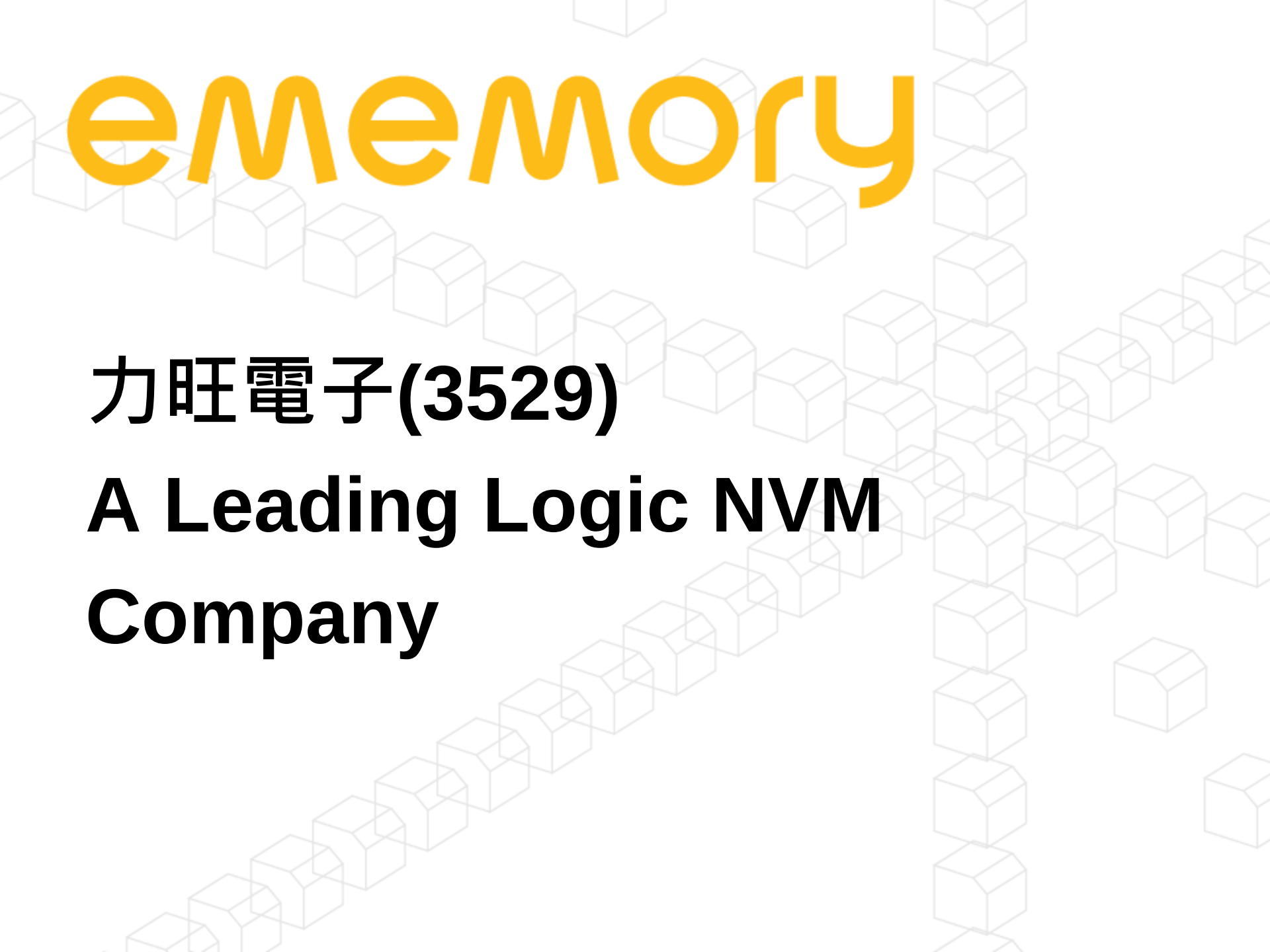


The background of the slide is filled with a pattern of white, 3D-outlined cubes. These cubes are arranged in a way that creates a sense of depth and movement, with some cubes appearing to be in the foreground and others receding into the background. The cubes are scattered across the entire slide, providing a modern, geometric aesthetic.

ememory

力旺電子(3529)

**A Leading Logic NVM
Company**

智慧財產權聲明

本文件內之資訊，包括文字、圖片、圖表、表格或其他檔案等，其所有權利或利益，包括但不限於所有權及智慧財產權，皆屬力旺電子所有，請尊重智慧財產權。本文件之內容包含力旺電子之機密資訊。部分內容可參見2014年出版之Logic Non-Volatile Memory (The NVM solutions from eMemory)一書。任何在此之資訊在未經力旺電子書面同意，不得影印、散佈、複製、使用本文件或將其揭露予第三人。

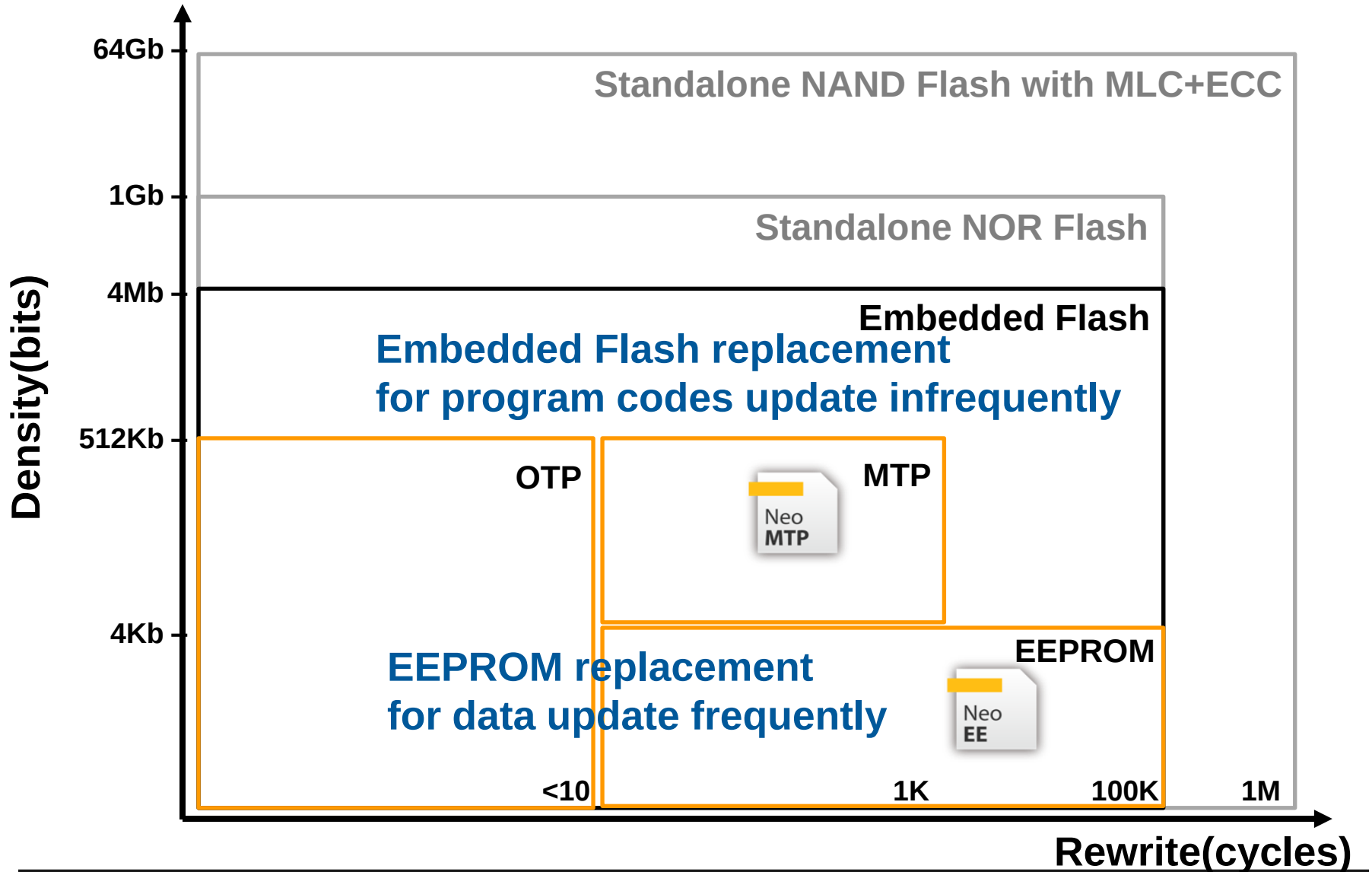
投資安全聲明

除簡報內所提供之歷史信息外，簡報事項係屬預測性陳述，受到風險及不確定性因素影響，可能造成實際結果與陳述內容發生不符，這些不確定性因素包括：技術平台是否順利導入利用、IP是否被客戶接受、客戶產品大量量產之能力及時間、產業及市場對半導體產品之供給及需求移轉、終端市場之穩定性及其他風險等。

