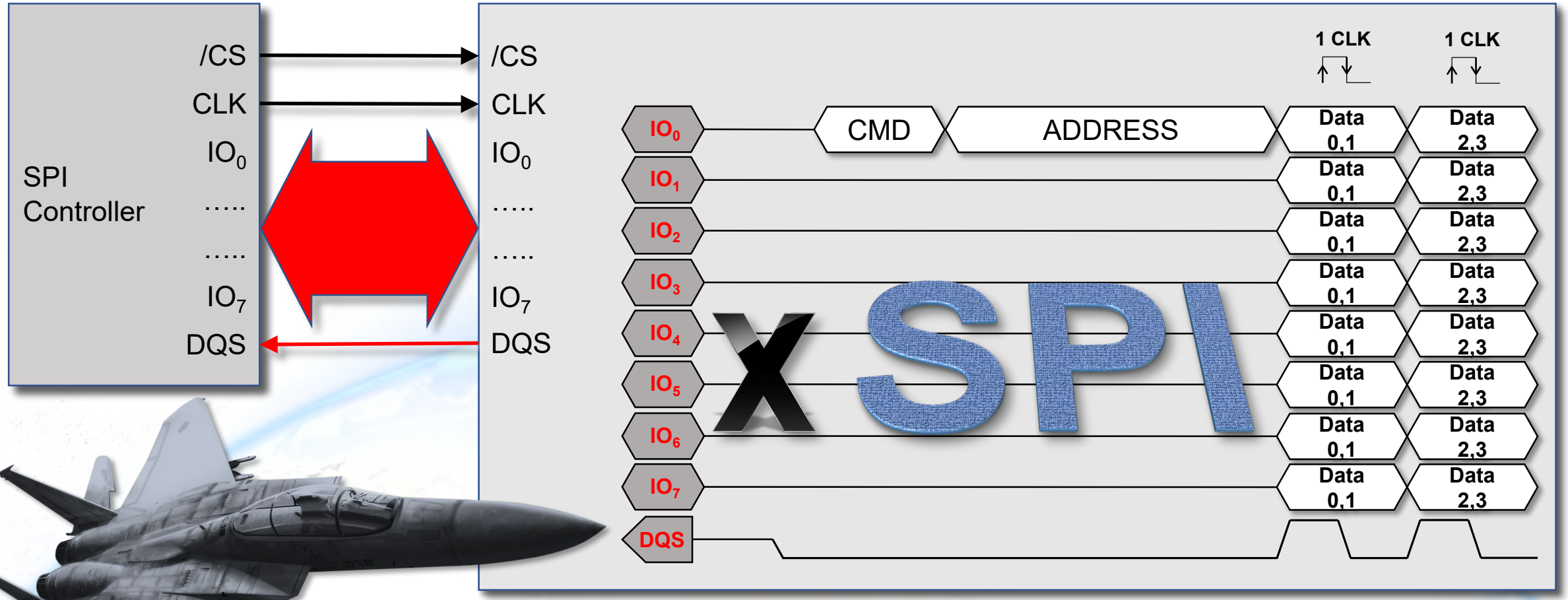


GD25LT Series: 200MHz Quad DTR



Year:	Frequency:	Throughput:
2019	200 MHz x4D	200 MB/s

GD25LX Series: 200MHz Octal DTR

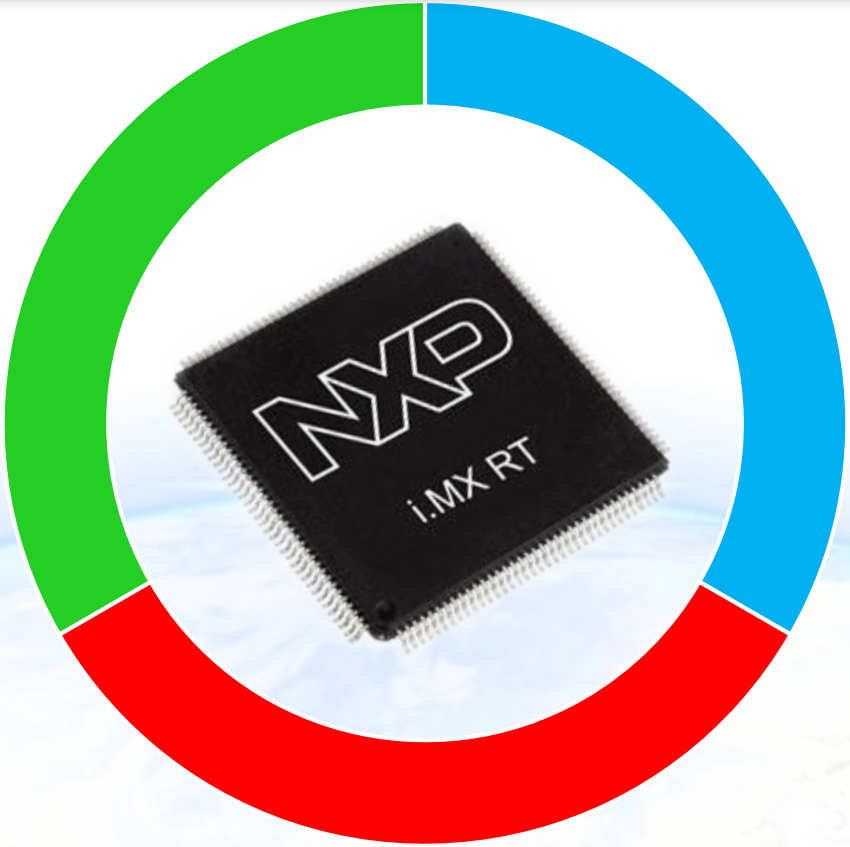


Year:	Frequency:	Throughput:
2019	200 MHz x8D	400 MB/s

