

ememory

**A Leading Logic NVM
Company**

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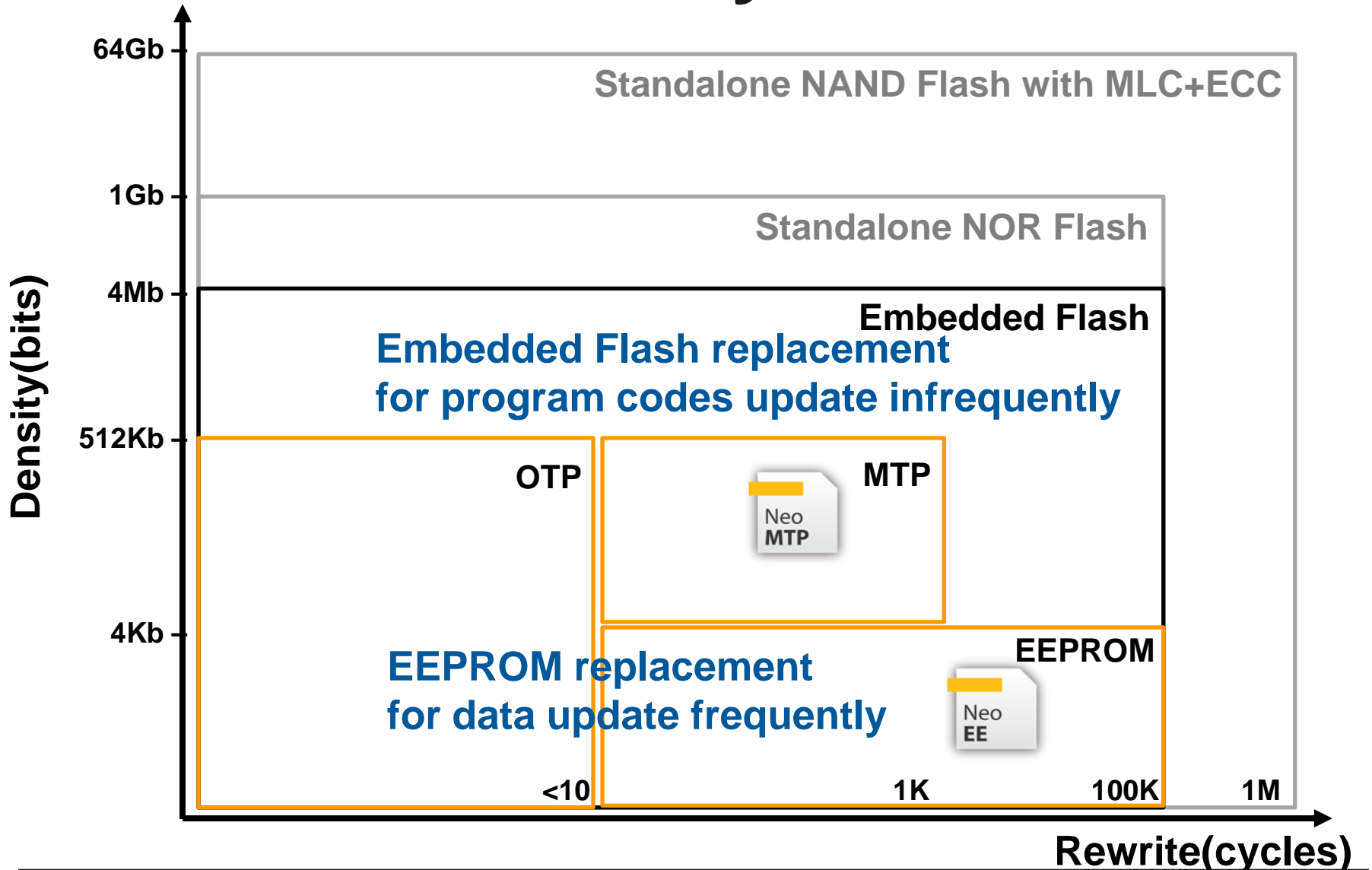
