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專為車用存儲需求的高速低成本串列式NAND方案

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快閃記憶體產品企劃技術副理

winbond
We Deliver

A Global Supplier of
Advanced Memory Solutions

Agenda

01 從成本考慮上，
串列式NAND 相比於串列式NOR，有何優勢?

02 從質量角度上，
串列式NAND 與串列式NOR 的比較?

03 從讀取速度上，
串列式NAND 與串列式NOR 的比較?

04 從寫入速度上，
串列式NAND 與串列式NOR 的比較?

05 串列式NAND 需要額外控制器做壞塊管理或 ECC 嗎?

Keep Innovating

1.2V Serial NOR
1.8V Serial NOR

Low Power

High Speed

Octal Flash 8 I/O
DTR Serial NAND
DTR Serial NOR

More Flexibility

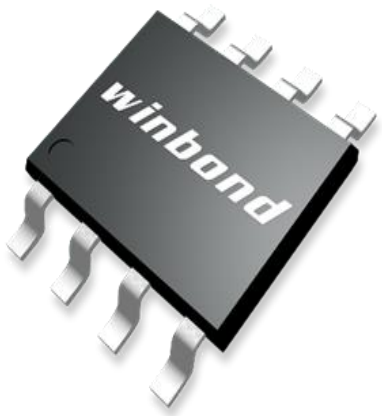
SpiStack NOR+NAND
NAND MCP
WLCSP, KGD

Security Future

Authentication NOR
Security Storage NOR
Secured NOR
Secured NAND

High Quality

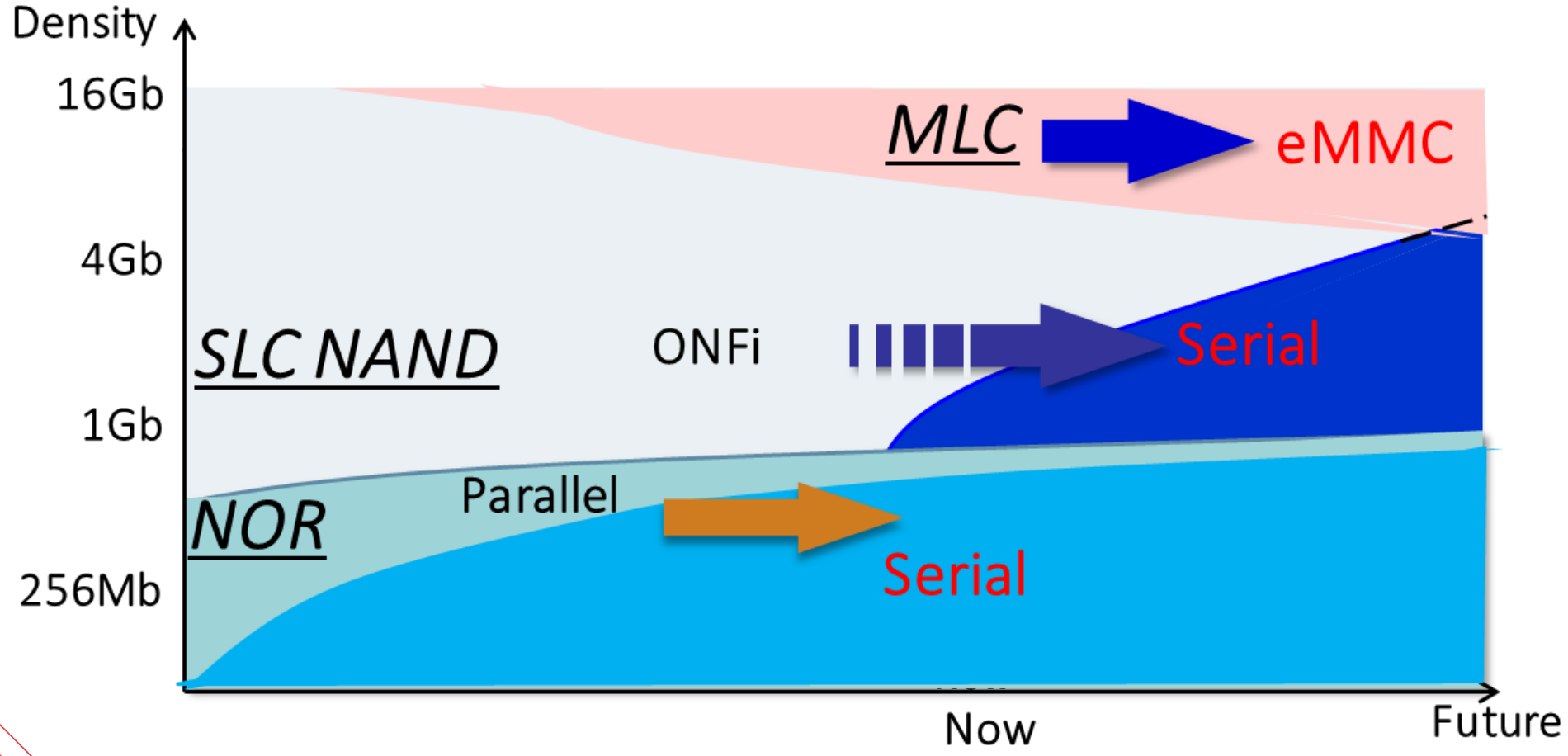
AG1 Serial NOR
AG2 Serial NAND
On-Chip ECC NOR



串列式NAND是趨勢

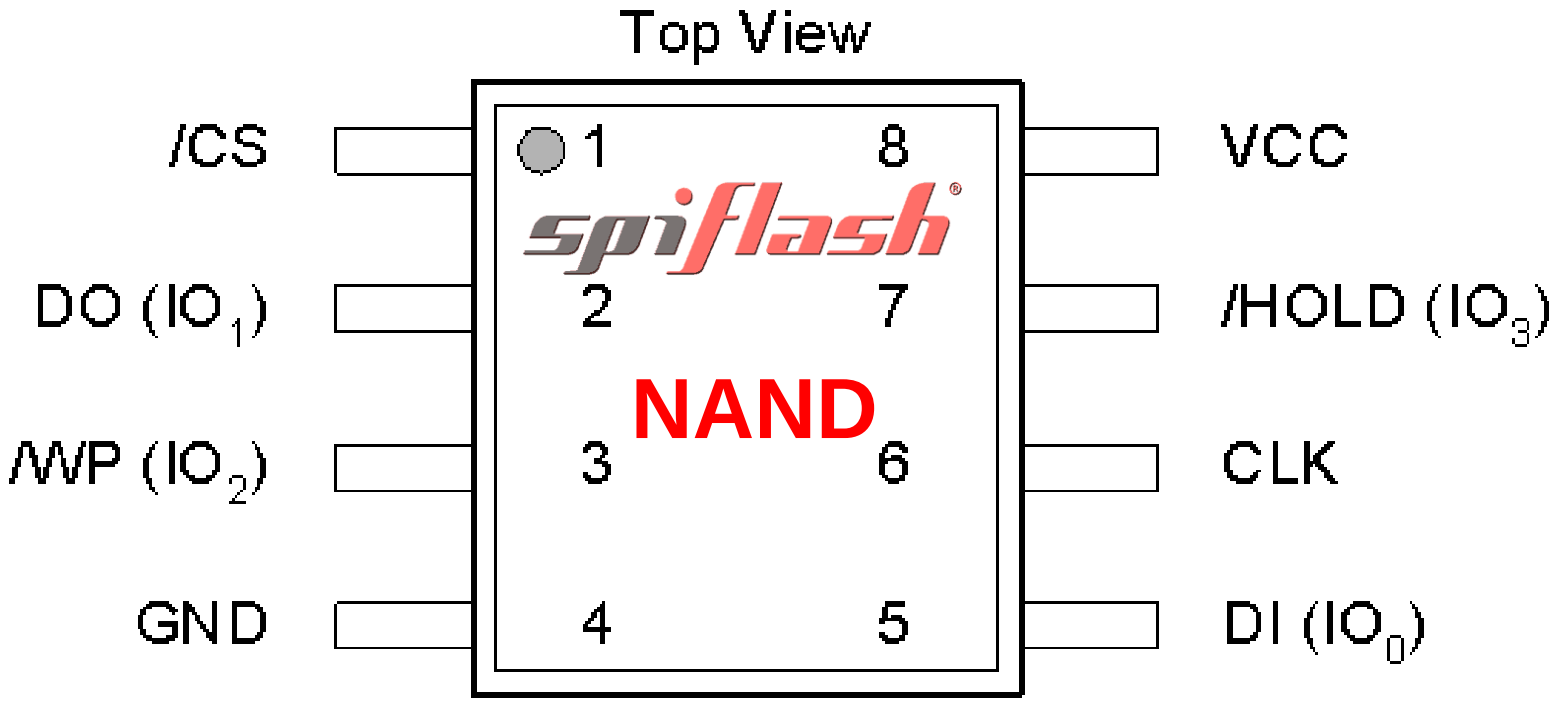
◇串列式NAND應用比例將超越SLC並口NAND.