High Performance Applications

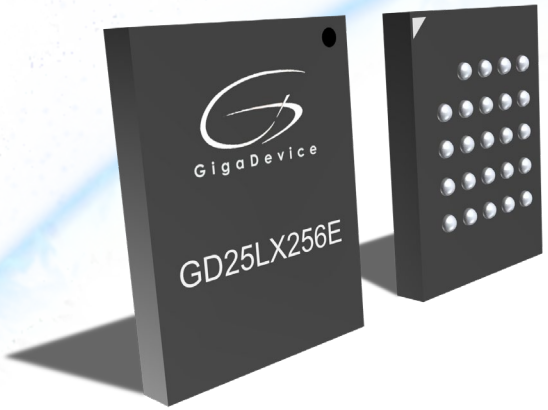
Automotive

- High Speed Download
- Instant-On Display



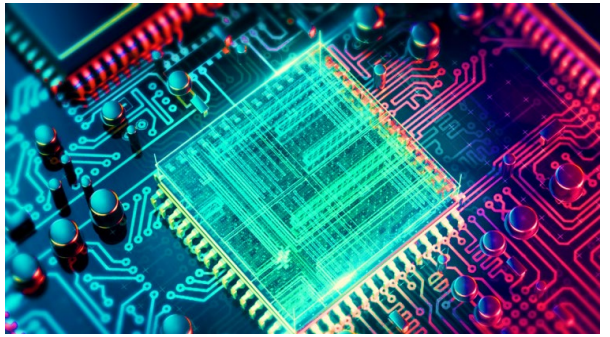
IoT

- Efficient XIP
- Minimize SoC Idle State

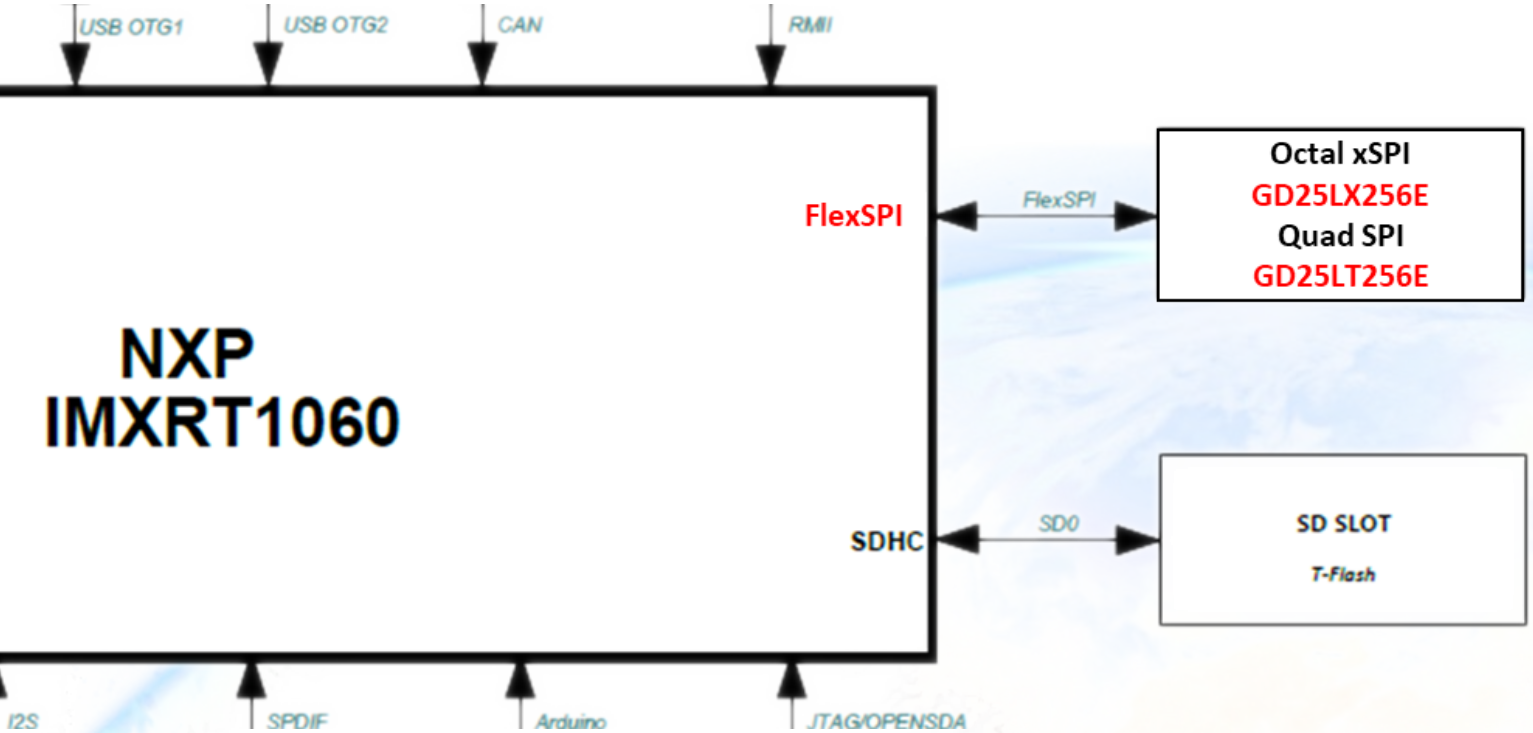


A.I.