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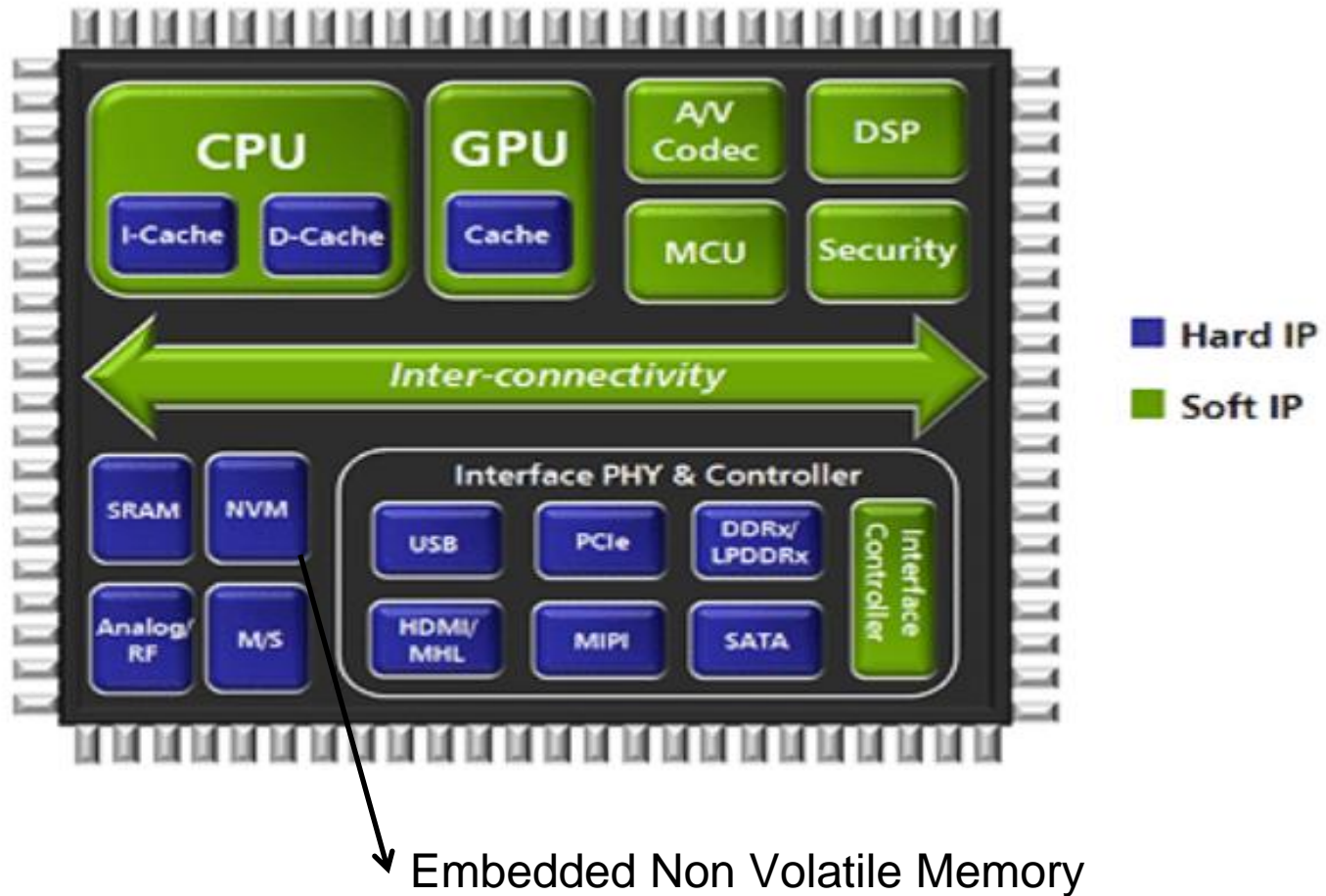
Outline