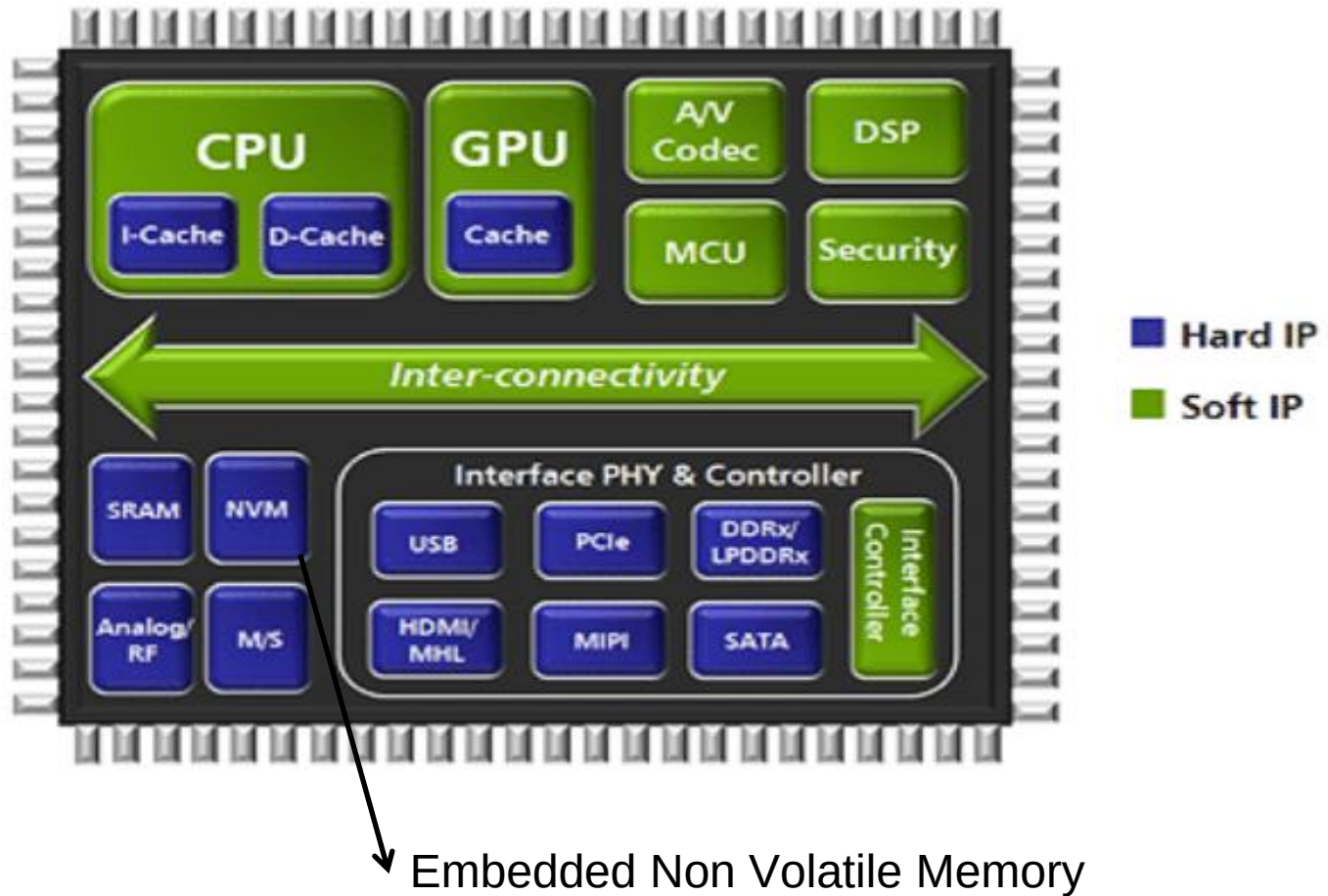
大綱

- 公司營運模式
- 營運回顧
- 成長機會與未來展望
- 問題與回答

嵌入式非揮發性記憶體分類



SOC Block Diagram

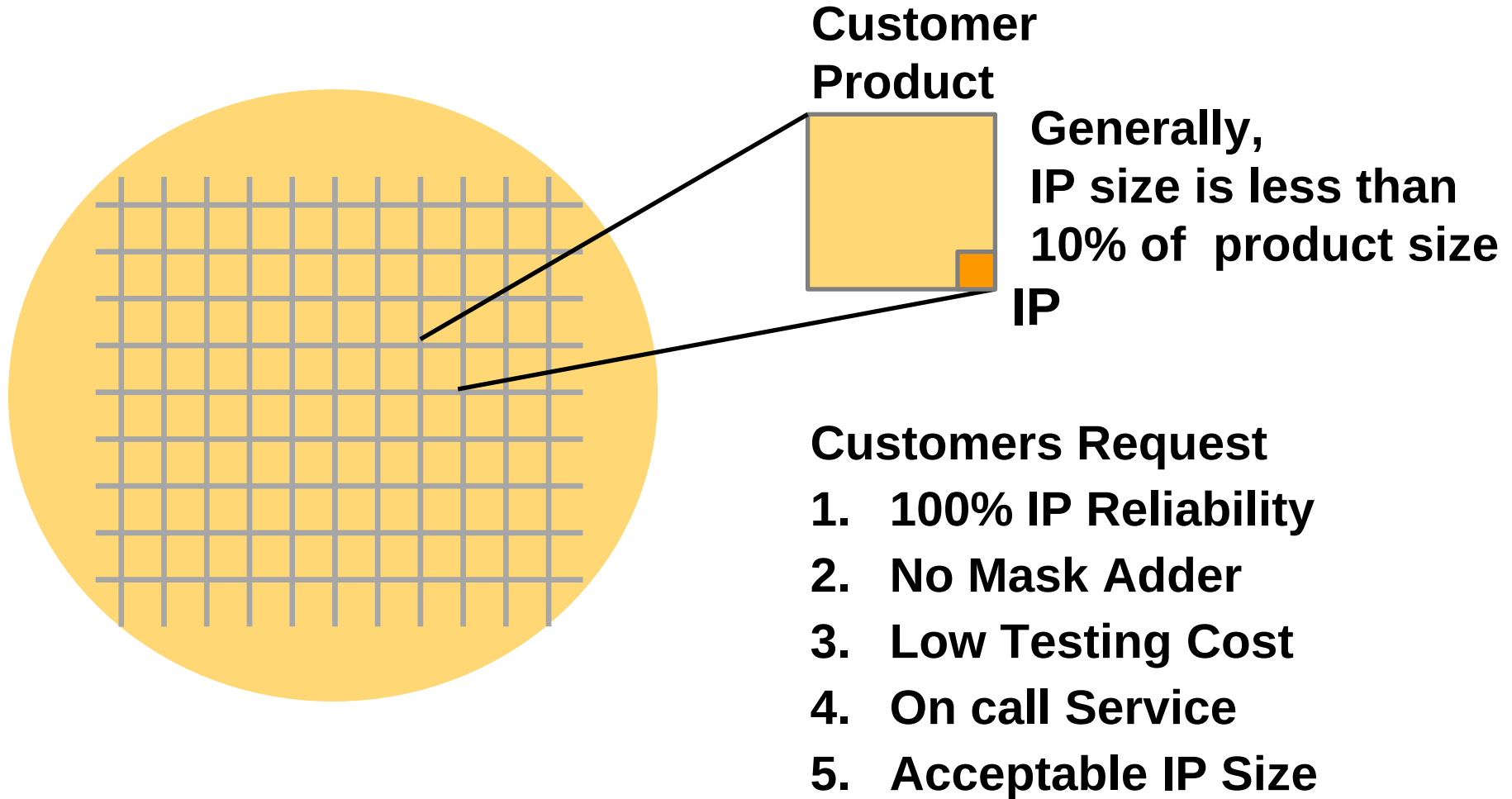


Source : tsmc

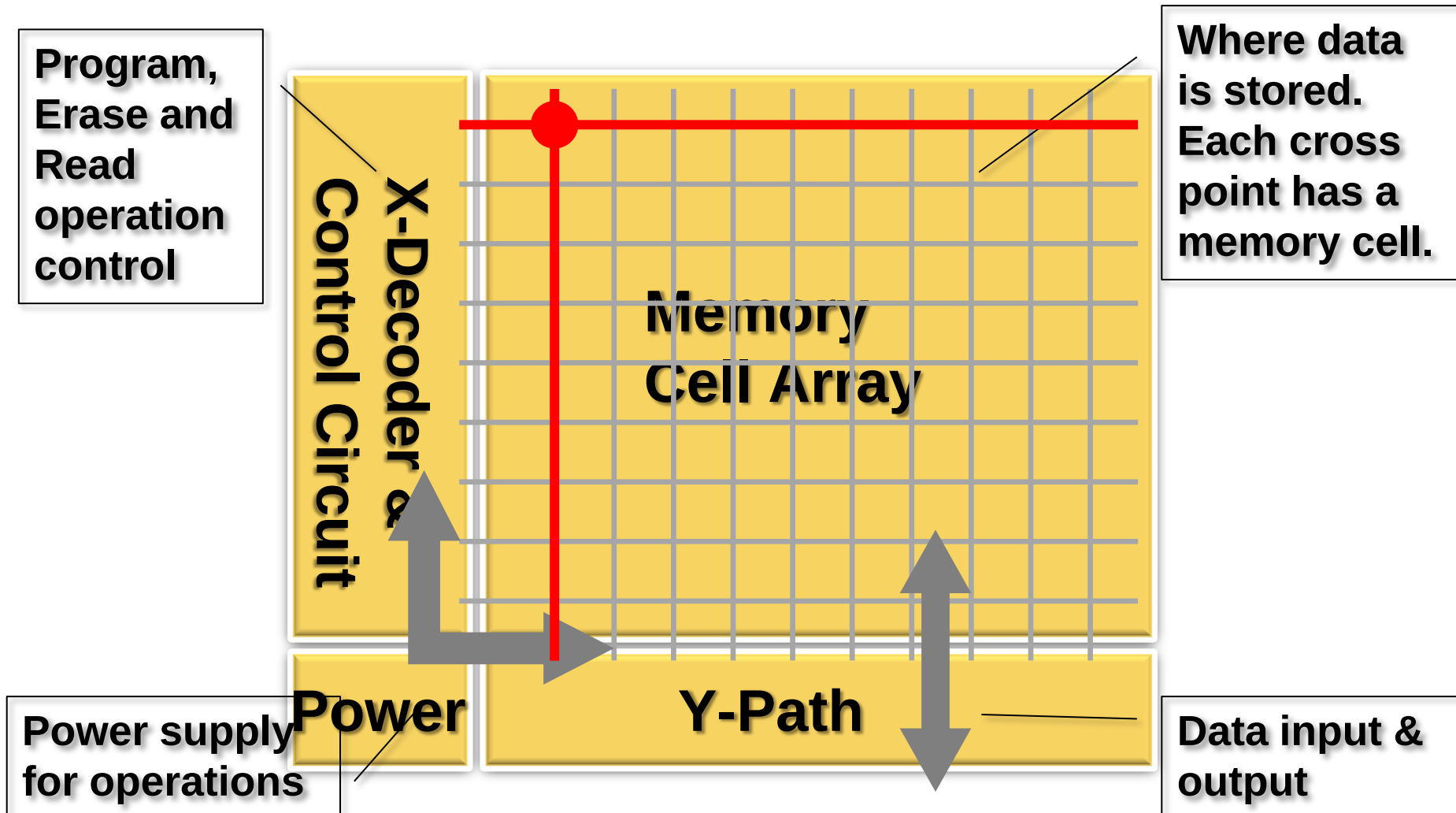
嵌入式非揮發性記憶體技術

	ROM	eFuse (OTP)	Antifuse (OTP)	CMOS Floating Gate (OTP)	CMOS Floating Gate (MTP)	Embedded Flash
Cell Structure	Transistor	Poly Fuse	Antifuse	Floating Gate	Floating Gate	Floating Gate
Standard CMOS Compatible	Yes	Yes	Yes	Yes	Yes	No
Bitcell Area	< 1	50	1	2	4	1
Endurance	No	No	< 10	< 10	10K-100K	100-1000K
Density	4Kb-1Mb	256bit-4Kb	16bit-1Mb	16Kb-1Mb	1Kb-2M	64Kb-4Mb
Security	Low	Low	High	High	High	High
Additional Steps	None	None	None	None	None	+10 Mask

採用IP之考量

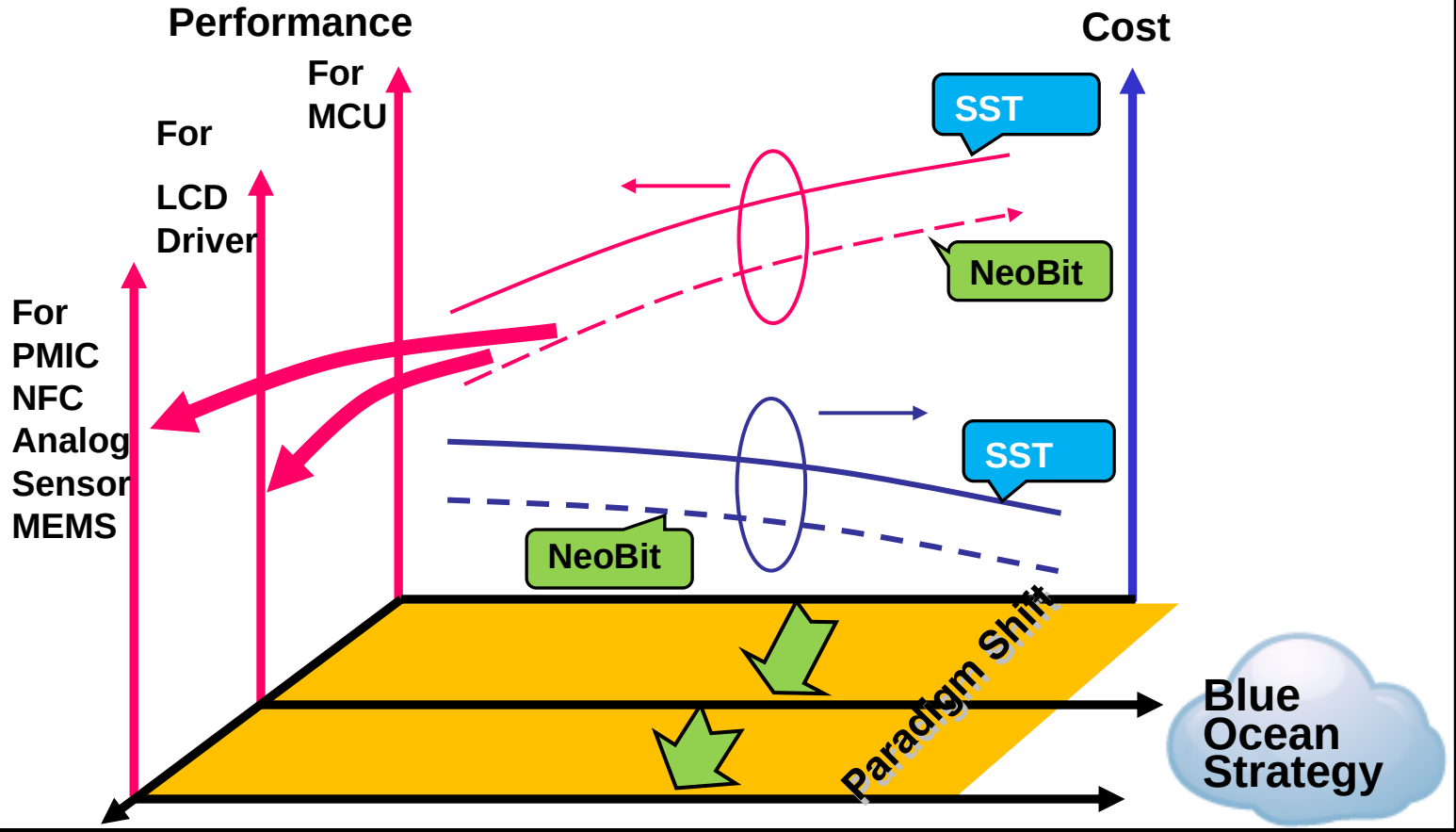


Nonvolatile Memory IP 内部

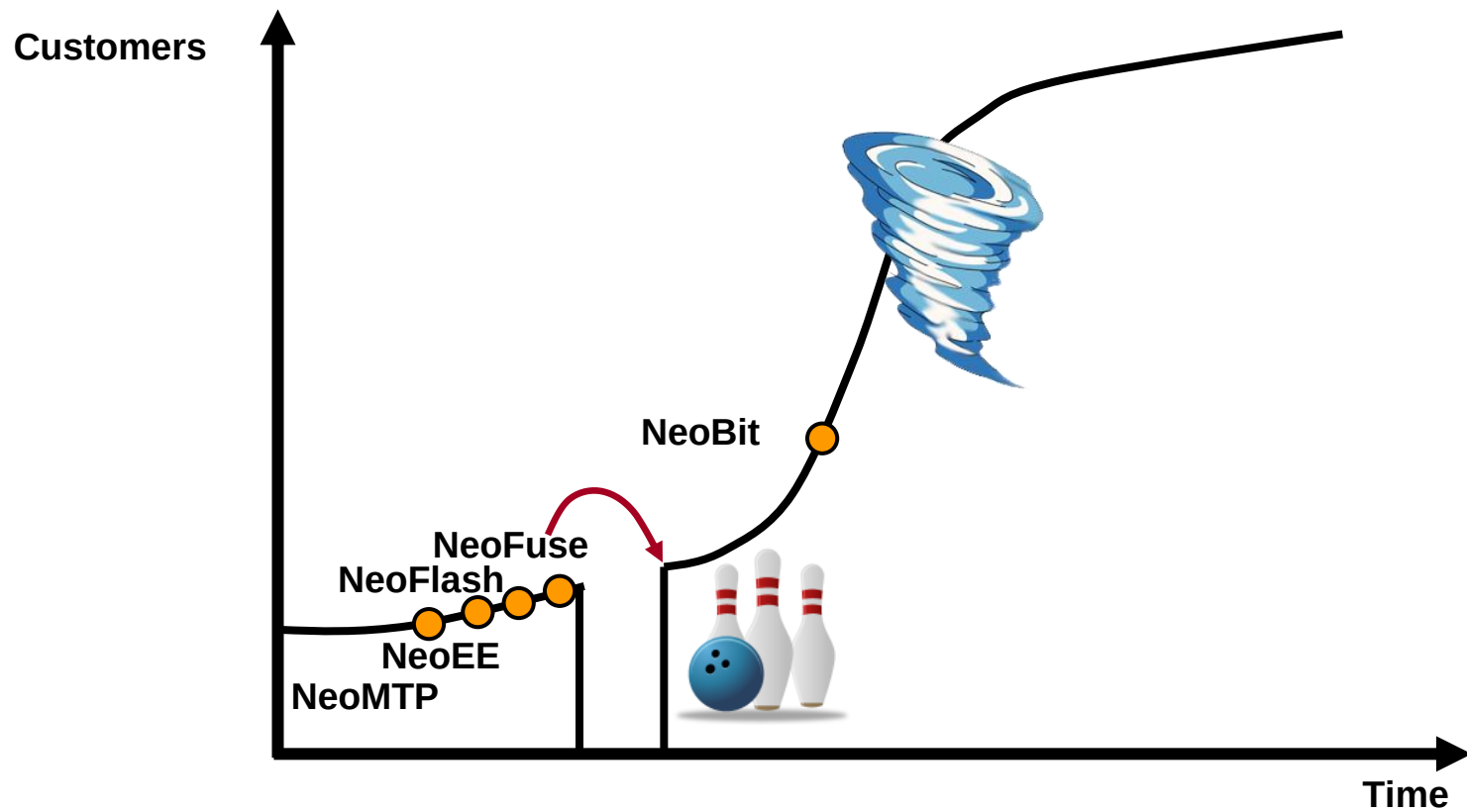


破壞性創新

● *Innovation, Innovation, and Innovation !*



跨越鴻溝



營運模式

- Founded in 2000. First customer engaged in 2002. Achieved profitability in 2005 and IPO in 2011. The largest logic non-volatile memory IP company, 228 employees (157 R&D)*.
- Since its IPO, the company initiated no new fund raising or bank debt, and has distributed in excess of 100% of earnings in cash dividends.
- **Growth Indices:** 1) No. of on-going technology platforms
2) No. of design licenses
3) Royalty