- High Reliability
- Zero Defect System



i.MX RT with FlexSPI Interface



FlexSPI Interface:

- Support ALL SPI Protocols:
  - ✓ Single/Dual/Quad SPI
  - ✓ SDR/DTR SPI
  - ✓ Octal SPI (xSPI)
  - ✓ HyperFlash
- **Truly Flexible SPI Interface**

Plug-n-Play SPI Flash:

GD25LX256E

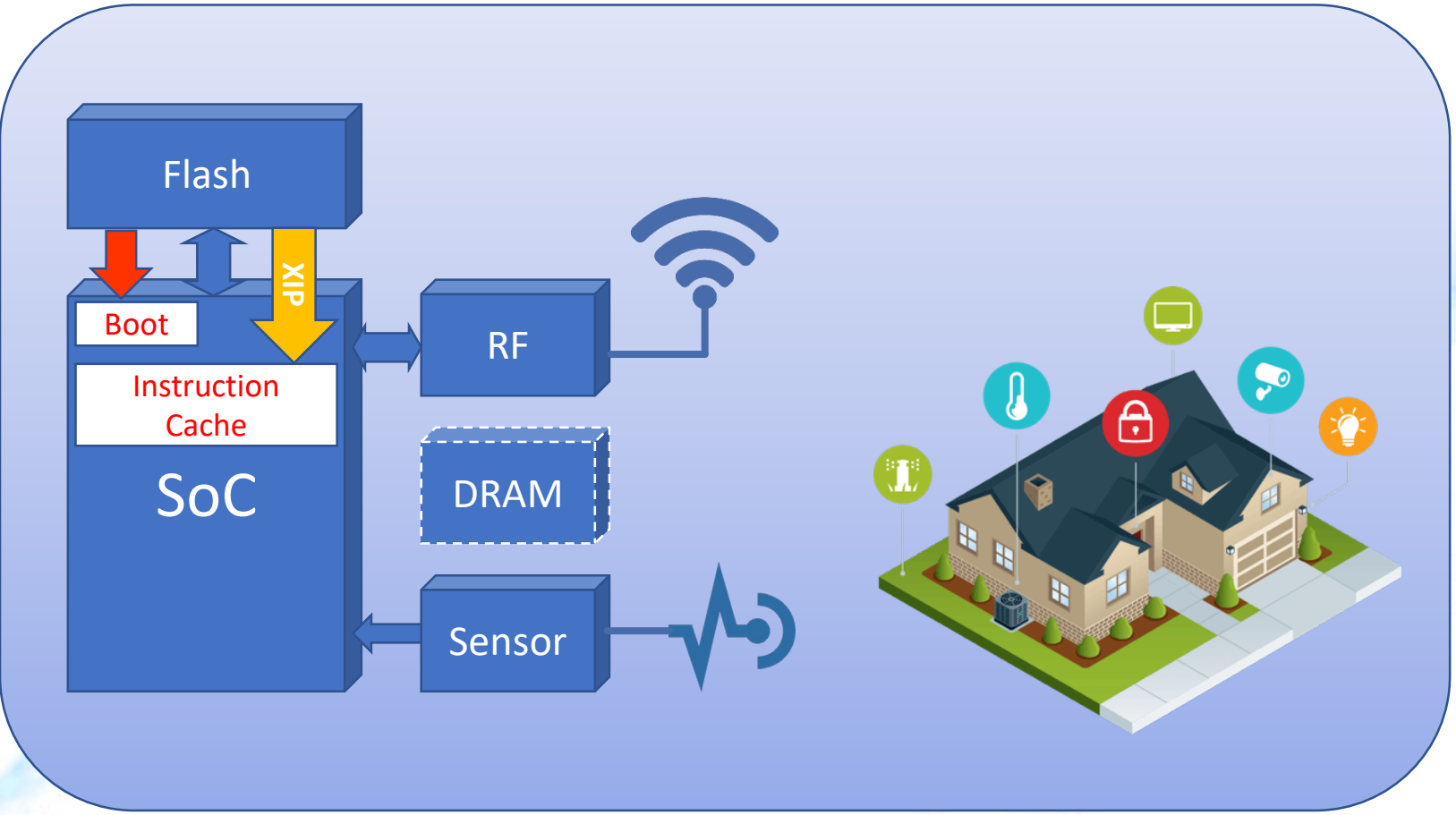
- **Octal DTR** SPI Flash
- 200MHz with DQS

GD25LT256E

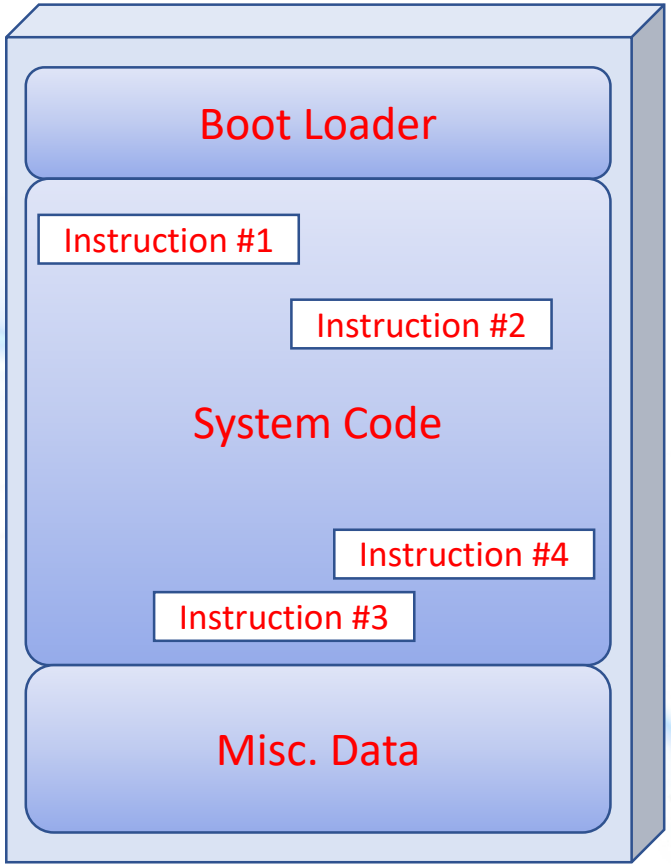
- **Quad DTR** SPI Flash
- 200MHz with DQS

IoT Applications

In a typical IoT system, due to power, cost & space limitation, designer will remove external DRAM, and execute code in Flash (XiP).