◇部份高容量串列式NOR市場已經被串列式NAND取代.



串列式NAND與NOR具有相容的引腳

- 硬體相容使導入串列式**NAND**的速度加快!
- 具有寫入速度快, 低成本, 相當品質的優點!



圖為華邦串列式NAND ***W25N***系列

傳統上

NOR

More Reliable

Low Density for Code

NAND

Not Perfect

Required “managed”

趨勢上

NOR

High Density Demand Increased

Process Stop Shrinking

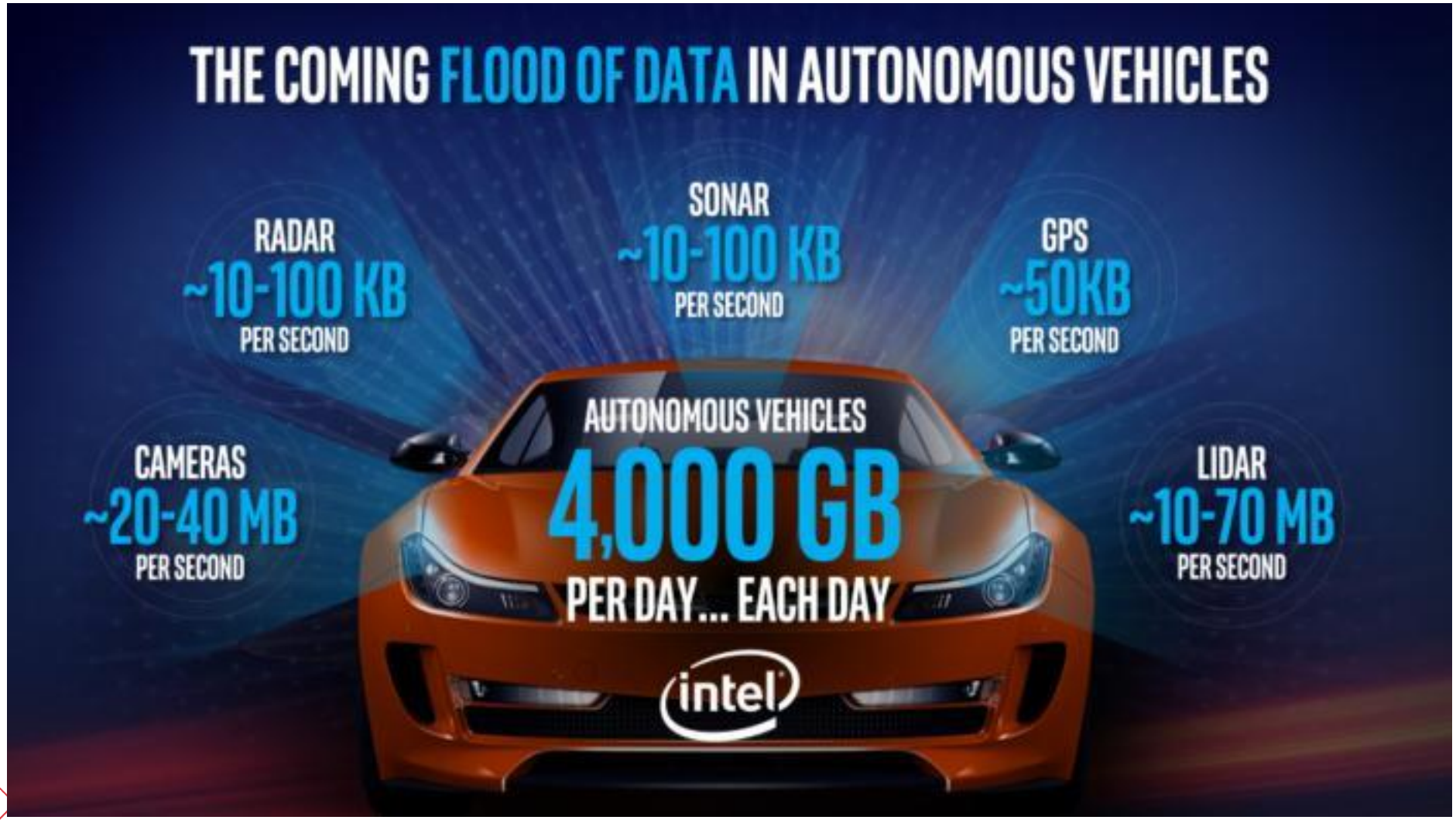
NAND

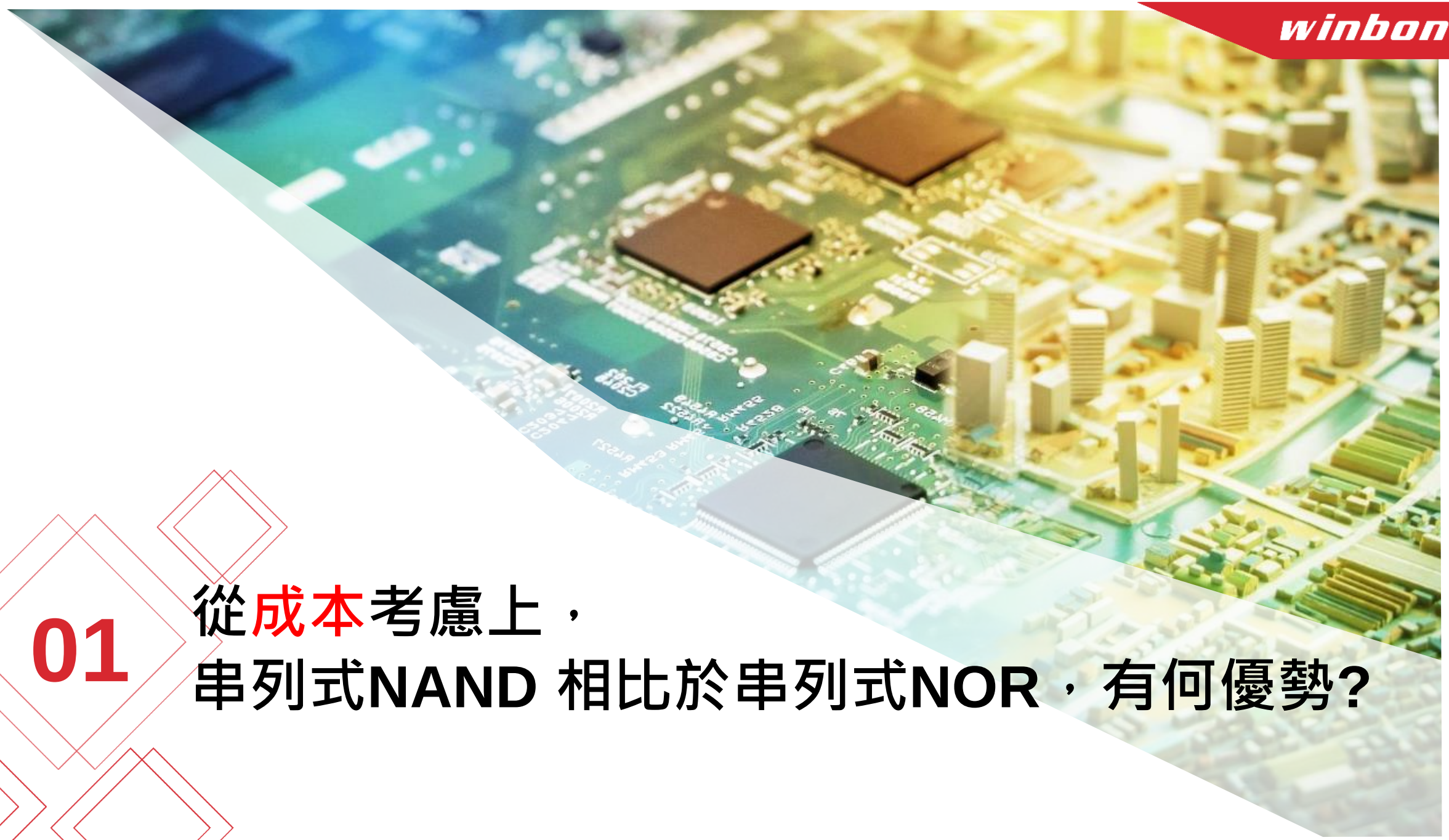
Cost Effective in Higher Density

SLC Quality can be Competed

Consider a Tough Application Scenario - Automotive

◇為什麼對flash 可靠度要求這麼高的汽車應用, 會選擇用SPI NAND來取代SPI NOR ?





01 從成本考慮上，串列式NAND 相比於串列式NOR，有何優勢?

英国诗人Geoffrey Chaucer