Note*: As of Dec. 31, 2015

全球客戶



Foundry



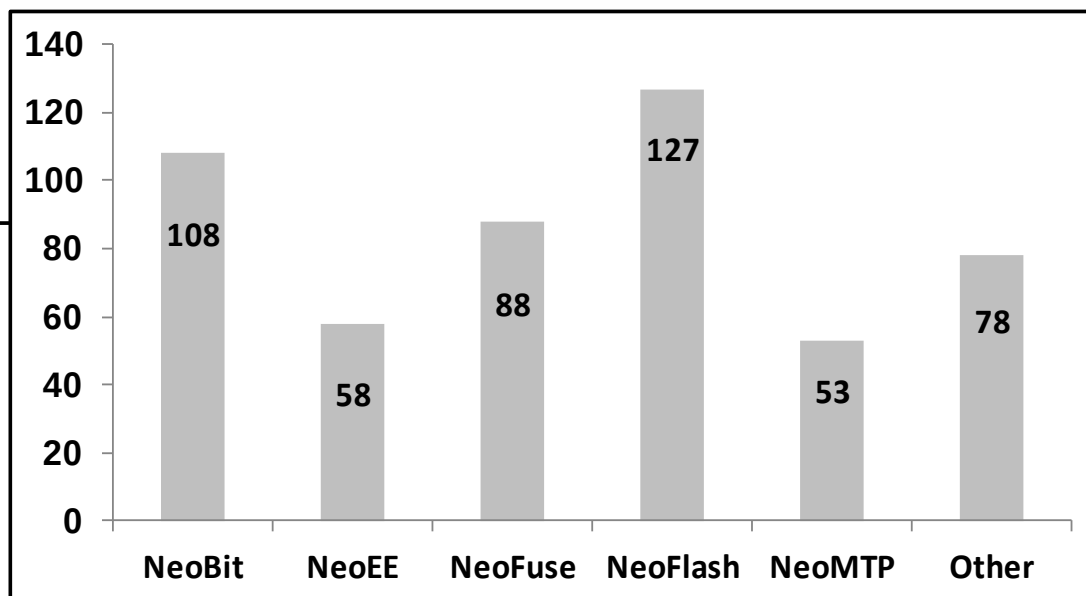
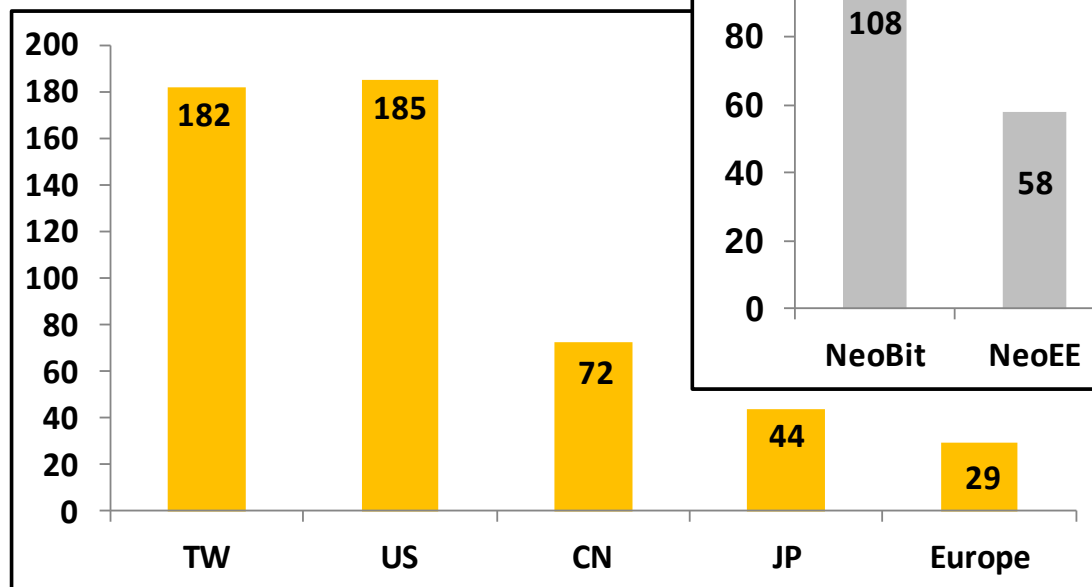
IDM



	Taiwan	China	Korea	Japan	North America	Europe	Others
Foundry	5	7	3	2	1	1	1
IDM	0	0	0	8	2	1	0
Fabless	237	351	51	36	181	94	40

專利佈局

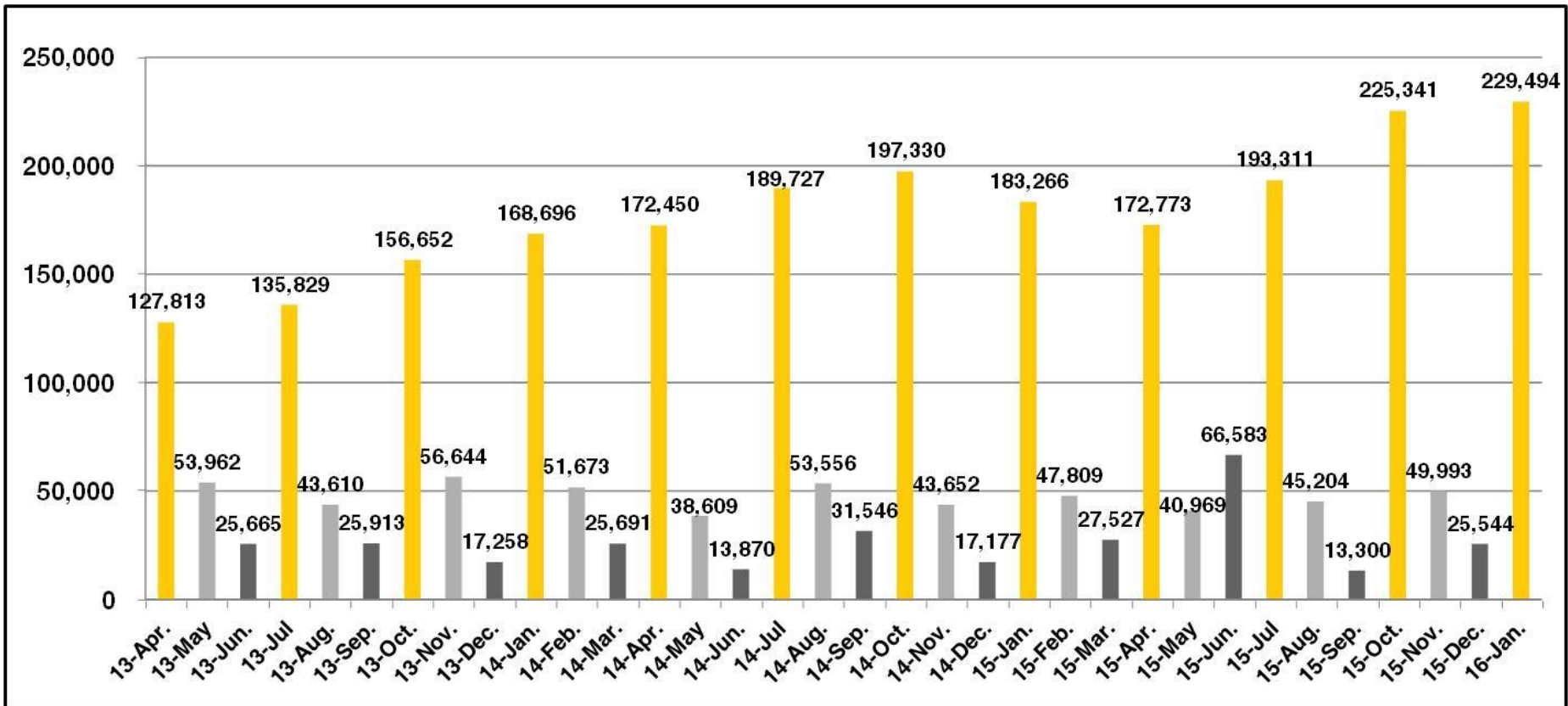
	Q3 15	Q4 15	Diff.
Pending	187	187	-
Issued	304	325	+21
Total	491	512	+21



每季營收模式

- 每季第一個月認列絕大部份晶圓廠前一季使用本公司IP的出貨晶圓權利金及當月產生的技術授權金及設計授權金；第二個月則是少部份晶圓廠權利金及當月授權金；第三個月則無權利金收入，只有授權金。

Unit : NTD Thousands



大綱

- 公司營運模式
- 營運回顧
- 成長機會與未來展望
- 問題與回答

Q4及2015各項營收

Unit: NTD thousands

	2015 Q4	2015 Q3	QoQ	2014 Q4	YoY	2015	2014	YoY
Licensing	69,307	38,167	81.59%	51,849	33.67%	267,512	246,073	8.71%
Royalty	231,571	213,648	8.39%	206,310	12.24%	824,108	757,904	8.74%
Total	300,878	251,815	19.48%	258,159	16.55%	1,091,620	1,003,977	8.73%

Unit: Number of contracts

		2015 Q4	2015 Q3	2015	2014
Technology Licenses		11	4	28	21
Design Licenses	NRE	9	10	57	82
	Usage	104	76	349	363

綜合損益表

(Unit: NTD thousands)	Q4 15	Q4 14	% change	2015	2014	% change
Revenue	300,878 *	258,159	16.5%	1,091,620 *	1,003,977	8.7%
Gross Margin	100% *	100%	-	100% *	100%	-
Operating Expenses	156,216 *	148,466	5.2%	570,403 *	540,286	5.6%
Operating Margin	48.1% *	42.5%	+5.6ppts	47.7% *	46.2%	+1.5ppts
Net Income	128,090 *	100,931	26.9%	479,111 *	418,604	14.5%
Net Margin	42.6% *	39.1%	+3.5ppts	43.9% *	41.7%	+2.2ppts
EPS (Unit: NTD)	1.69 *	1.33	27.1%	6.32 *	5.52	14.5%
ROE	28.4% *	23.4%	+5.0ppts	26.6% *	24.3%	+2.3ppts

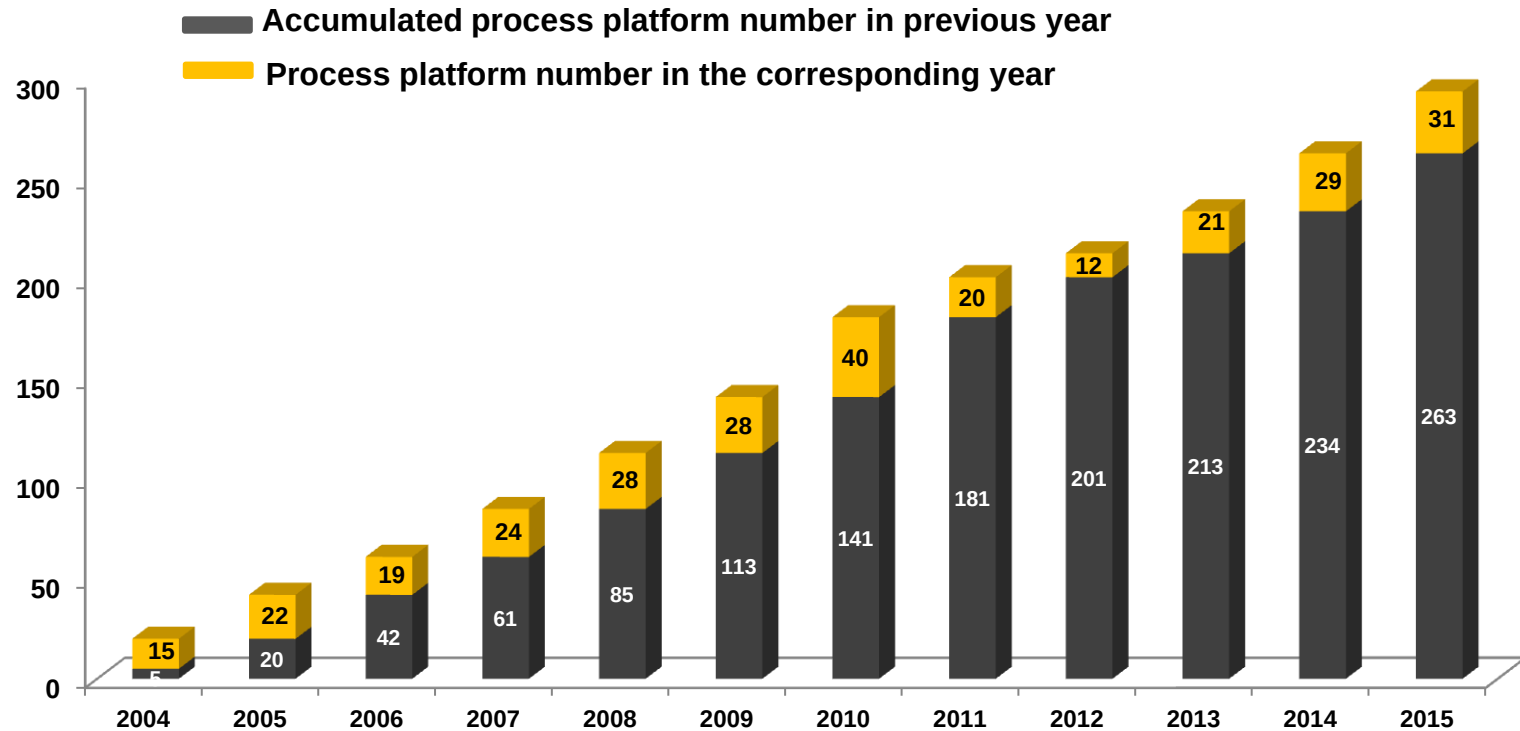
* Unaudited

技術授權合約及累計平台數

Unit: Number of contract

Year	2013	2014	2015
License number	19	21	28

Note: The terms (including number of process platforms and licensing fees) for each technology license are set contractually. Payments are made according to set milestones, and there are no particular seasonal factors involved.