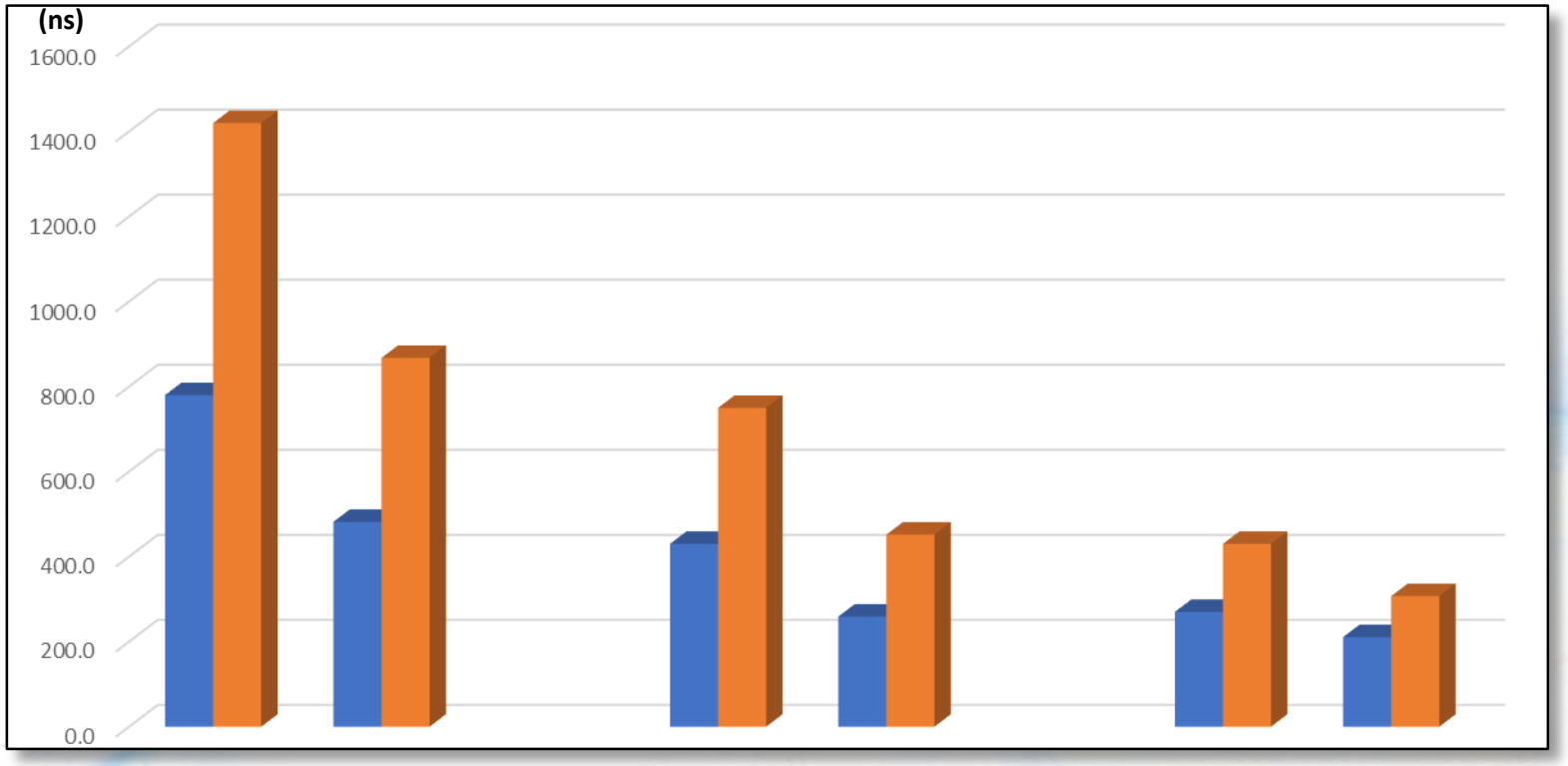


Flash Partition



XiP Performance Comparison

32/64-Byte Read Time (XiP Fetch Time)