“All good things must come to an end”

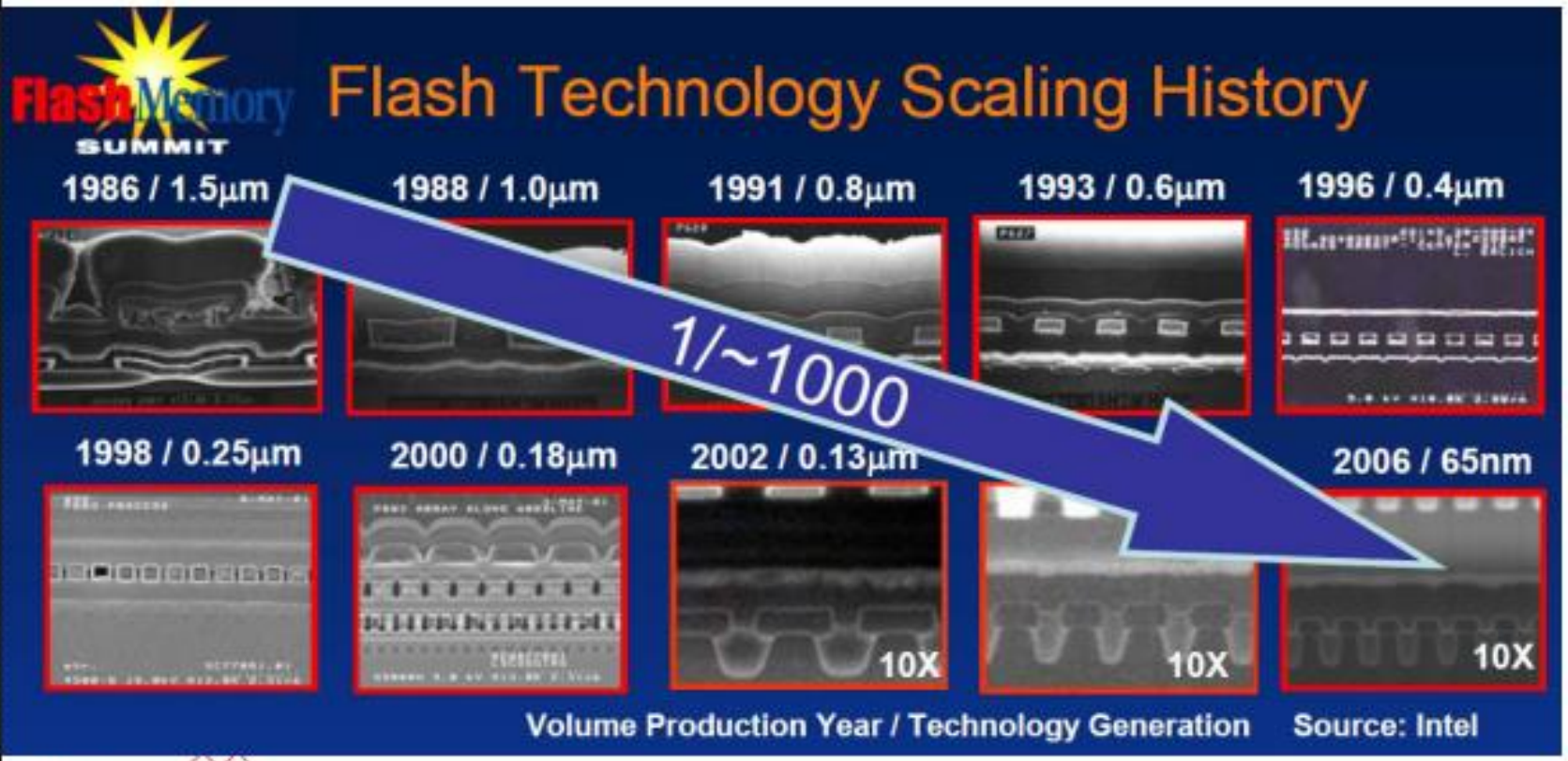
“所有美好的事物，終會有結束的一天”

“煙花易冷 人事易分”

NOR scaling slows down @65nm & runs into dead end @45nm.

This created compelling reason for System Architects to consider SLC NAND at 512Mb~2Gb density
. . Further SLC NAND cell size $4F^2$, whereas NOR cell size $10F^2$ (cost difference can be 1:2 at 1Gb density)

Intel had published 45nm NOR Flash paper in IEEE 2008, and NOR Flash is still stalled at 45nm – 10 years later!
"A 45nm NOR Flash Technology with Self-Aligned Contacts and 0.024um2 Cell Size for Multi-Level Applications", Fastow, Intel, IEEE 2008[1]