目前正在建構的技術製程平台

- Total (As of Dec.) : **100**
- **16** for NeoBit, **38** for NeoFuse, **26** for NeoEE, and **20** for NeoMTP.

	10nm	14/16nm	28nm	40nm	55/65nm	80/90nm	0.11~ 0.13um	0.15~ 0.18um	>0.25 um	Total
NeoBit	-	-	-	-	-	-	5	11	-	16
NeoFuse	1	3	9	4	9	3	6	3	-	38
NeoFlash	-	-	-	-	-	-	-	-	-	0
NeoEE	-	-	-	2	-	1	6	17	-	26
NeoMTP	-	-	-	1	2	2	4	11	-	20

目前正在建構的技術製程平台

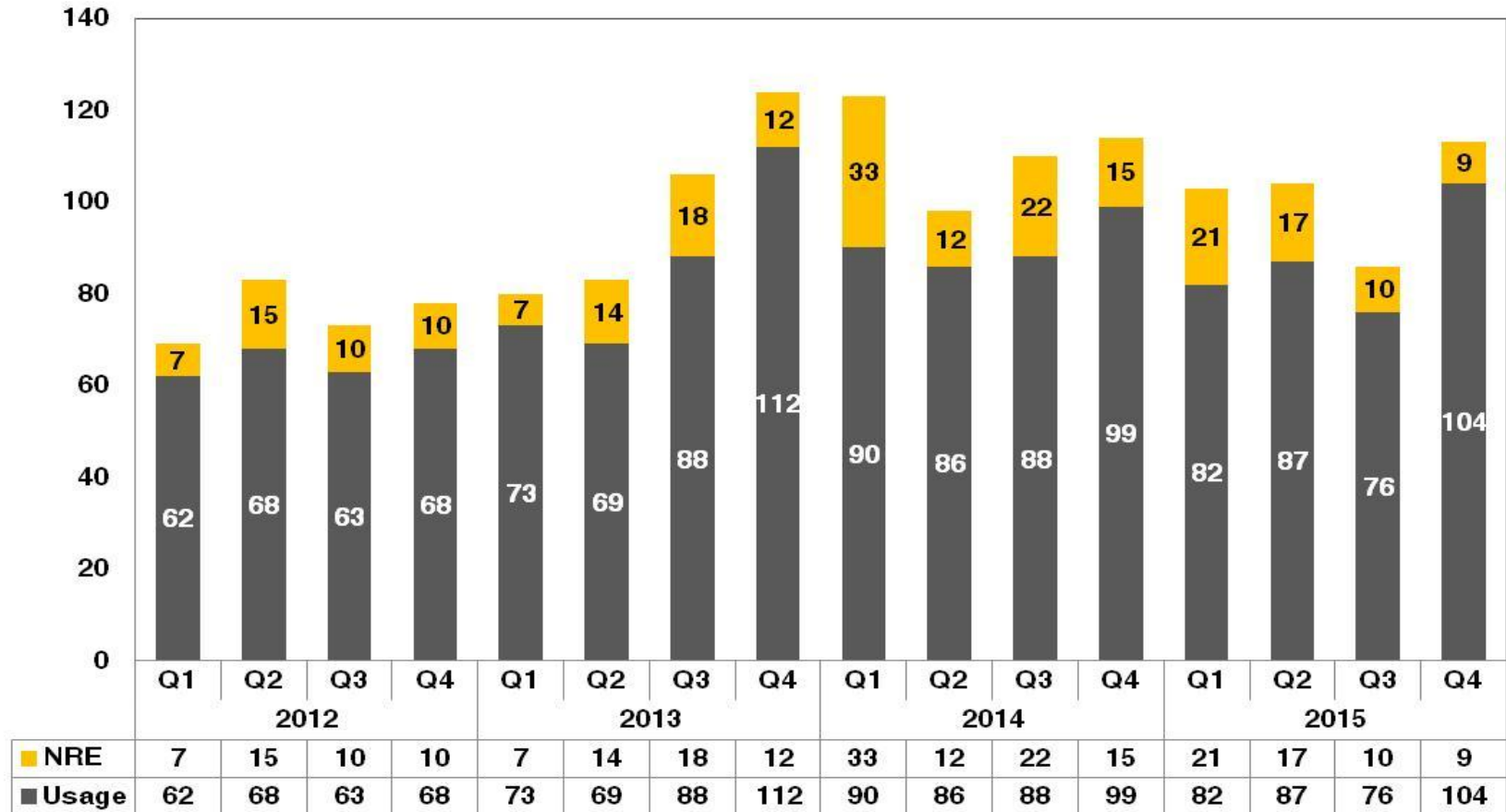
12" Fabs	Production	Development	NVM Type	Process Type
10nm	0	1	OTP	FF
14/16nm	0	3	OTP	FF+
28nm	5	9	OTP	LP/HPM, HLP/HPM, LPS
40nm	2	7	OTP, MTP	HV-DDI, LP
55/65nm	10	11	OTP, MTP, Flash	LP, HV-DDI, HV-OLED, DRAM, CIS
80/90nm	5	6	OTP, MTP	HV-DDI, HV-OLED, LP
0.13/0.11um	6	4	OTP, Flash	HV-DDI, BCD, Generic
0.18um	1	0	OTP	BCD

8" Fabs	Development	NVM Type	Process Type
0.13/0.11um	17	OTP, MTP, Flash	HV-DDI, BCD, LP, RF, CIS, LL
0.18/0.16/0.152um	42	OTP, MTP	Generic, LP, LL, MR, HV, Green, BCD
0.25um	0	OTP, MTP	BCD
0.35um	0	OTP	UHV

*As of Dec. 31, 2015

每季設計授權數(New Tape Out)

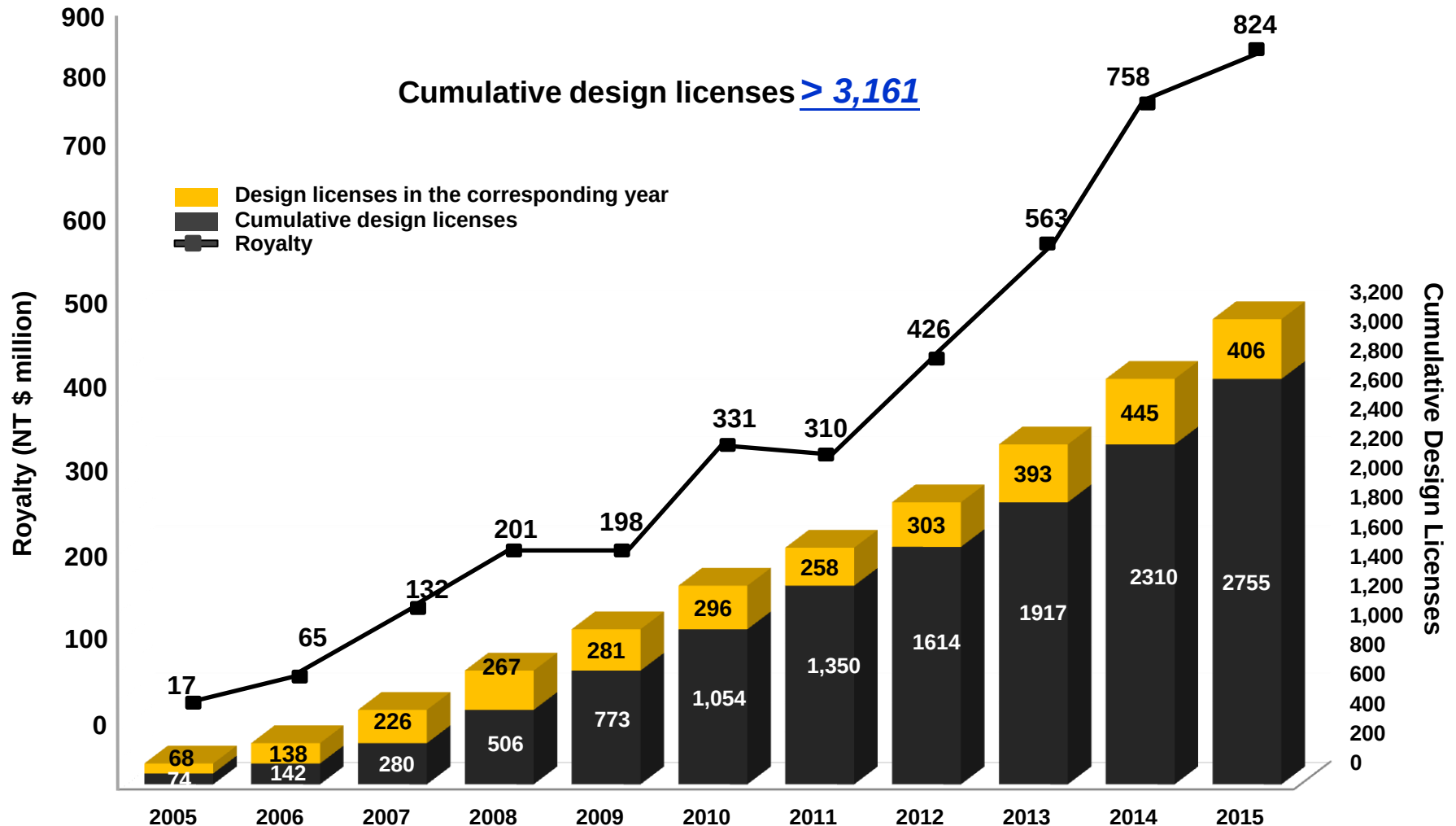
- Total **406** NTO in 2015 (**445**@2014 **393**@2013, **303**@2012, **258**@2011)



Usage : Usage of pre-qualified and verified IP (charged by per product tape out or annual package), the cycle time from design implementation to royalty payments for mass production is faster, typically less than one year.

NRE: NRE covers the customization of IP that must undergo new verification or qualification. It typically requires 1 to 1.5 years before resulting in royalty revenue.

權利金取決於過去累積的設計授權數目

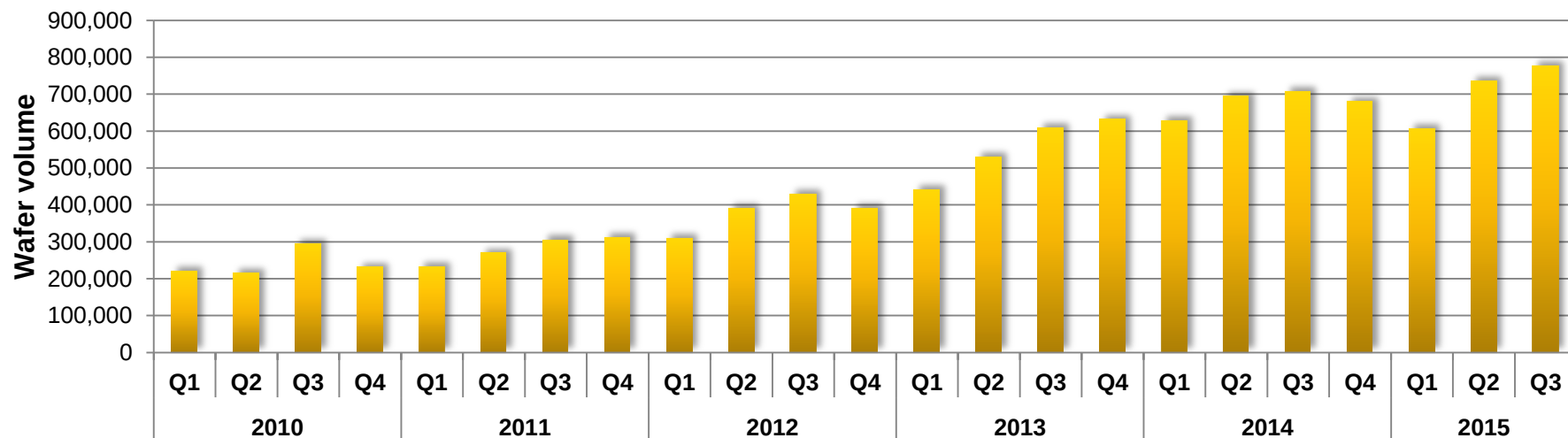


note 1: Due to the 2009 recession, royalty income was down annually 1.5%.

note 2: Pre-payment of royalty fees by a single customer contributed to 2010 annual growth of 67%, causing a drop of 6.3% in the following year, 2011.

note 3: CAGR for 2009-2013 was 30%.