Quad I/O Fast Read, 100MHz

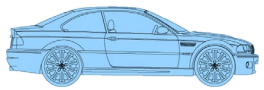
Quad I/O Fast Read, 166MHz

Quad I/O **DTR** Read, 100MHz

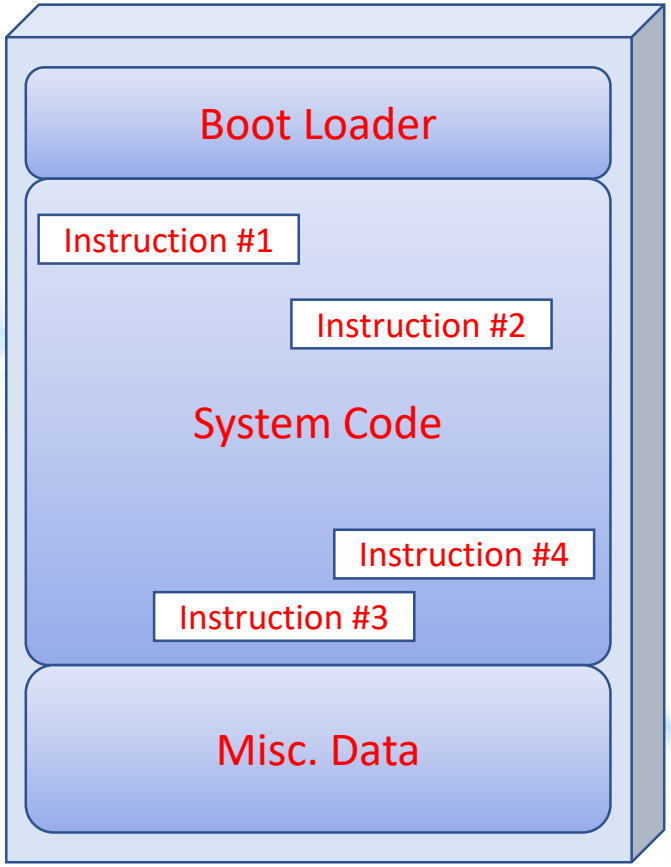
Quad I/O **DTR** Read, 166MHz

Octal I/O **DTR** Read, 100MHz

Octal I/O **DTR** Read, 166MHz



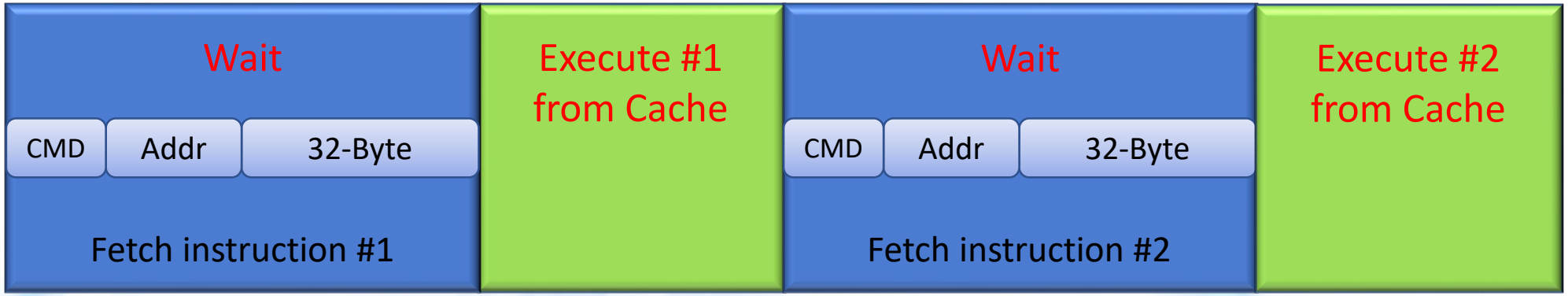
Flash Partition



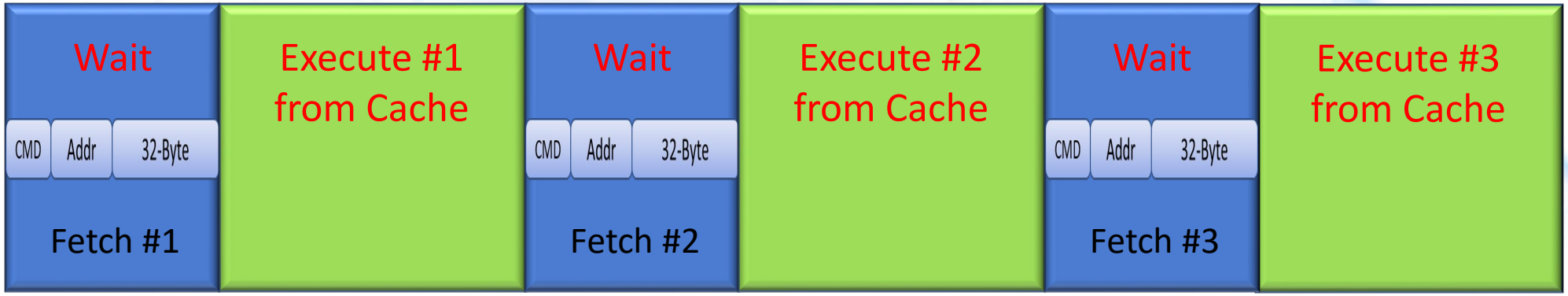
XiP in IoT Applications

High efficiency eXecute-In-Place (XiP) operation requires High Data Throughput from the external Flash, so that an “Instruction Fetch” with 32-/64-Byte Data Read Time is minimized, reducing SoC Idle/Wait time.

XiP with 80MHz x4 DTR (2 fetch/execution)

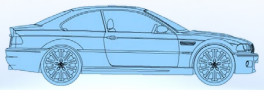


XiP with 200MHz x8 DTR (3 fetch/execution)



i.MX RT CoreMark with SPI Flash XiP

- RT Device: i.MXRT1062
- RT Board: MIMXRT1060-EVK
- Core Frequency: 600MHz
- Cache for Flash region: **Disabled**
- IDE: IAR v7.80.4



Target	ITCM	GD25LB256E	GD25LT256E	GD25LX256E
Configuration	64bit@600MHz	4bit@133MHz SDR	4bit@166MHz DTR	8bit@166MHz DTR
CoreMark Score （Cache Disabled）	3036.02	87.19	**153.29**	**271.50**

- Test code: https://github.com/JayHeng/Cortex-M-Apps/tree/master/apps/coremark_imxrt1062/bsp/build7804