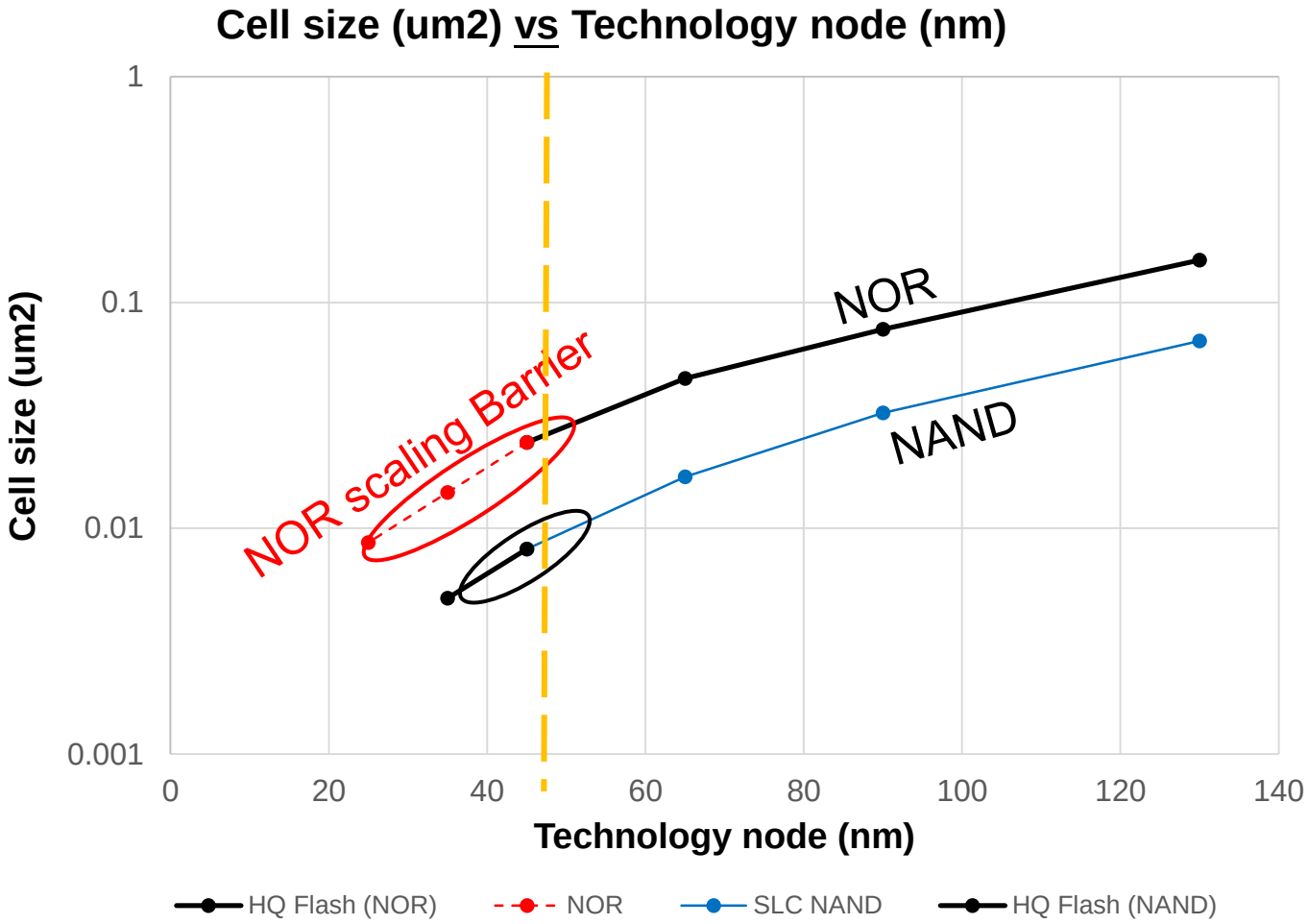


Intel was pioneer in developing multiple gen. of NOR Flash products 1986~2008

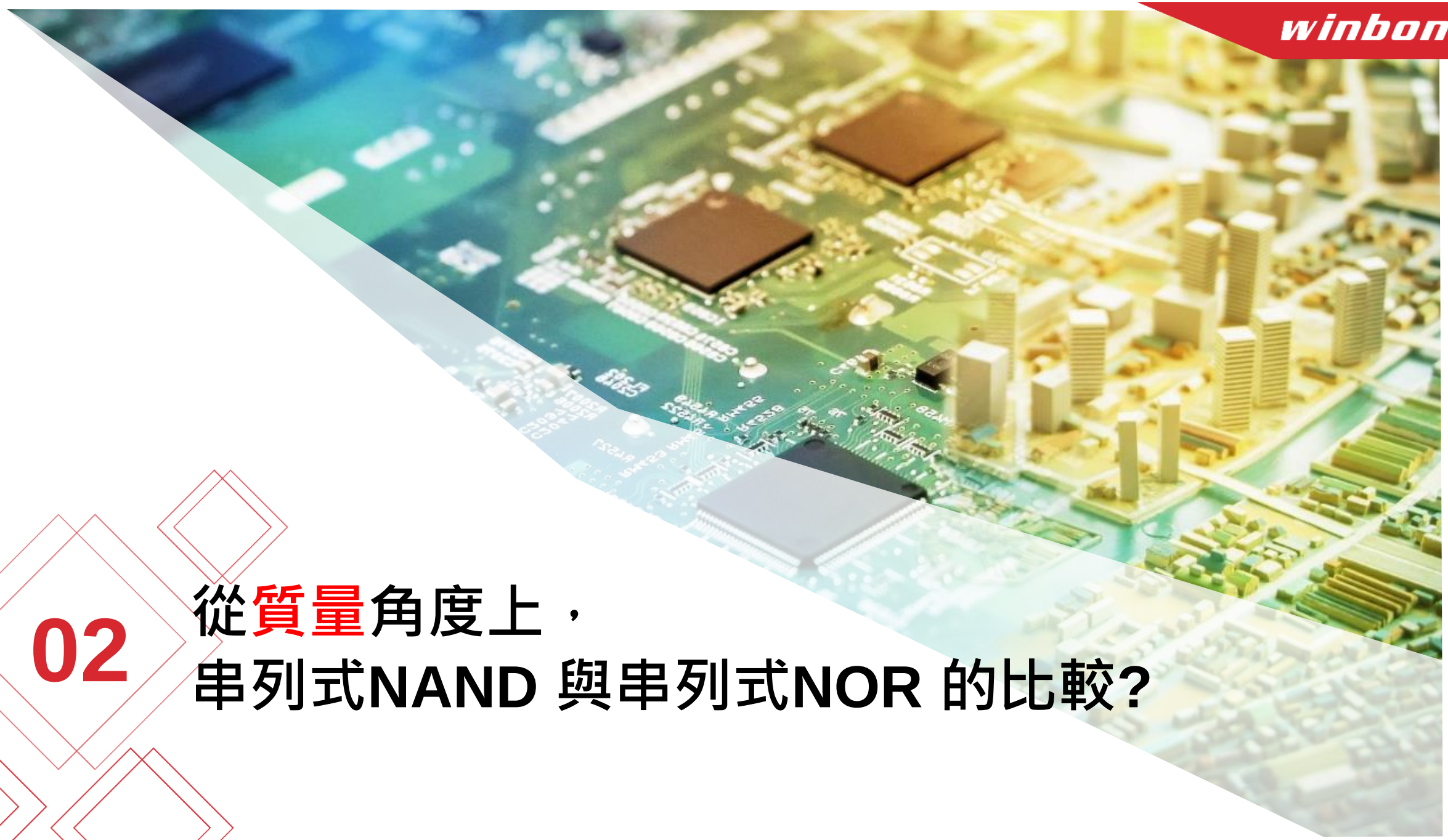
Reference for Flash Memory Summit figure: "An Introduction to Emerging Memory Technologies, Greg Komoto", Intel Corporation, Flash Memory Summit , 2007

從成本考慮上，串列式NAND 相比於 NOR，有何優勢?

1Gb Serial NAND is ~½ cost of 1Gb NOR (NAND cell $4F^2$ vs NOR cell ~$10F^2$)



4Xnm NAND extends scaling 2 gen past 45nm NOR:
4Xnm NAND cell size same as extrapolated 25nm NOR