- **Business Model**
- **Review of Operations**
- **Growth Opportunity and Future Outlook**
- **Q & A**

Nonvolatile Memory Classifications



SOC Block Diagram



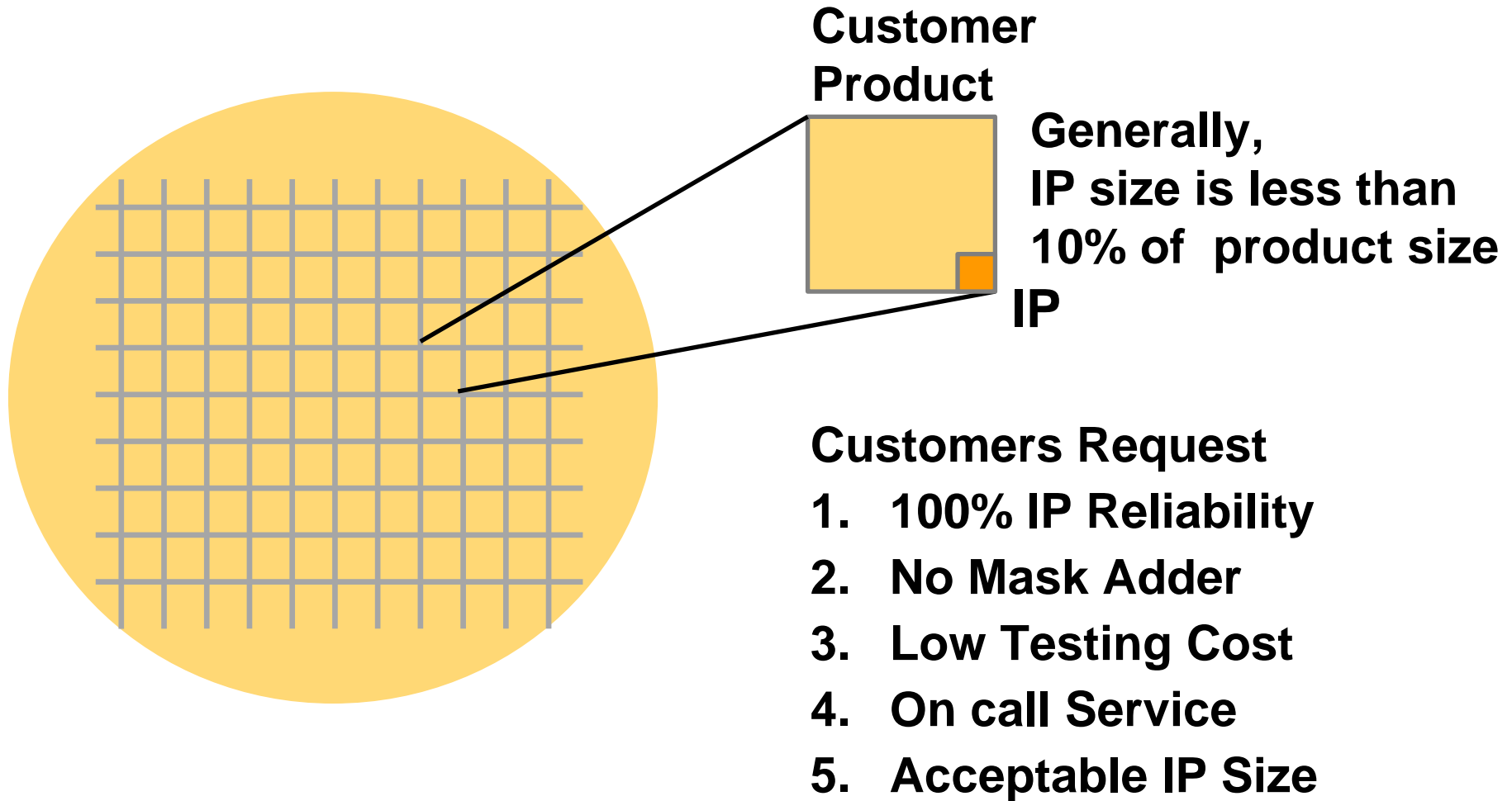
Source : tsmc

Embedded NVM Technologies

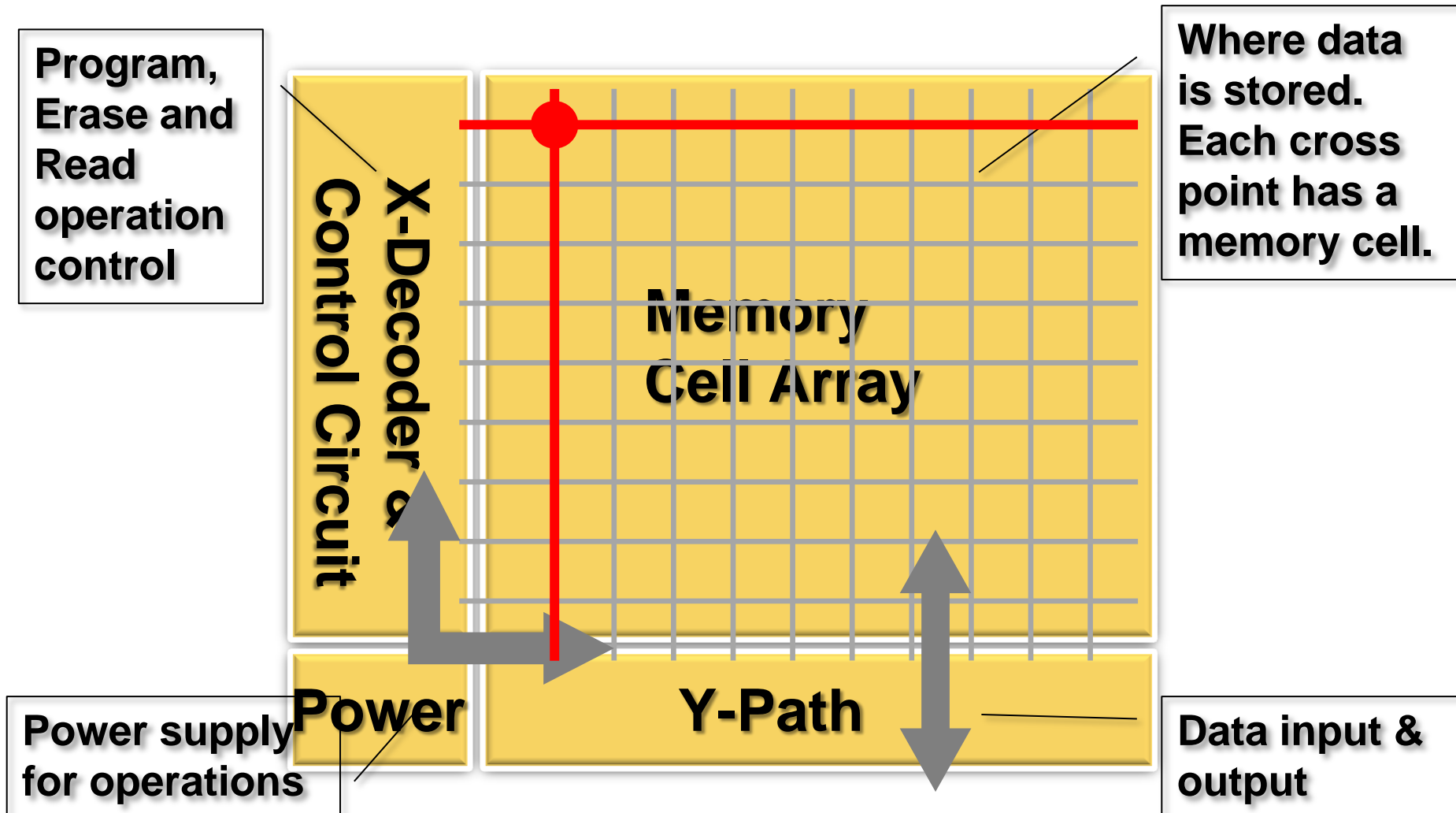
	ROM	eFuse (OTP)	Antifuse (OTP)	CMOS Floating Gate (OTP)	CMOS Floating Gate (MTP)	Embedded Flash
Cell Structure	Transistor	Poly Fuse	Antifuse	Floating Gate	Floating Gate	Floating Gate
Standard CMOS Compatible	Yes	Yes	Yes	Yes	Yes	No
Bitcell Area	< 1	50	1	2	4	1
Endurance	No	No	< 10	< 10	10K-100K	100-1000K
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