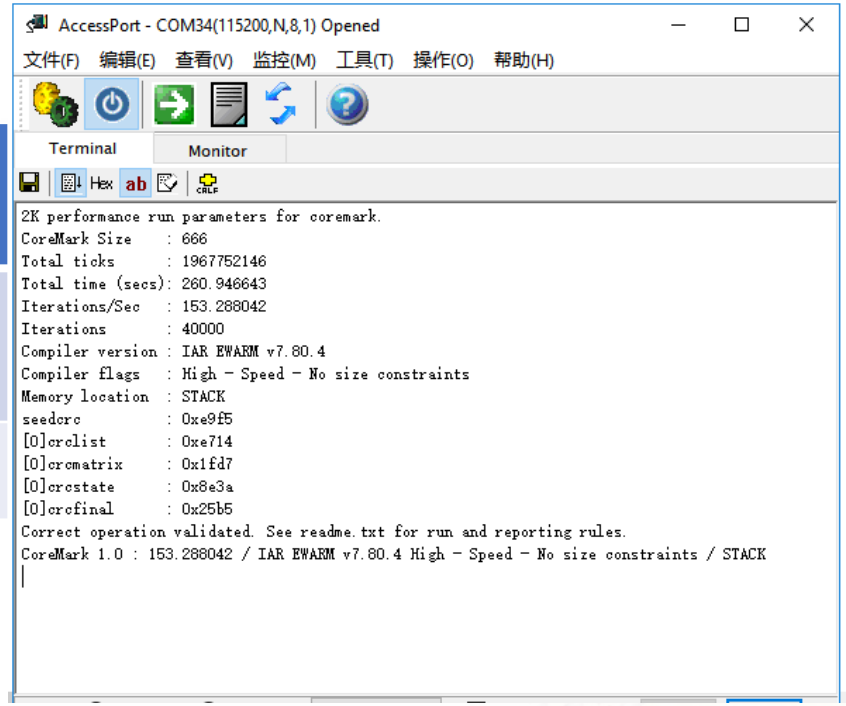
i.MX RT CoreMark with SPI Flash XiP

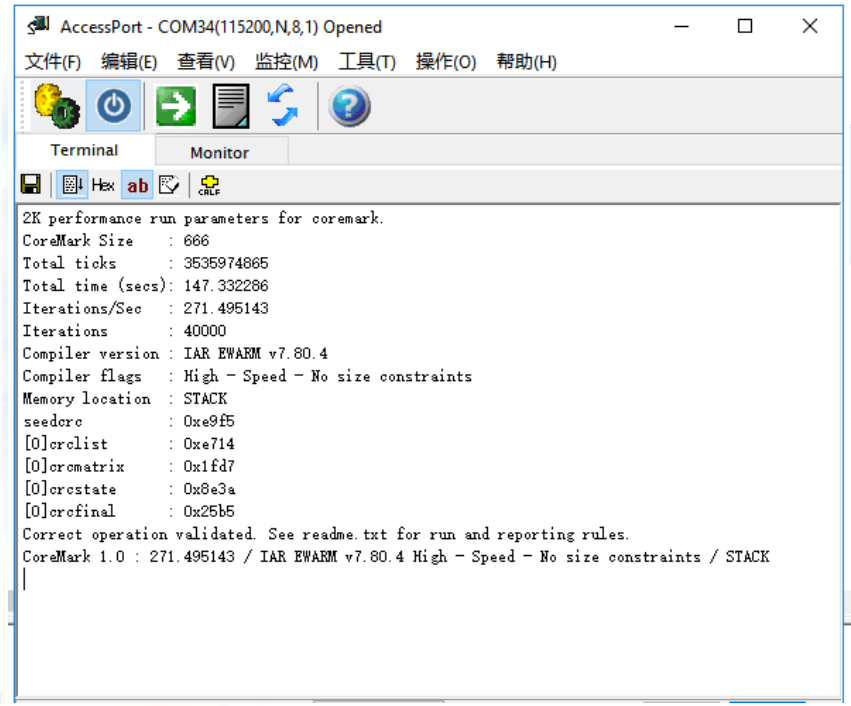
GD25LT256E

4bit@166MHz

DTR

153.29





GD25LX256E

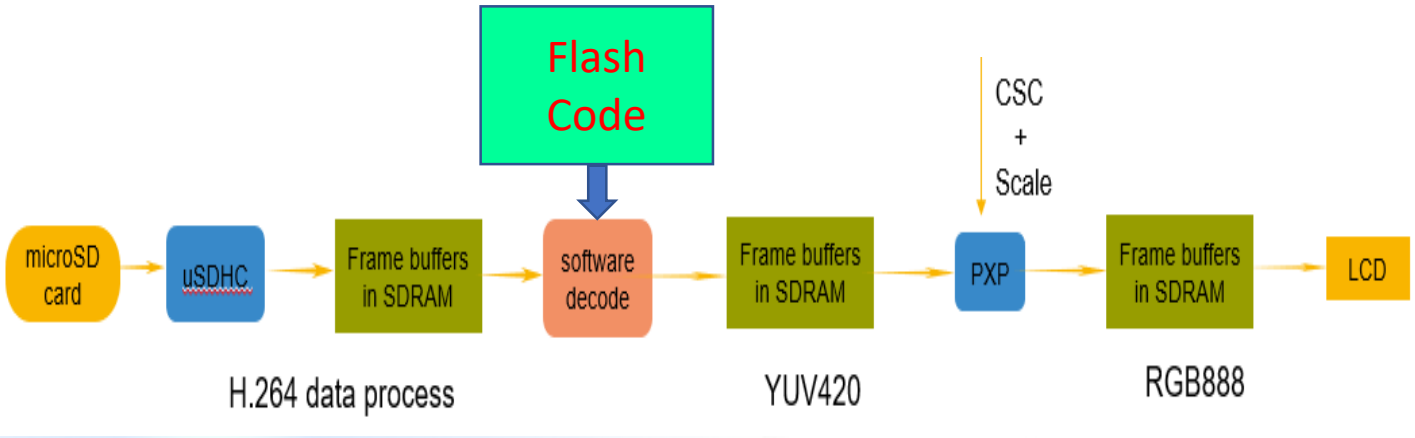
8bit@166MHz

DTR

271.50

i.MX RT FFmpeg Decoder with SPI Flash Code

- RT Device: i.MXRT1062
- RT Board: MIMXRT1060-EVK
- Core Frequency: 600MHz, SDRAM-166MHz
- Cache for Flash region: Disabled
- IDE: IAR v8.32.2
- Source video resolution: 480x272