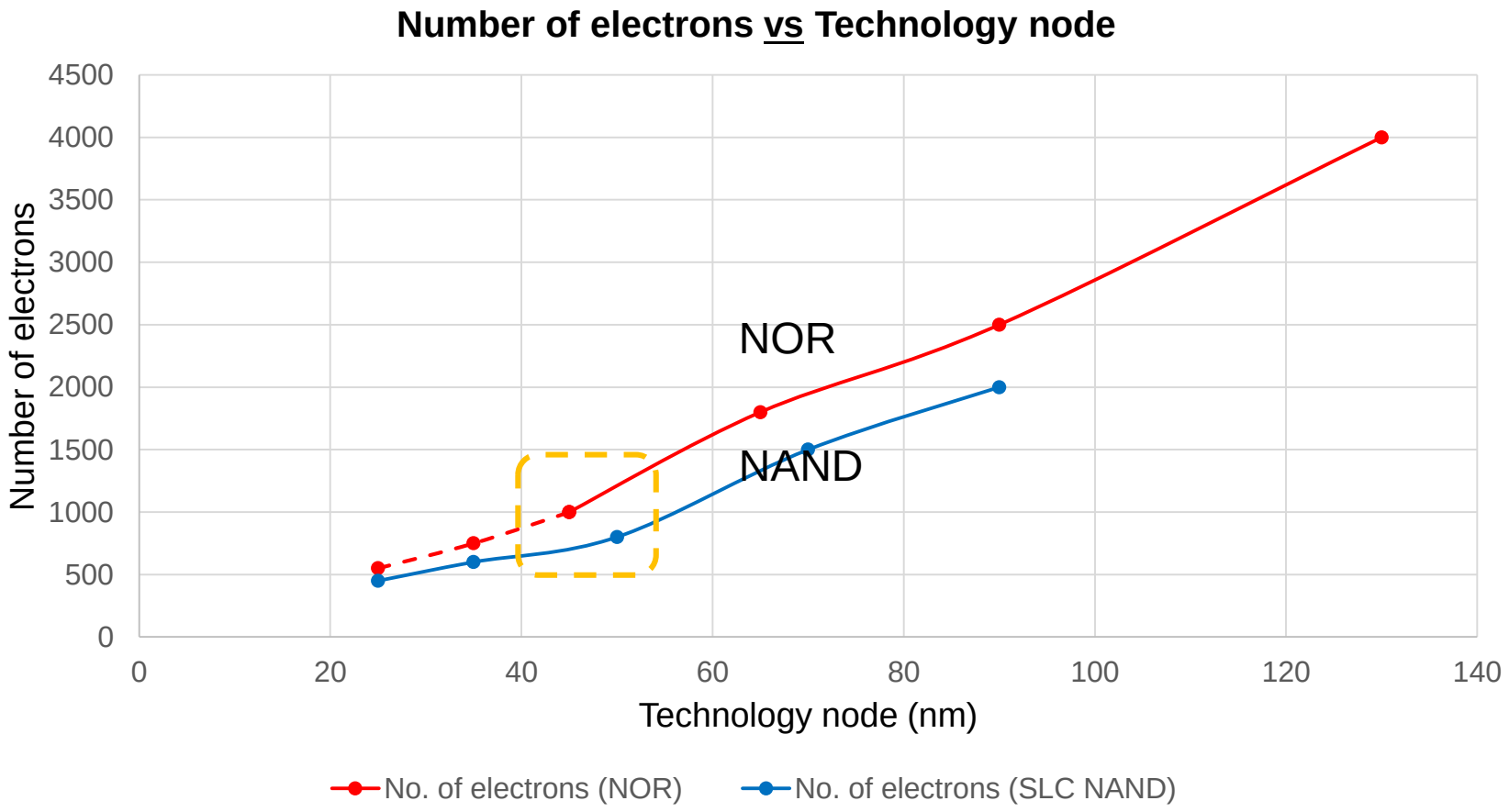


02

從質量角度上，
串列式NAND 與串列式NOR 的比較?

從品質角度上，串列式NAND 與串列式NOR 的比較?

4X-nm NAND & 45nm NOR Quality similar, as both have comparable electrons

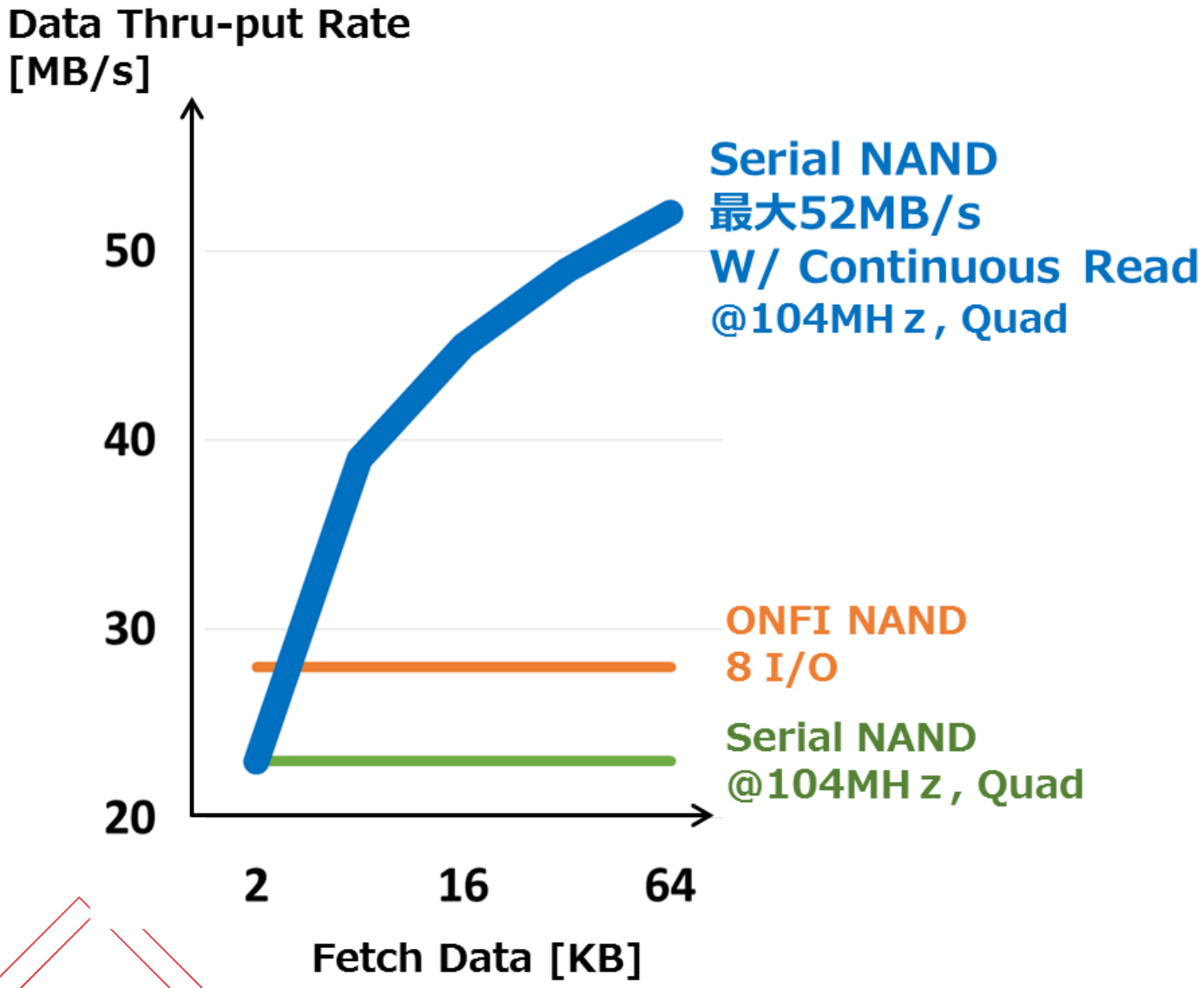


No. of electrons (NAND) computed for Vt shift of 4V

Reference: https://www.eetimes.com/document.asp?doc_id=1333091

03 從讀取速度上，串列式NAND 與串列式NOR 的比較?