每季量產晶圓片數



embedded eMemory IP in T Company (\$revenue); * % of Process node in T company total revenue in Q4 15

	Process node	*% of T	Q4 15	Q3 15	2015	2014
8"	0.25/0.35	4%	47.61%	38.2%	33.49%	30.5%
	0.15/0.18	11%	10.11%	7.9%	8.73%	11.9%
	0.11/0.13	3%	29.24%	30.9%	29%	20.8%
12"	90nm	7%	20.20%	21.8%	19.85%	16.3%
	65nm	11%	0.61%	0.9%	0.55%	0%
	40/45nm	14%	0%	0%	0%	0%
	28nm	25%	0.18%	0.02%	0.05%	0%
	16/20nm	24%	0%	0%	0%	0%
8"		19%	21.64%	16.3%	16.64%	15.6%
12"		81%	1.88%	2.3%	1.87%	1.4%
Total		100%	5.42%	5.0%	4.76%	4.5%

大綱

- 公司營運模式
- 營運回顧
- 成長機會與未來展望
- 問題與回答

力旺之NVM技術

- **Logic NVM portfolio offers one-stop-shop solution.**
 - › Compatible to any process
 - › Robust structure
 - › Low process cost
 - › Competitive macro sizes
 - › Easy integration
 - › Easy porting

eMemory's NVM Technology	OTP			MTP	
	NeoBit	NeoFuse	NeoFlash	NeoEE	NeoMTP
Product Type	OTP	OTP	Flash	EEPROM	MTP
Endurance (Cycles)	10	10	1K~10K	10K~100K	1K~10K
Additional Mask Steps	0	0	2-3	0	0
Technology	Floating gate	Anti-Fuse	SONOS	Floating gate	Floating gate
Scalability	Simple	Simple	Simple	Simple	Simple
Memory Density	HD < 512Kb GHD < 16Mb	< 4Mb	< 2Mb	< 4Kb	< 512Kb

力旺IP的應用

12"

8"

16/20nm

28nm

40nm

55/65nm

80/90nm

110/130nm

160/180nm

250nm

350nm

NeoBit

NeoFuse

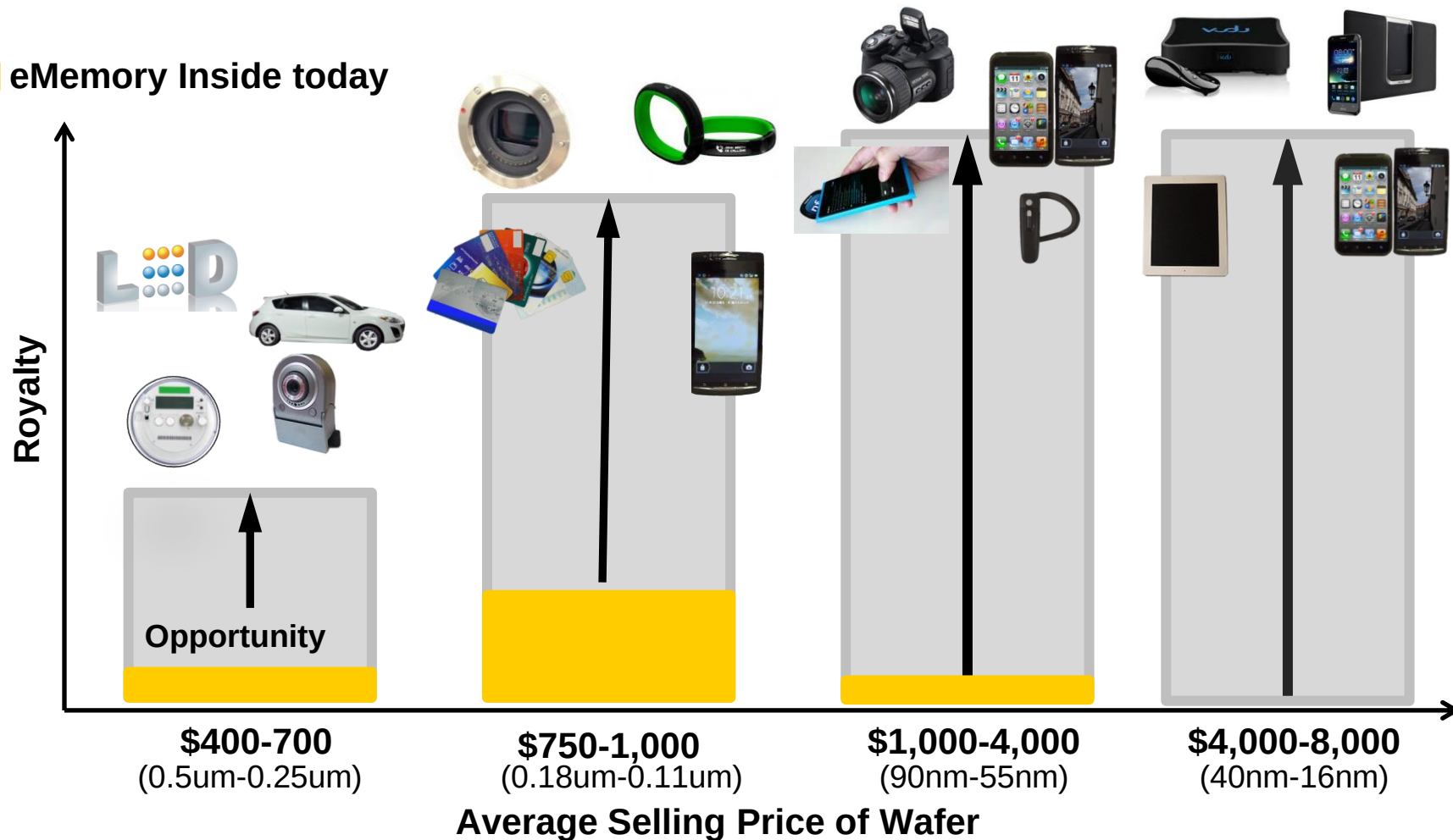
NeoFlash

NeoEE

NeoMTP

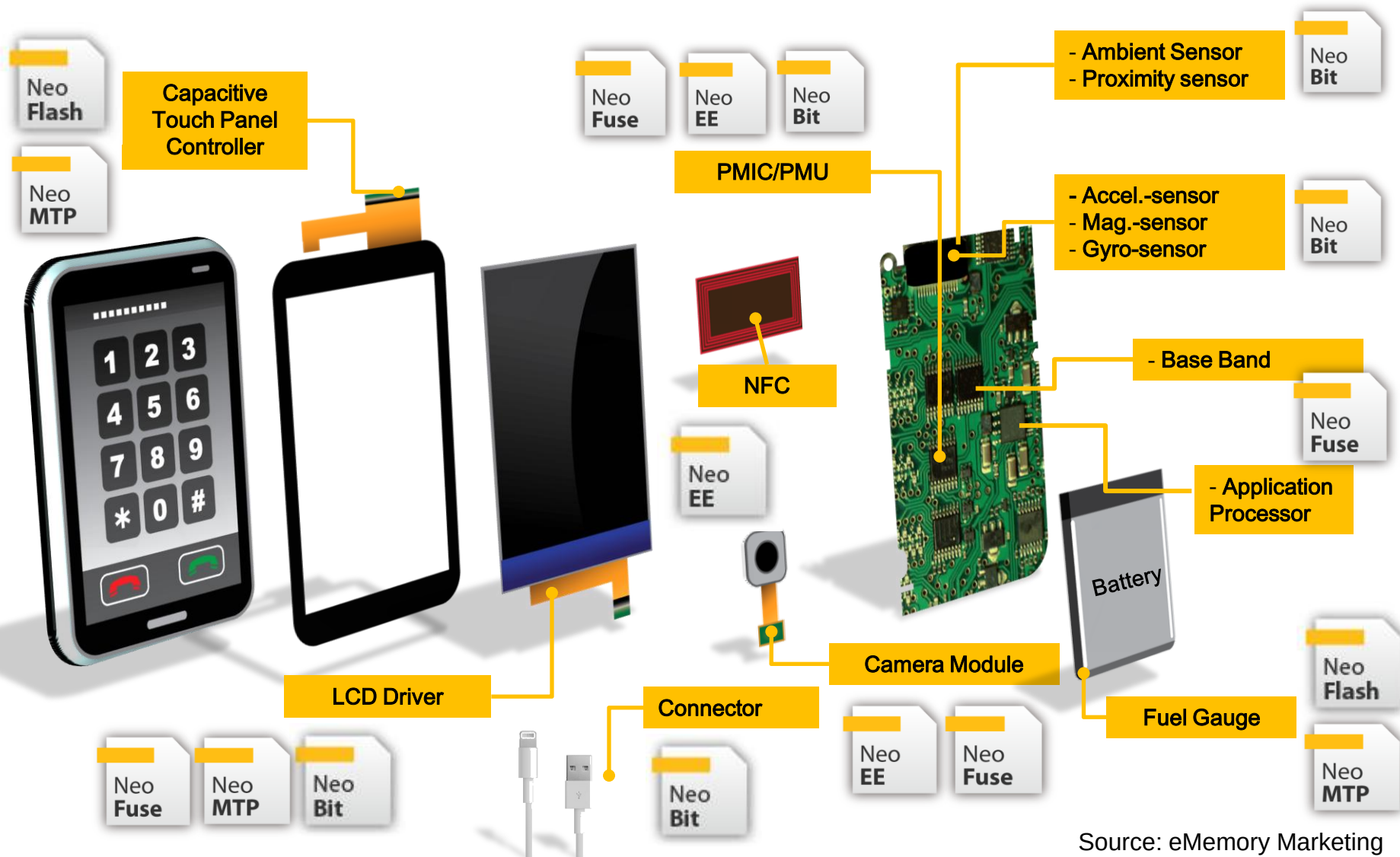
商機與潛力

 eMemory Inside today



Note: 2.2 million 8" equivalent wafers with eMemory IP were shipped in 2013. (~5% of WW foundry shipment)

智慧型手機中力旺 IP 的應用



Source: eMemory Marketing

Benefits from Using eMemory IPs

Design-in for

1. Trimming
2. Parameter Setting
3. Code Storage
4. Identification Setting
5. Encryption
6. Function Selection

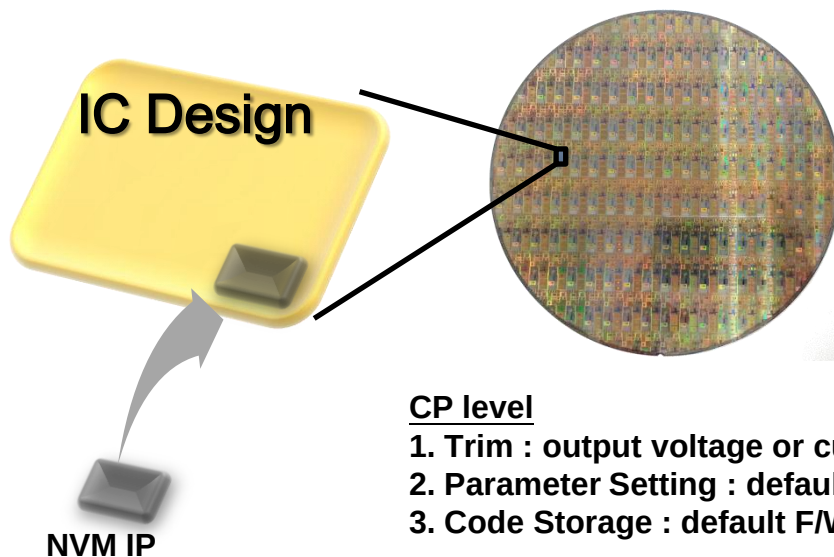
Package/FT level

1. Trim : SPEC shift
2. Parameter Setting : cross chip optimization
3. Identification Setting : manufacturer resume
4. Function Selection : setting for target market

CP Test

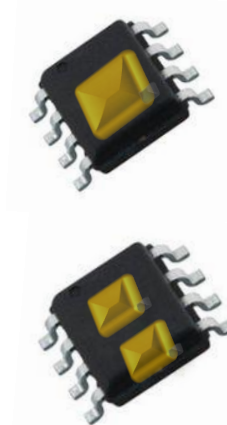
Package/FT

System Assembling



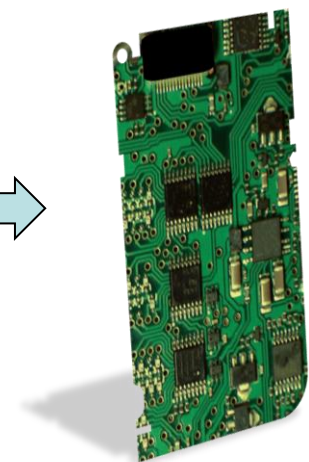
CP level

1. Trim : output voltage or current
2. Parameter Setting : default value
3. Code Storage : default F/W code



System Assembling

1. Parameter Setting : cross chip optimization
2. Code Storage : F/W code modification
3. Identification Setting : manufacturer resume
4. Encryption : Security algorithm or key storage



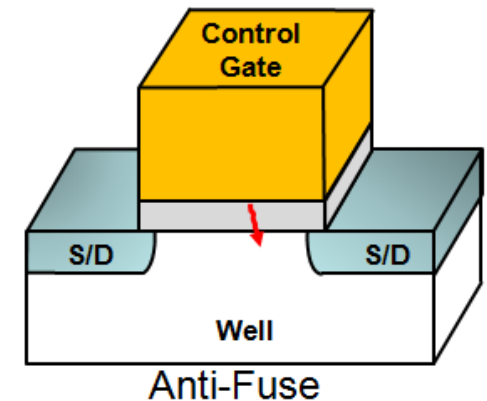
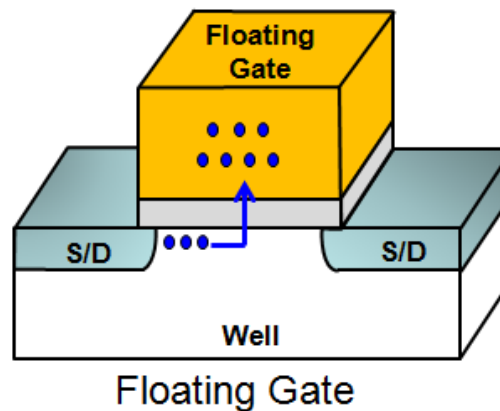
高機密性的安全設定