Target	ITCM	GD25LB256E	GD25LT256E	GD25LX256E
Configuration	64bit@600MHz	4bit@133MHz SDR	4bit@166MHz SDR	8bit@166MHz DTR
FFmpeg fps	20.28	0.49	0.52	**1.65**

- Test code: https://github.com/JayHeng/RT-MPlayer/tree/master/boards/evkmimxrt1060/demo_apps/mp4

i.MX RT Flash JPEG with SPI Flash Storage

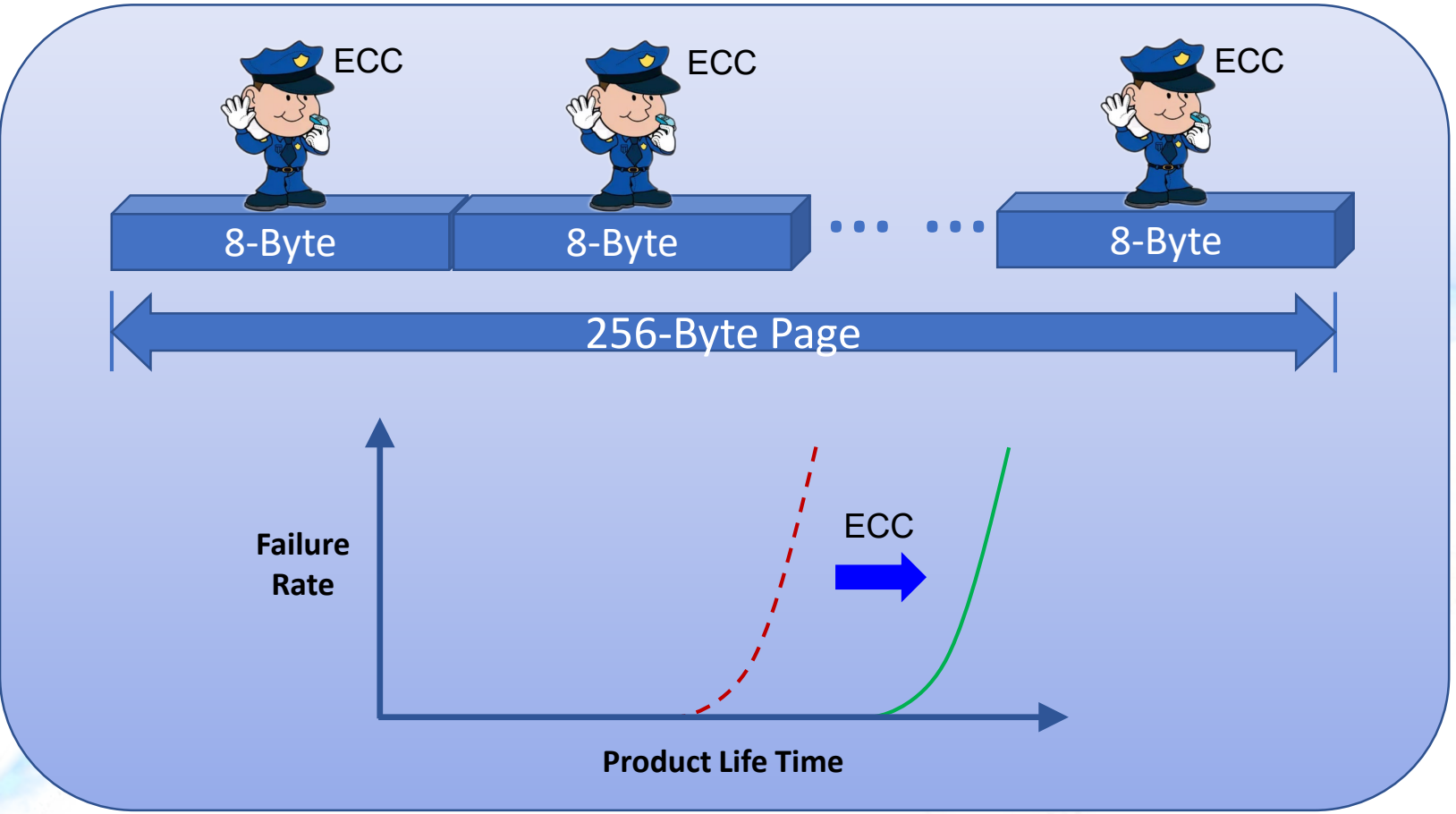
- RT Device: i.MXRT1062
- RT Board: MIMXRT1060-EVK
- Core Frequency: 600MHz
- IDE: IAR v8.32.2
- Target LCD resolution: 480x272