Winbond 1st gen. Serial NAND with Continuous Read



Winbond 獨有
Continuous Read

最高 52MB/s
資料傳輸速度

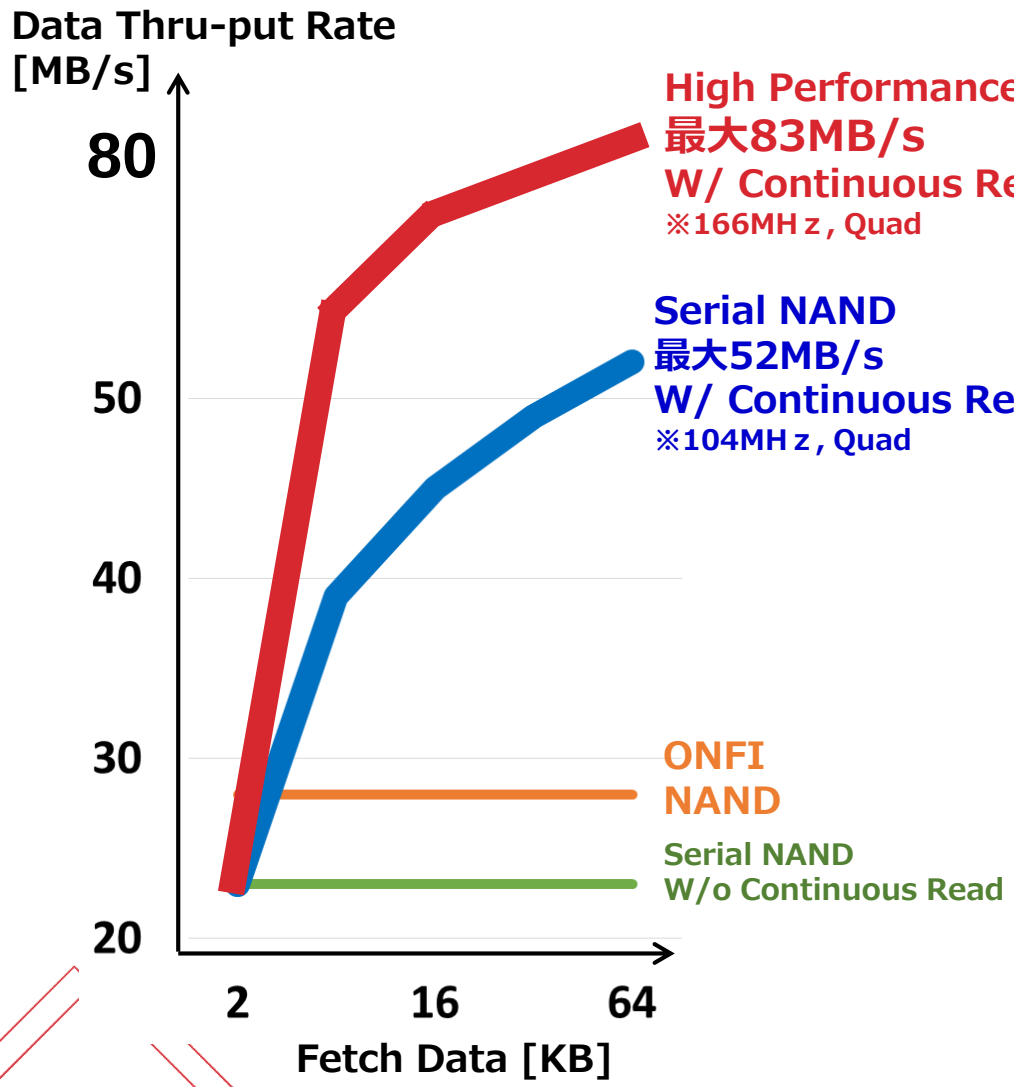
First Born in the World

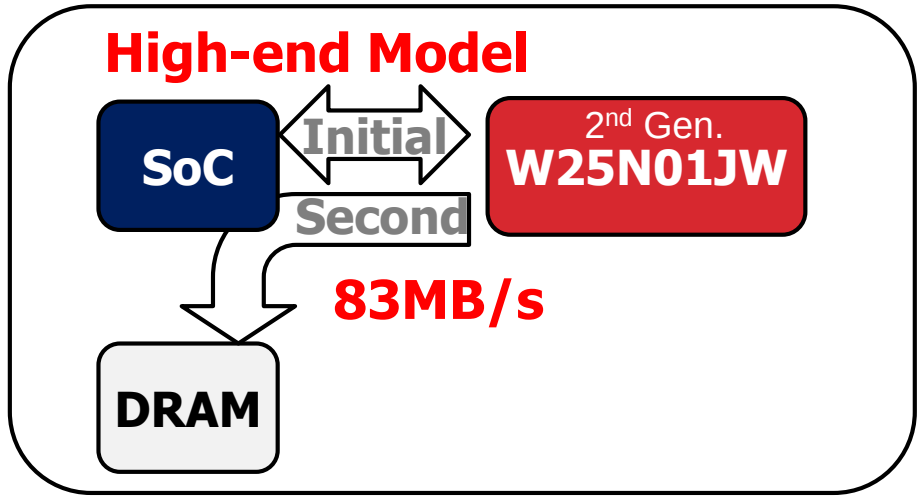
WINBOND 2nd gen. Serial NAND

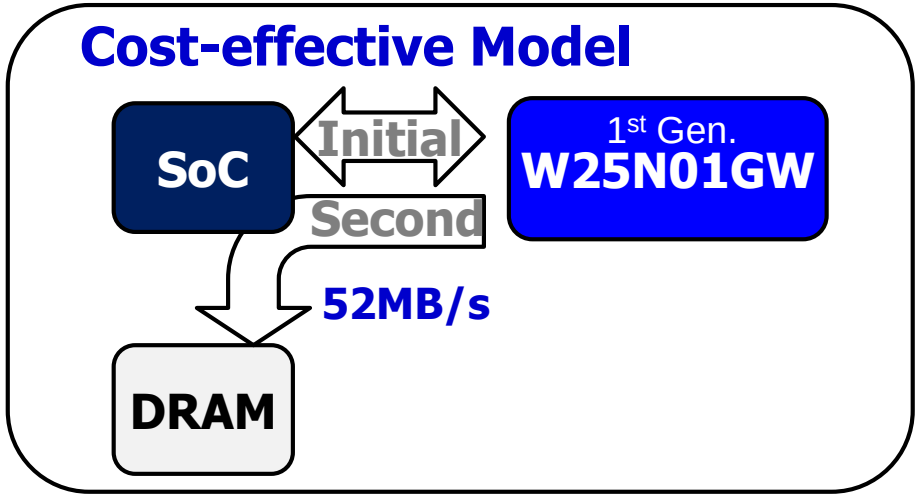
High
Performance

- STR=166Mhz
- DTR= 83Mhz
- Read 83MB/s

Continuous Read with 2nd gen. Serial NAND – High Performance Serial NAND







從讀取速度上，串列式NAND 與串列式NOR 的比較?

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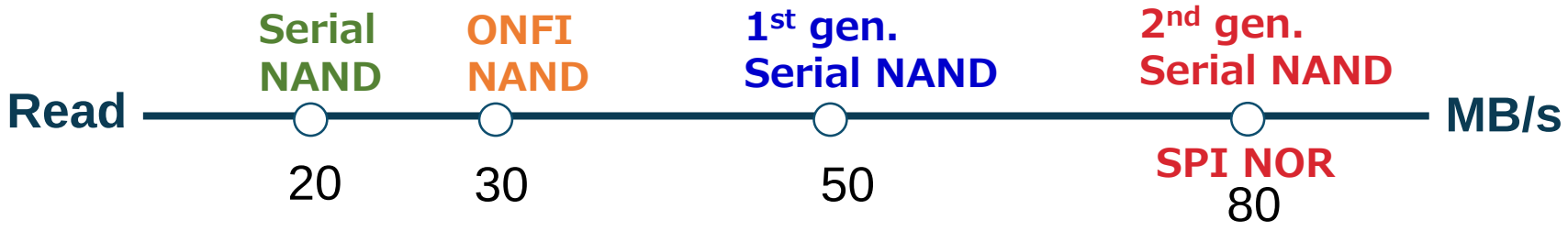
◇ Winbond 2nd gen Serial NAND compete with NOR in Read!

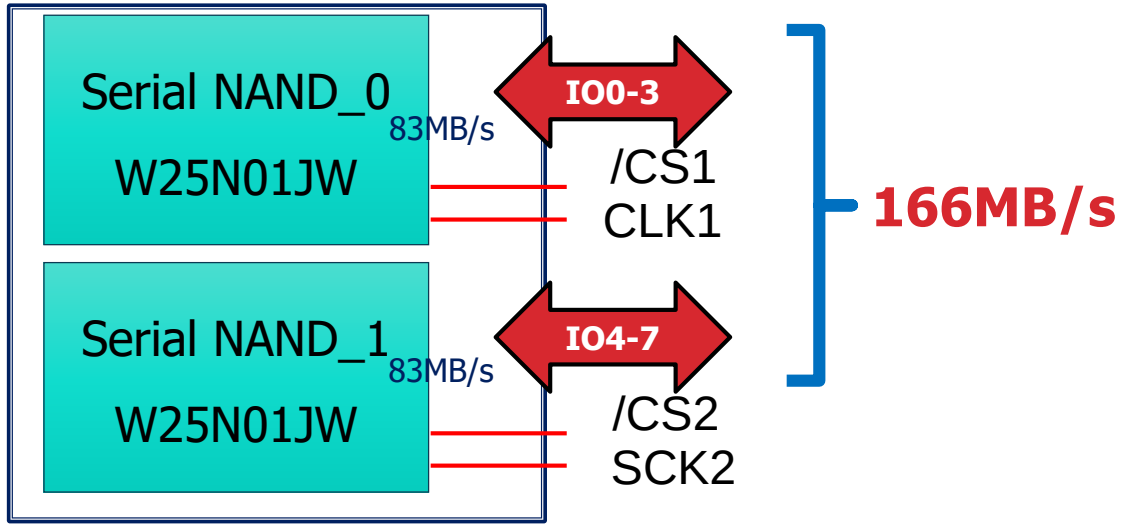
		Quad Interface	
		SPI NOR: W25H256JV	**2nd gen. Serial NAND**: W25N01JW
Sample status		NOW	Sampling
Process		58nm	46nm
Density		256Mb	1Gb
VCC (Supply Voltage)		3V	1.8V
Read	Spec	STR 133MHz DTR 80MHz	**STR 166MHz** **DTR 83MHz**
	MB/s	**80 MB/s**	**83 MB/s**
On-chip ECC		Yes	Yes
Signal #s (Except Vcc/GND)		7 signals (includes /RST)	7 signals (includes /RST)