- Provide “Invisible Hardware Key” for invisible storage
- Prevent reverse-engineering to detect content of security key
- Protect firmware and hardware of ICs from pirating
- Extend & protect customer’s business

eFuse Key: Data is easily observed



Invisible Hardware Key : Data is hard to be detected



硬體設計防護

Authorized Product



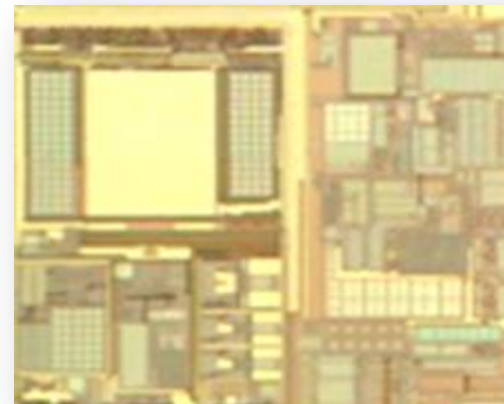
reverse
copy

re-produce



without protection

Fake Product

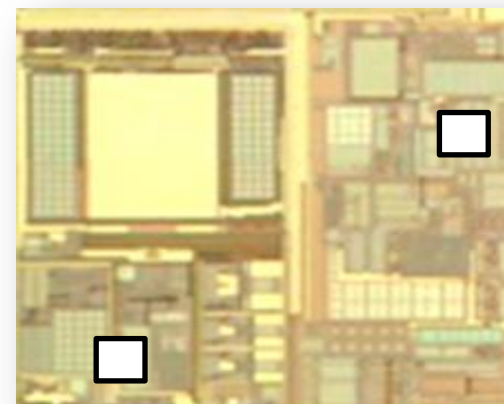


reverse
copy

re-produce



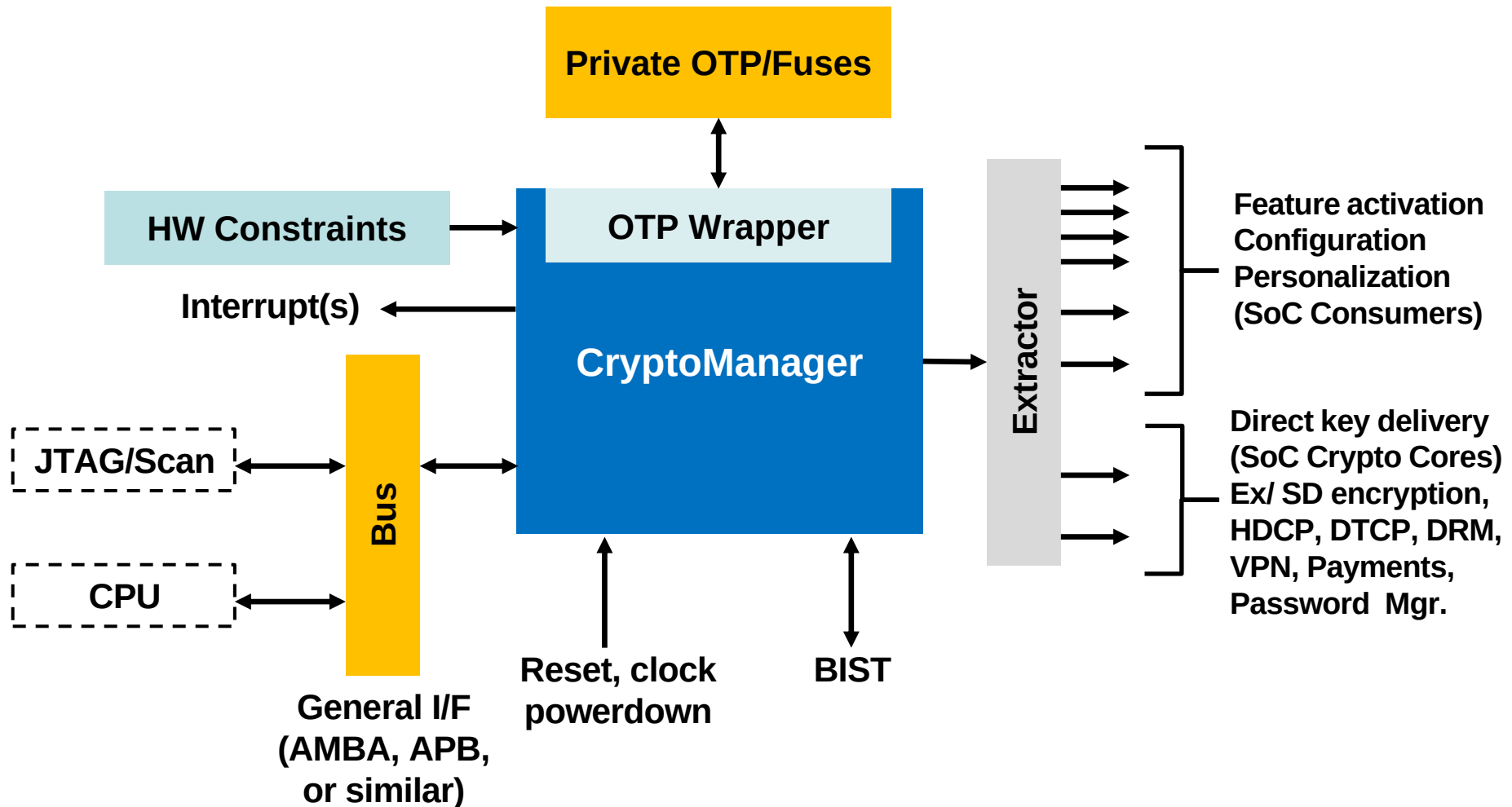
with protection



Security IP/Code by
Authorized Use

Can NOT Work w/o
Security IP/Code

OTP for security storage

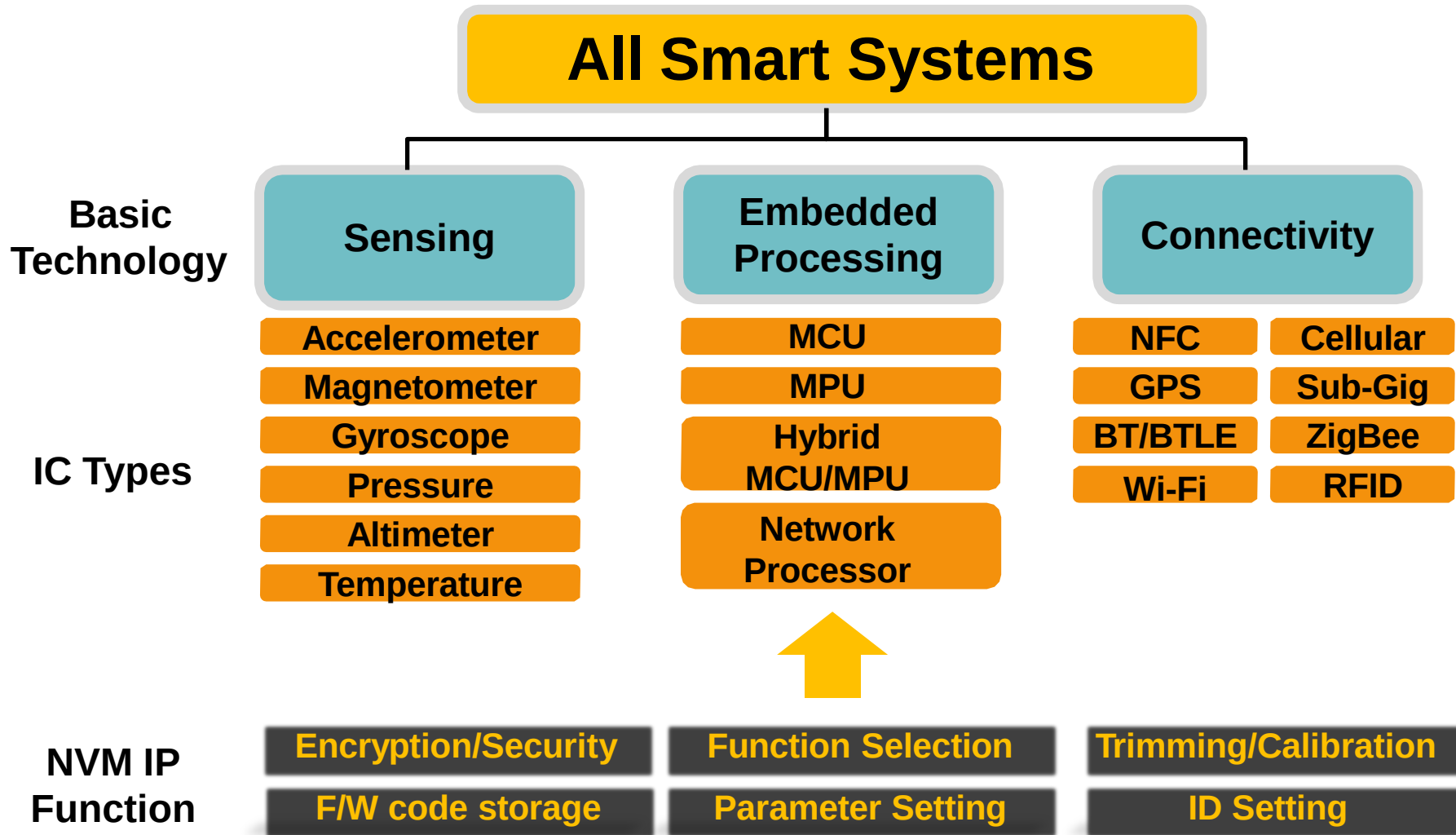


Source : Rambus crypto manager platform

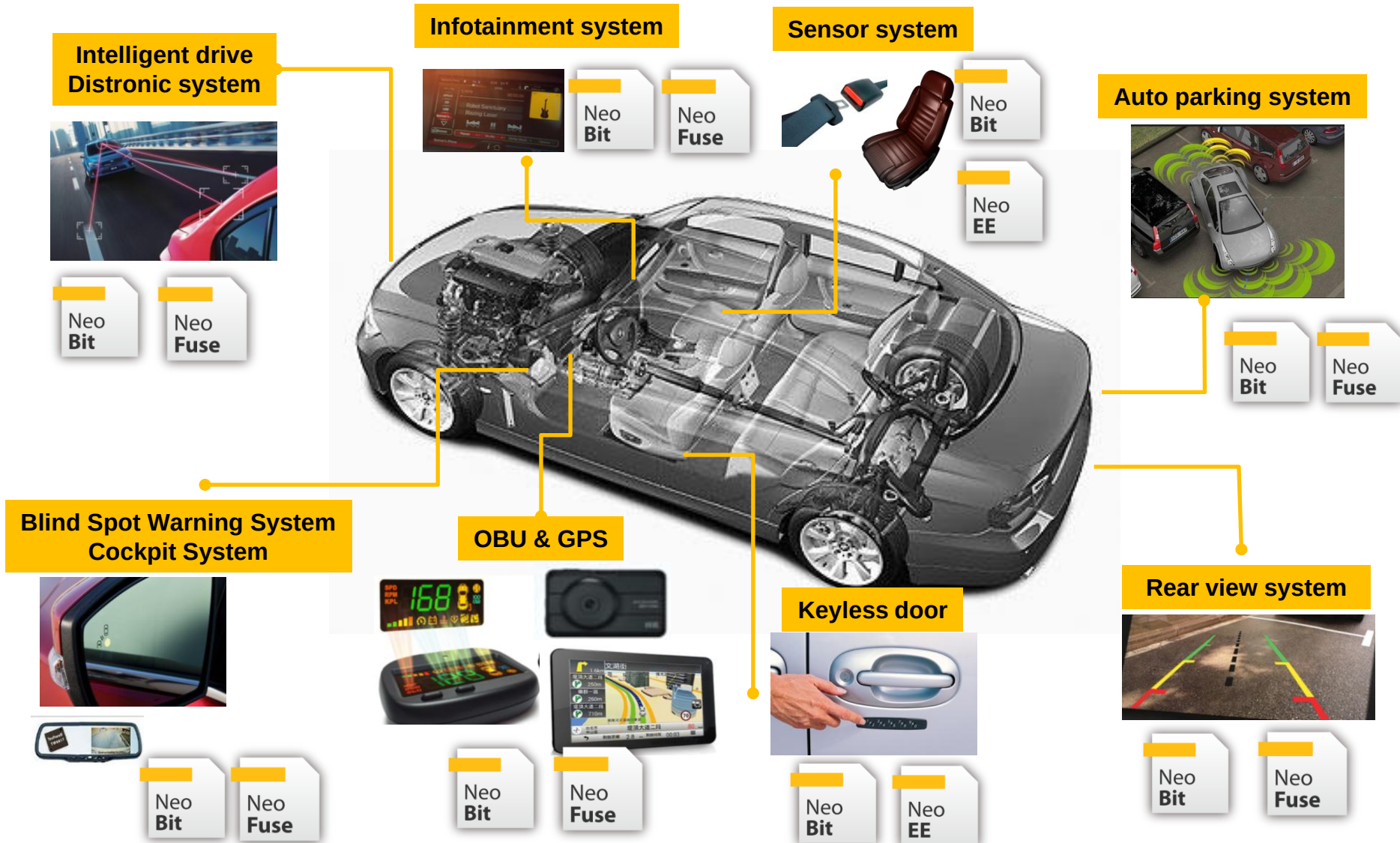
力旺矽智財引領高安全性應用



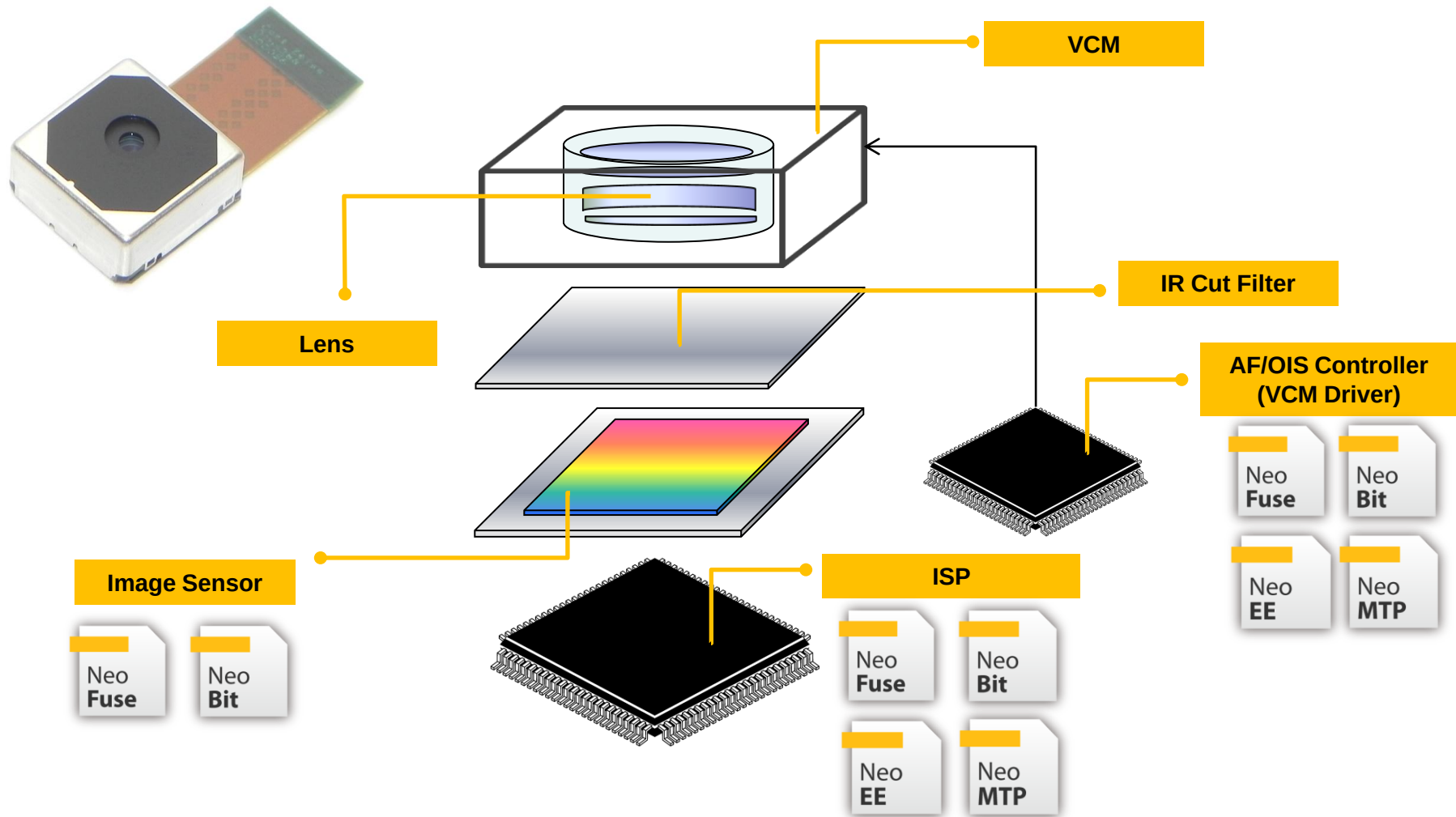
在IoT中之NVM IP 需求



Autotronics with eMemory IPs



Imager Module with eMemory IPs



先進液晶顯示驅動晶片

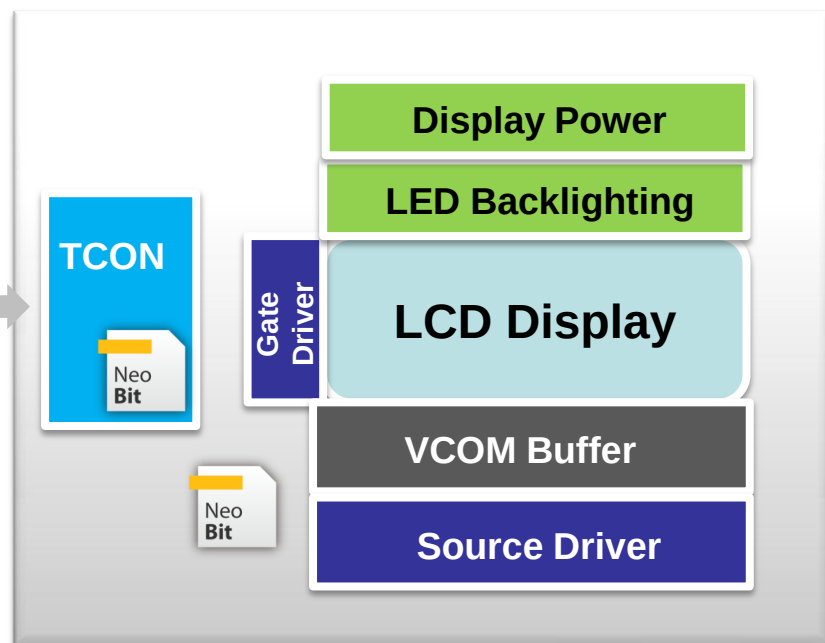
Process Technology : 0.11um HV/80nm HV/55nm HV



I/F
(LVDS, MIPI,...)