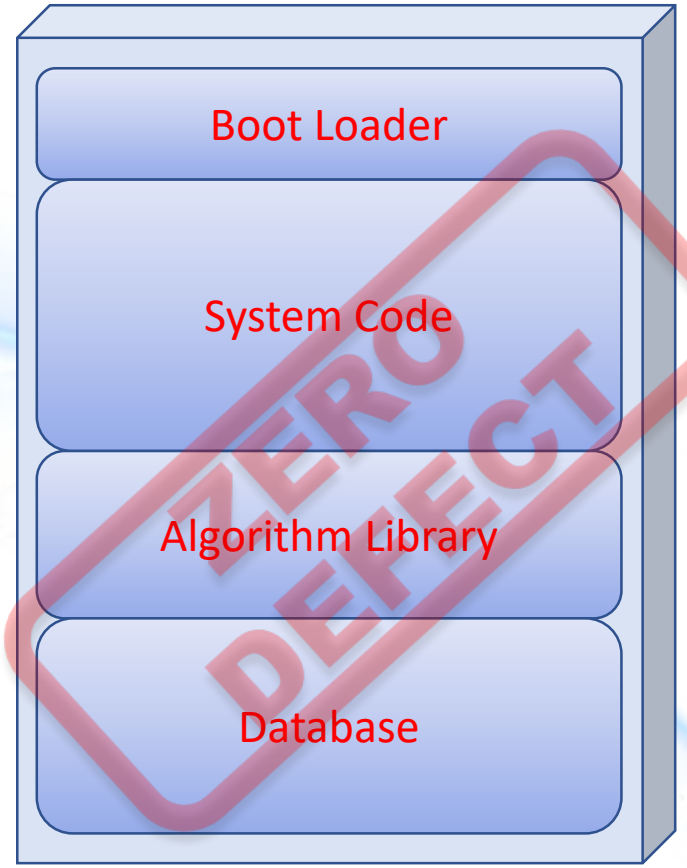
Max freq/ Device	30MHz	60MHz	80MHz	100MHZ	133MHz	166MHz
GD25LB256E 4bit-SDR	30fps	60fps	90fps	110fps	130fps	150fps
GD25LT256E 4bit-DTR	60fps	130fps	180fps	230fps	N/A	N/A
GD25LX256E 8bit-DTR	130fps	260fps	350fps	450fps	N/A	N/A

- Test code: https://github.com/JayHeng/RT-MPlayer/tree/master/boards/evkmimxrt1060/demo_apps/flash_jpeg

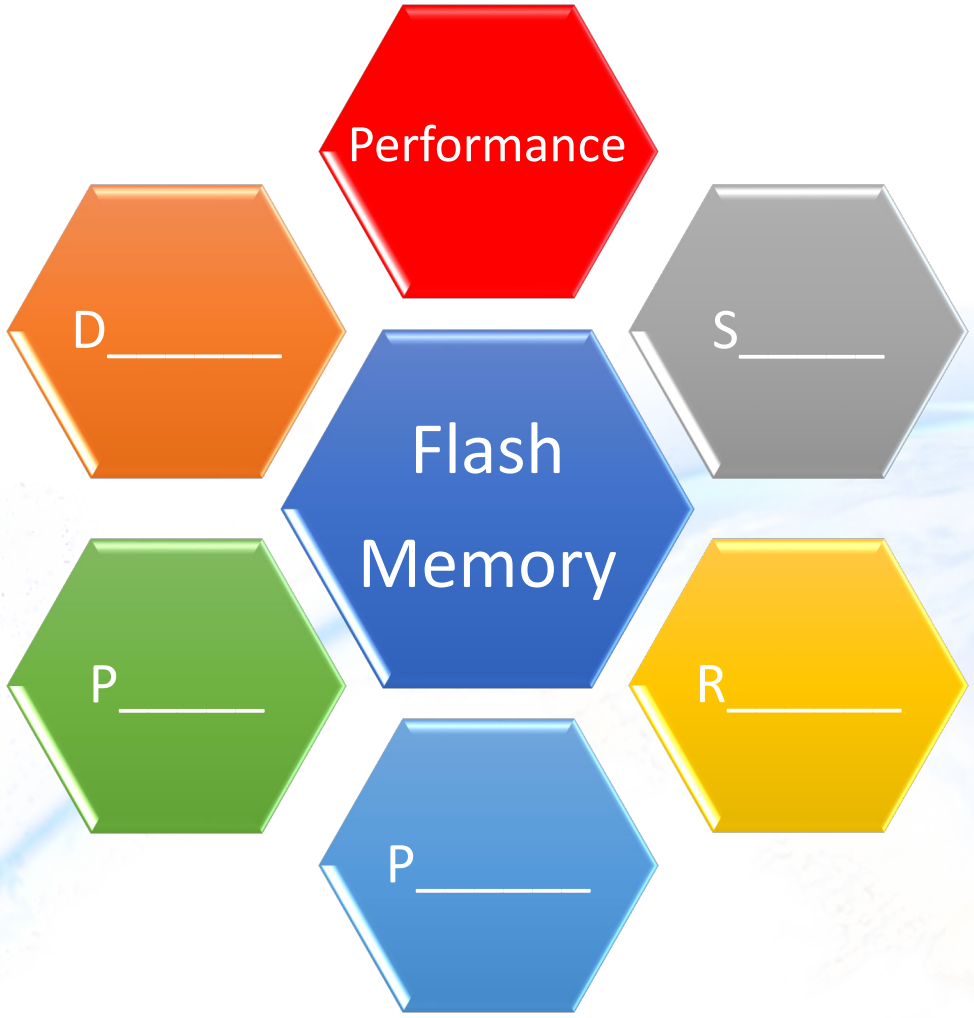
High Reliability in GD25LX & GD25LT

Internal ECC algorithm (1-bit Correction in 8-Byte) in GD25LT & GD25LX ensures Flash data reliability, extends product life time.





Serial Flash Development Trends



	Performance	D_____	S_____	R_____	P_____	P_____
Computing	Low					
Networking	Medium					
Consumer	Medium					
Mobile	Medium					
Automotive	Very High					
IoT	Low ~ High					

NXP

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Thank you!