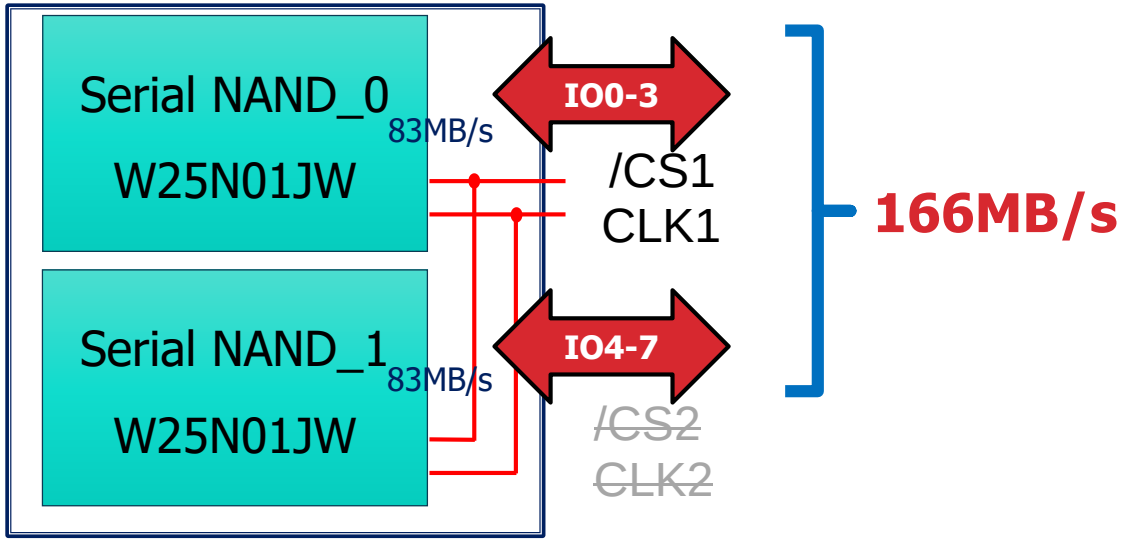
更火的是 Dual Quad

Two chips in One Package

1st Step : Parallel control



2nd Step : Single control



8 I/O 166MB/S

- Single Package
- Dual Quad
- W72N Series

04

從寫入速度上，
串列式NAND 與串列式NOR 的比較?

從寫入速度上，串列式NAND 與串列式NOR 的比較?

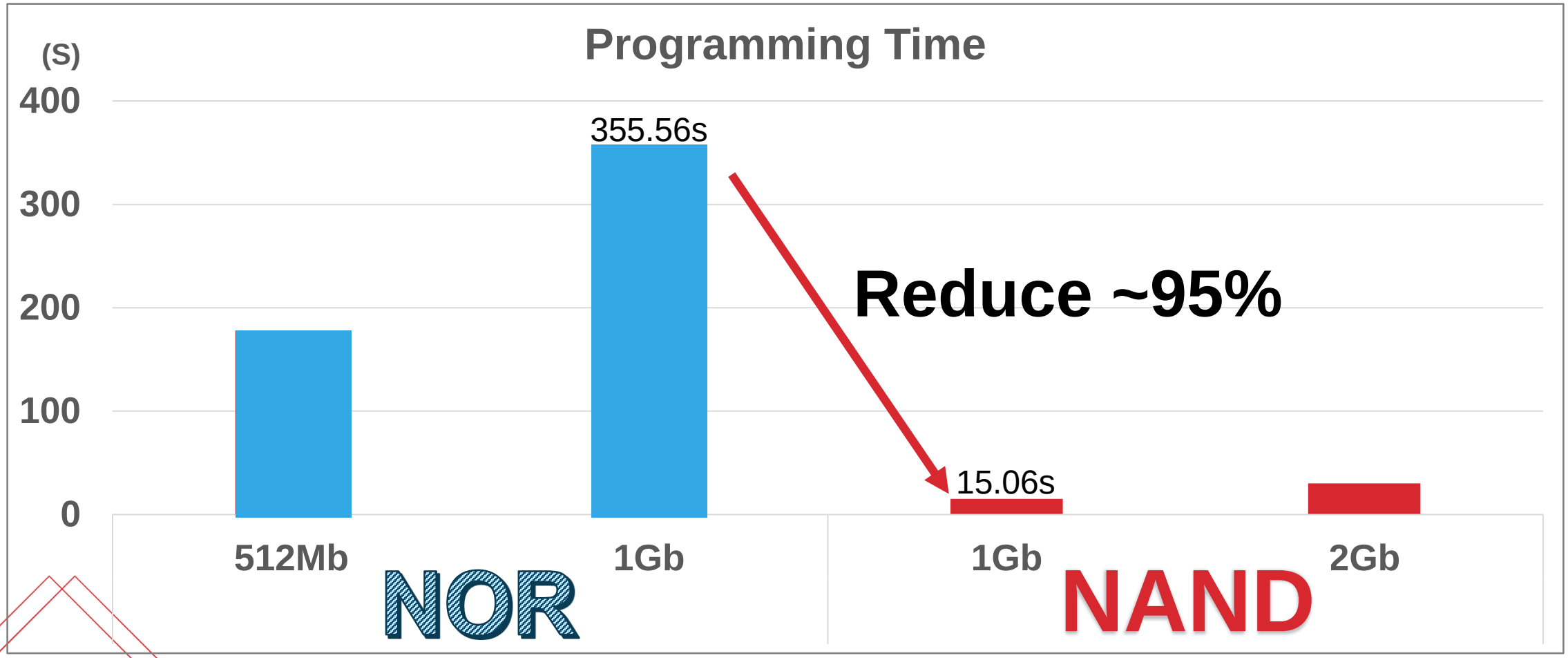
Serial NAND 寫入速度 >10 倍快 擦除 >100 倍快 **than NOR**