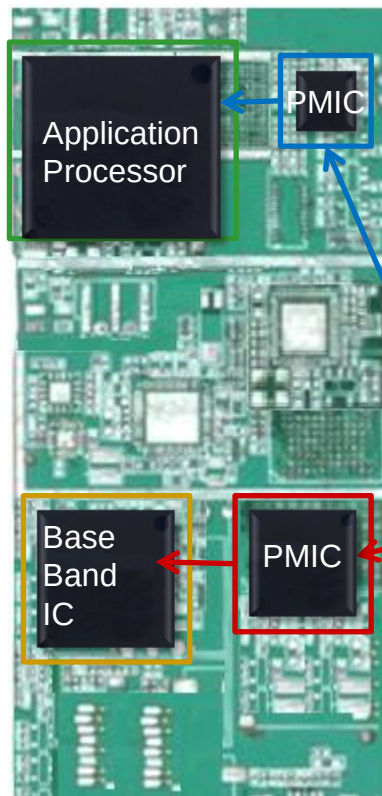
DDI



Density	Endurance	NVM Type	Purpose	NVM Usage
2K8~4K8	1	OTP	Trimming	1. Accuracy enhancement 2. Mismatch cancellation
			Code Storage	1. Gamma Correction Table 2. Timing Control Pattern 3. Color Engine Enhancement

應用於Baseband與Application Processor的電源管理晶片

Process Technology : Advanced 0.25um BCD/ 0.18um BCD/ 0.13um BCD
Mature 0.18um/0.16um/0.152um Logic

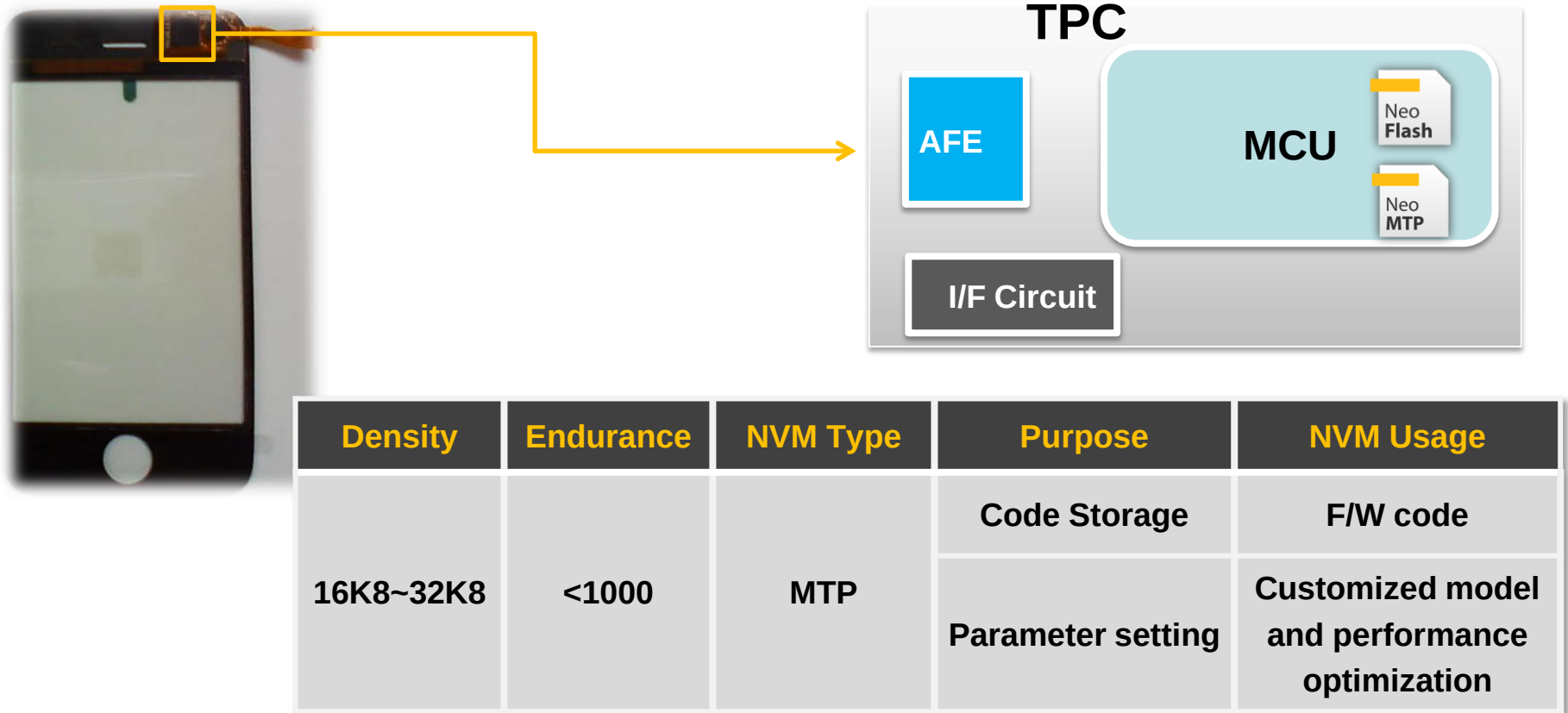


Density	NVM Type	Purpose	NVM Usage
2Kb~4Kb	OTP	Trimming	DC/DC, Bandgap
		Parameter Setting	Design flexibility & Performance optimization
		Code Storage	Start-up behavior & smart power saving algorithm



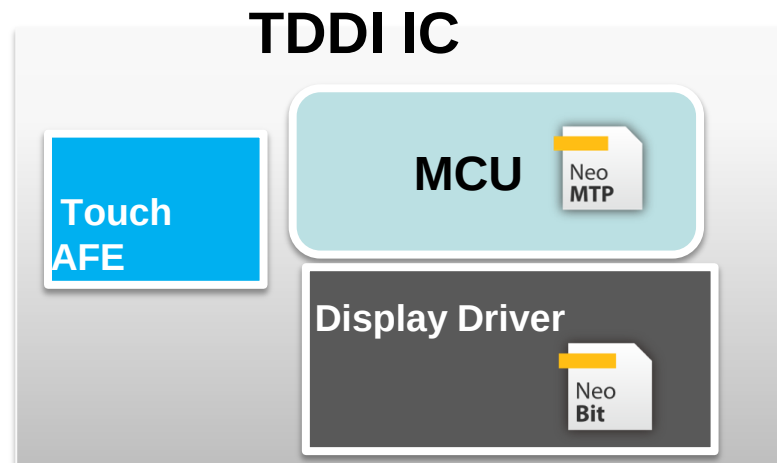
觸控面板控制器晶片

Process Technology : 0.16um HV/0.11um G



內嵌式觸控面板控制器晶片

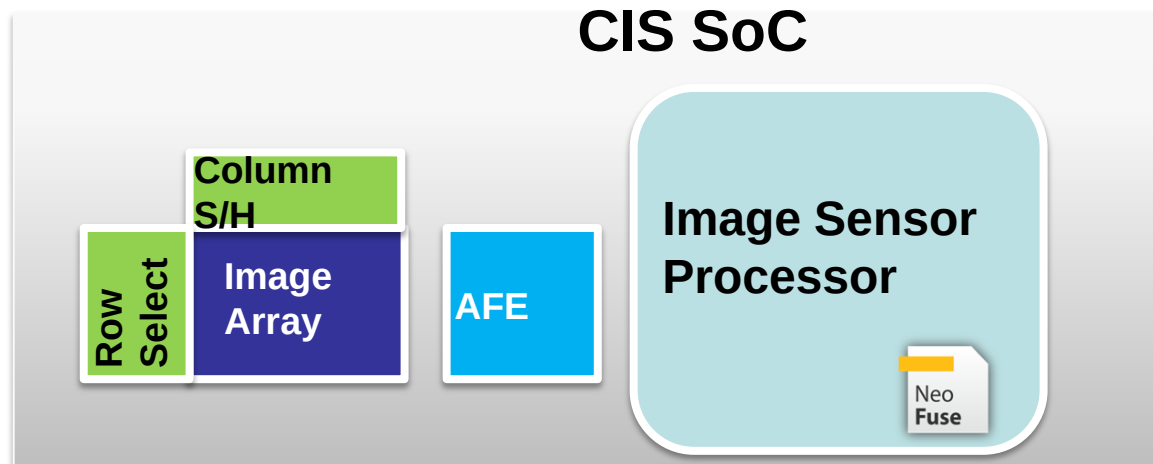
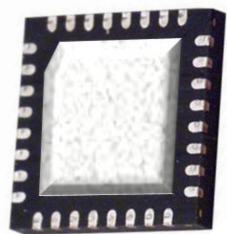
Process Technology : 0.11um HV/80nm HV/55nm HV



Density	Endurance	NVM Type	Purpose	NVM Usage
2K8~4K8	1	OTP	Trimming	Accuracy
			Code Storage	Gamma Table
16K8~32K8	<1000	MTP	Code Storage	Touch F/W Code
			Parameter setting	Performance Optimization

CMOS 影像感測器

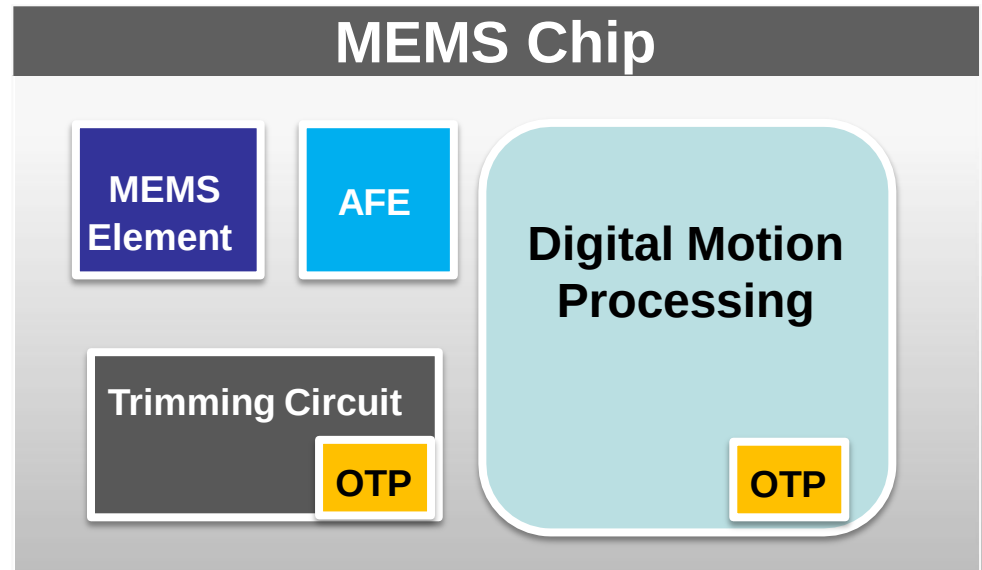
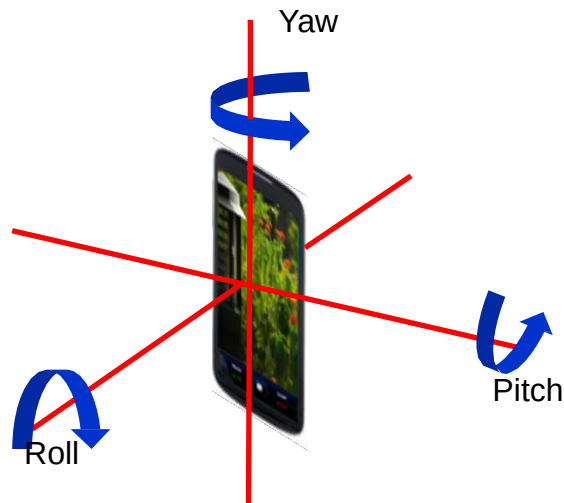
Process Technology : 0.11um CIS/90nm CIS/65nm CIS



Density	Endurance	NVM Type	Purpose	NVM Usage
2Kb~4Kb	1	OTP	Identification Setting	Product Code
			Parameter Setting	Start-up Initial Setting
32K8	1	OTP/ROM	Code Storage	Boot Load

微機電系統(MEMS)

180/160/15x nm HV/Logic for MEMS Controller

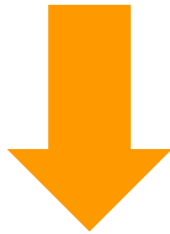


Density	NVM Type	Purpose	NVM Usage
2Kb~4Kb	OTP	Trimming	Factory trimming
		Parameter Setting	Signal filtering
		Code Storage	Geometric computation

取代嵌入式快閃記憶體之競爭優勢

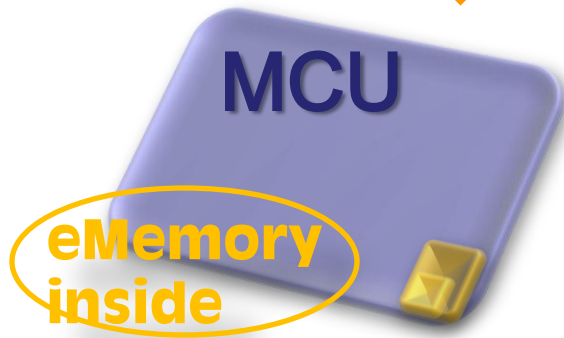


product design & manufacturing by
embedded Flash
Logic Process + 10 Masks



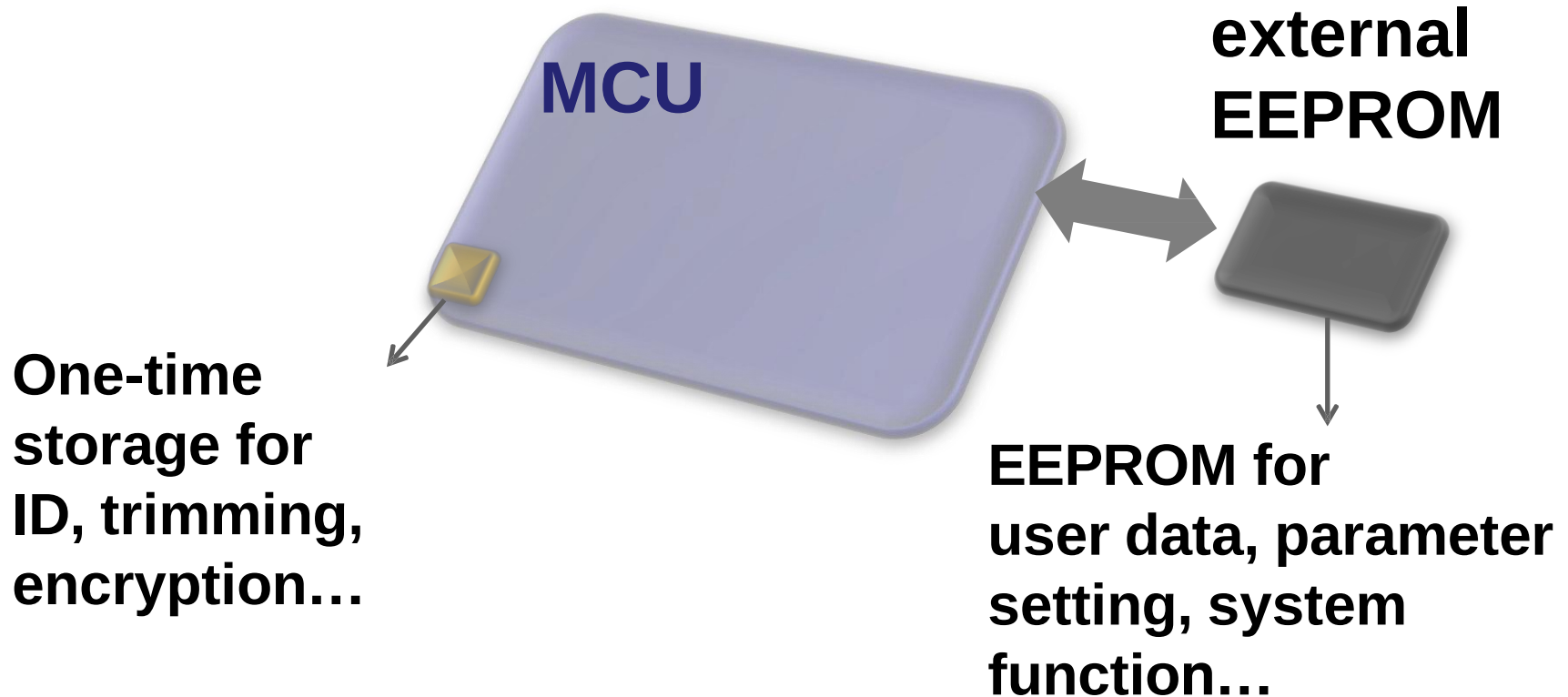
***30% more
cost reduction***

***wafer cost &
testing time***



product design & manufacturing by
Embedded Logic NVM (OTP/MTP)
Logic Process

EEPROM應用於MCU



NeoBit + NeoEE

Hybrid NVM solution (NeoBit + NeoEE) with customized SPEC & optimized size



- **One single IP by integration of NeoBit & NeoEE**
- **Help for system size reduction**

IC種類之晶圓需求

IC Type	Equa to 8-inch wafer (K)
AP	5740
PMU	5255
Base Band controller	2945
Smart card controller	2683
Fingerprint	2500
CIS sensor	2215
LCD driver (int with TCON)	1955
Gauge IC	708
TV controller	619
Touch panel controller (C)	602
Connectivity	463
STB controller	348
DC-DC/AC-DC	239
Wifi controller	231
Accelator sensor controller	166
LED driver	140
Light snesor	126
Gyroscope sensor controller	120
BT controller	107
TAG IC	104
MCU (8bits, LV/3.3V)	90
MCU (8bits, pure 5V)	88
ISP	82
DVD controller	67
P-Gamma	47
NB CAM controller	38
Pressure sensor controller	23
Touch pad controller	16
PC CAM controller	14
Touch panel controller (R)	3
TCON (w/o driver)	3
Speech controller	0

2015 Q3 updated

未來展望

- 在先進製程上開展順利，幾個授權進入最後協商，對於授權費的成長仍是相當樂觀。
- **PMIC的應用持續擴大導入wireless charger、fast charger相關電源管理應用。**
- **高階DDI量產持續，近兩年累計tape out數已超過50個，客戶也規劃相關晶片往更先進製程發展。**
- **28nm Set-top Box處理器客戶已順利量產，客戶持續tape-out。其他廠商也在2016 Q1 即將tape-out新產品。**

未來展望

- **Fingerprint及CIS客戶已開始小量生產。**
- **16nm FF+已進入可靠性測試，預計2016三月底完成。**
- **16nm FFC驗證成功，2016 Q1會進行可靠性測試。**
- **10nmFF預計三月底tape-out，已有客戶。**
- **車用電子之部分，持續擴大應用領域從PMIC到LCD Driver。**

成長驅動力

Growth in application per mobile devices

- More chip applications per smartphone/tablet product.

Growth into more markets

- From consumer electronics and mobile devices to wearable devices.
- Adding new NVM product lines further enable more product applications.

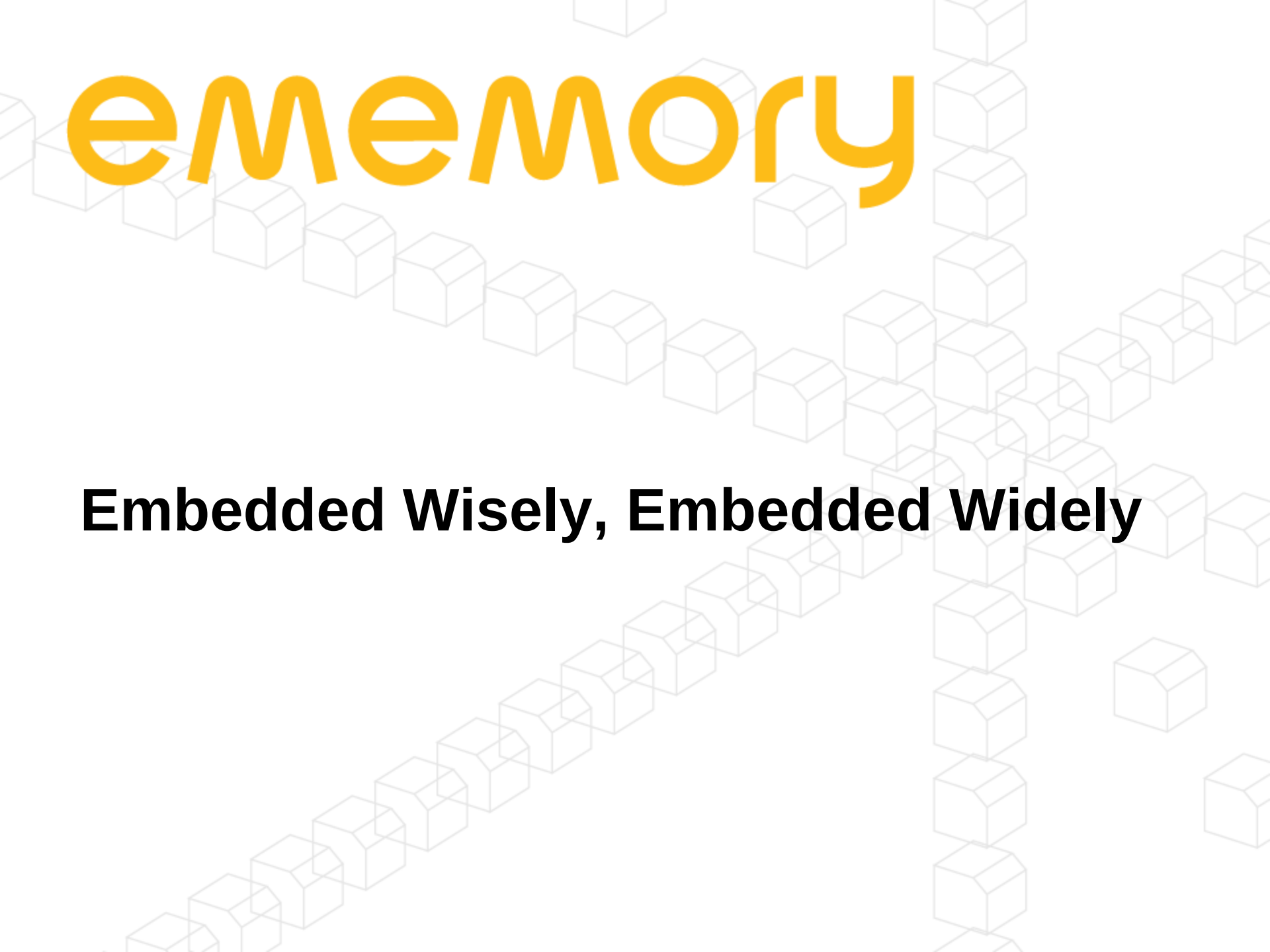
Growth in advanced technology

- Higher royalty per wafer is contributed from more advanced technology nodes.

Great IoT era

- Embedded Logic NVM will be a must.

Q & A



ememory

Embedded Wisely, Embedded Widely