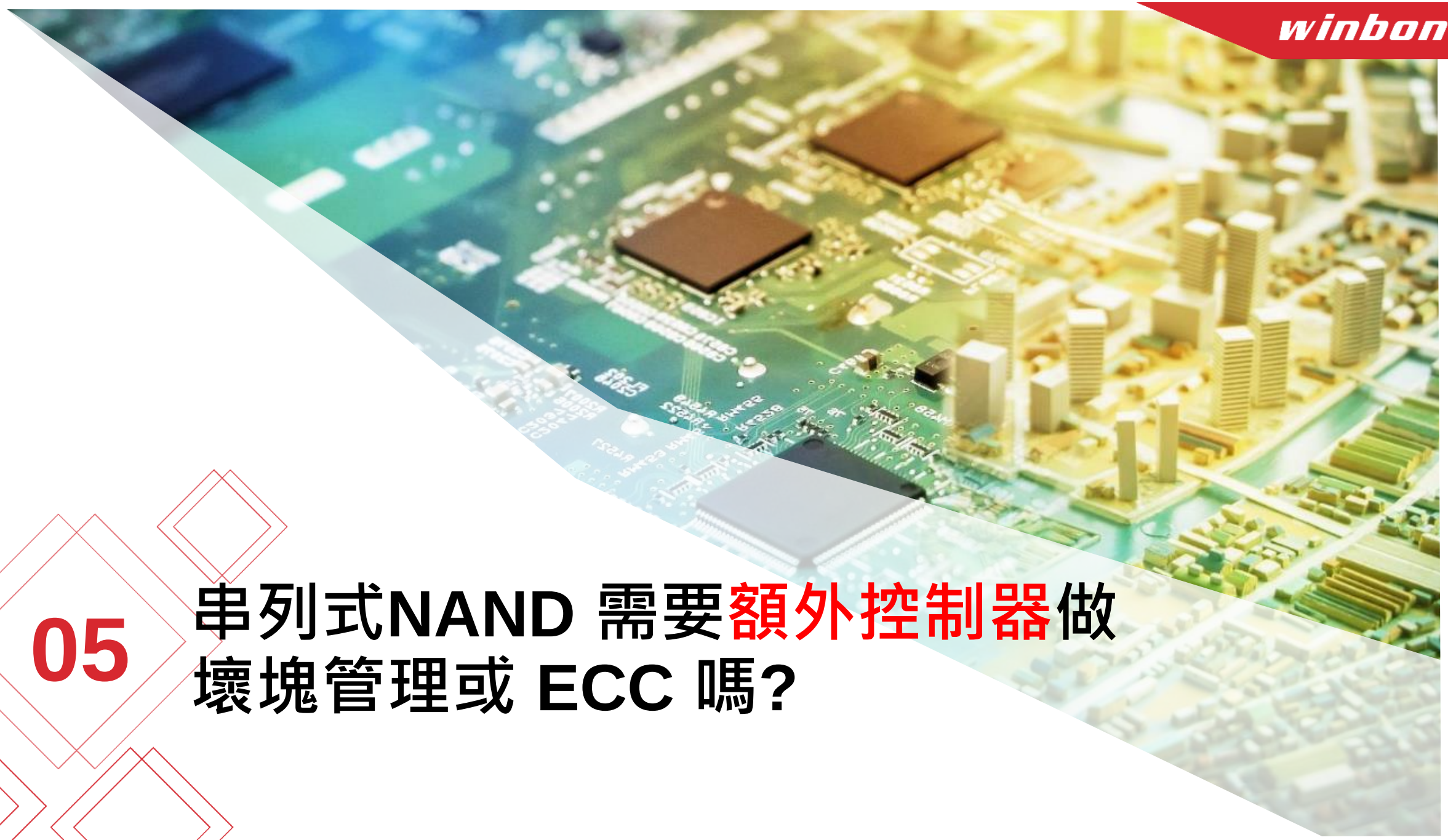
*1 : Quad mode *2 : Quad mode & Cont. read *3 : On chip ECC = enable		Quad Interface	
		SPI NOR: W25H256JV	**2nd gen. Serial NAND**: W25N01JW
Sample status		NOW	Sampling
Process		58nm	46nm
Density		256Mb	1Gb
VCC (Supply Voltage)		3V	1.8V
Program	Spec	700us	250us
	Size	256 Byte	2048 Byte (+ 64 spare Byte)
	MB/s	**0.36 MB/s**	**8.5 MB/s**
Erase	**Spec**	**30ms / 150ms**	**2ms**
	Size	4KB / 64KB	128KB
On-chip ECC		Yes	Yes
Signal #s (Except Vcc/GND)		7 signals (includes /RST)	7 signals (includes /RST)

Saving Programming Time

◇快速燒錄, 降低生產成本

◇快速線上更新, Fast OTA





05 串列式NAND 需要額外控制器做壞塊管理或 ECC 嗎?

串列式NAND 需要額外控制器做壞塊管理或 ECC 嗎?

◇Serial NAND with on-chip ECC and BBM with LUT

Features in "Managed NAND"	eMMC	Winbond Industrial Grade Serial NAND	Winbond Automotive Grade Serial NAND
ECC (錯誤糾正碼)	Fully built-in	Fully built-in	Fully built-in
Bad Block Management (壞塊管理)	Fully built-in	• Built in hardware LUT	• Shipping with zero initial bad block. (出廠零壞塊) • Built in hardware LUT
Wear leveling (耗損均衡)	Fully built-in	• Not necessary for few thousand P/E cycles per block • Winbond 46nm Industrial grade NAND Qualified to JEDEC Qual for 100K cycle	• Not necessary for few thousand P/E cycles per block • Winbond 46nm Automotive grade SLC NAND Qualified to AEC-Q100 Qual for 10K cycle

Automotive:

- Winbond takes lead in Industry to offer Automotive Grade NAND part with "0" initial bad block.
- Winbond offers "Block swap" command (A1h) as well as ability to store Address mapping LUT for BBM in the Flash chip.

06

最後: 華邦 串列式NAND 產品特色
總結串列式NAND帶來的優勢

取代高容量串列式NOR的方案

◇華邦 串列式NAND W25N系列 產品特色

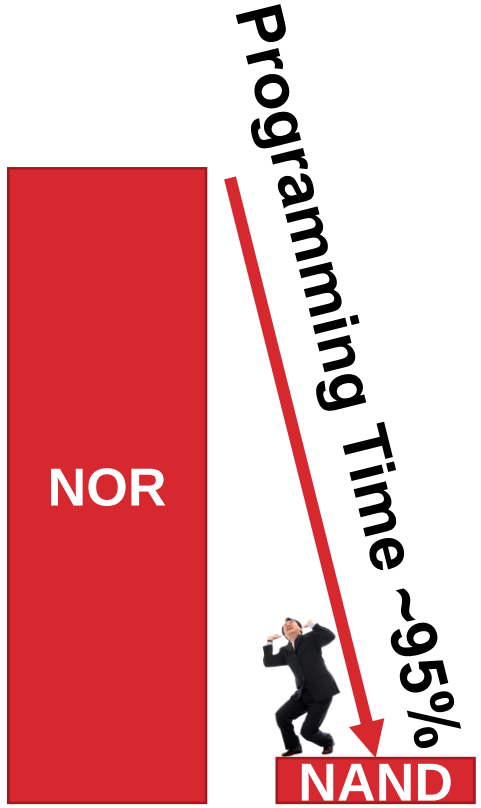
- **Seamless transition to *Serial NAND* with standard SPI interface and package**
  - ***46nm*** SLC NAND technology in Winbond's 12" wafer Fab
  - ***512Mb, 1Gb and 2Gb*** density available now
  - ***3V / 1.8V*** power supply
  - *Continuous Read* ***52MB/s Data Throughput*** ideal for Code-Shadowing
  - ***Low pin-count*** packages (WSON-8, TFBGA-24) with MCP options
  - On Chip ***1-Bit ECC*** and On Chip ***Look-Up-Table*** for Bad Block Management
  - ***Industrial*** grade & ***Automotive*** grade
  - *Flexible device configurations* by customers' need (Buffer/Continuous Read, Array/Device Lock-Down/OTP/write protection)

SPI Interface, 8-pin small package

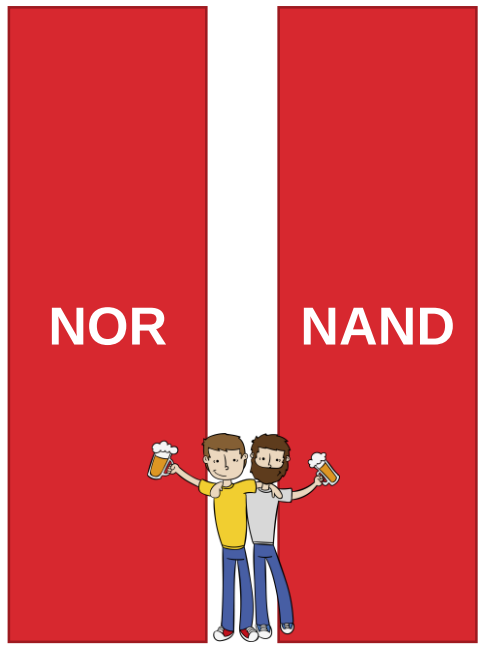
Built-in features offloads external controller – ECC, Bad Block Management

Continuous Read – Improves system efficiency

總結 串列式NAND的優勢



Same Quality Level



Thank You

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