- ROM not programmable, eFuse cannot scale beyond 16Kb, embedded flash expensive and cannot scale after 40 nm
- eMemory's IPs: OTP (antifuse, floating gate) and MTP (floating gate)

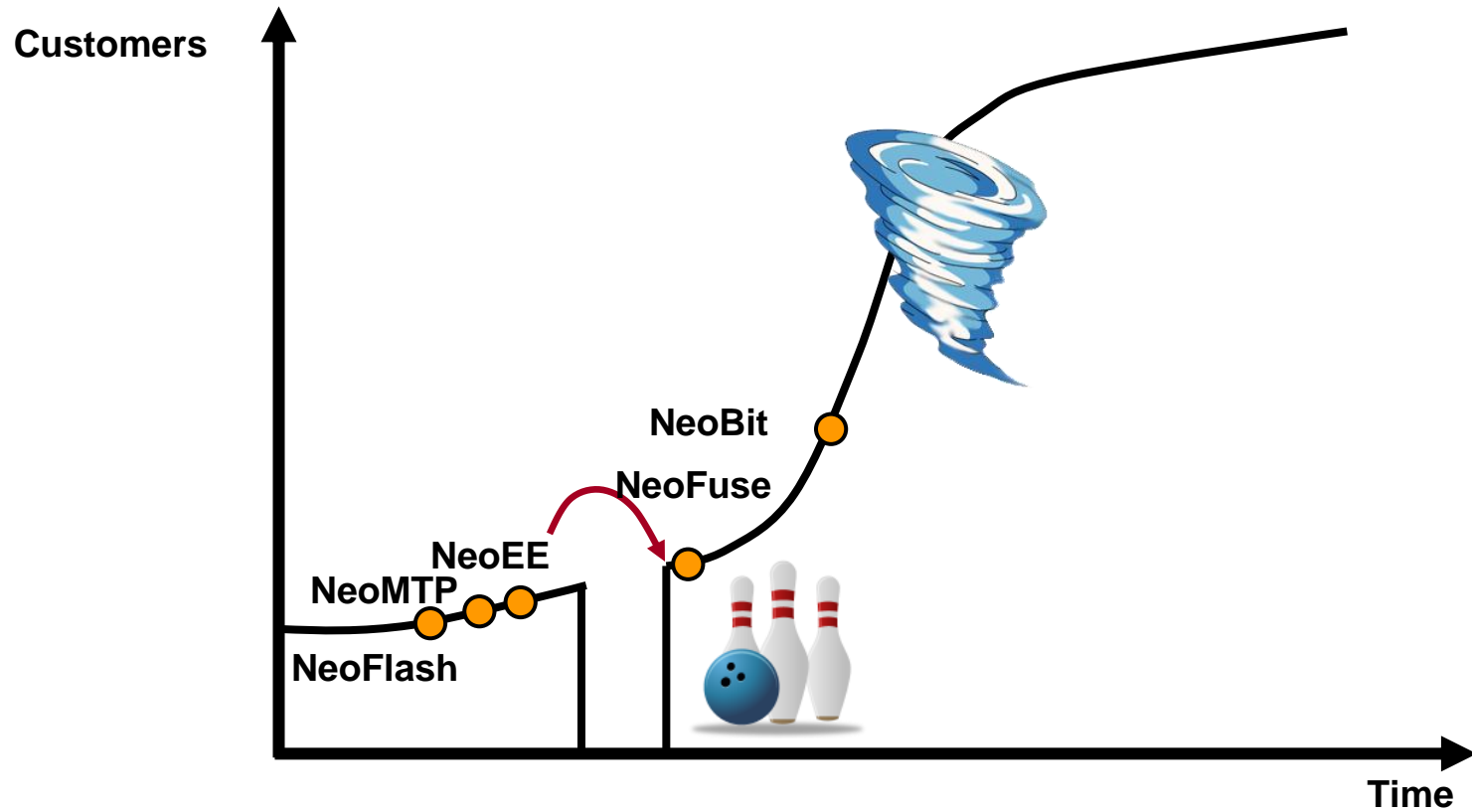
Considerations for IP Adoption



Inside Nonvolatile Memory IP

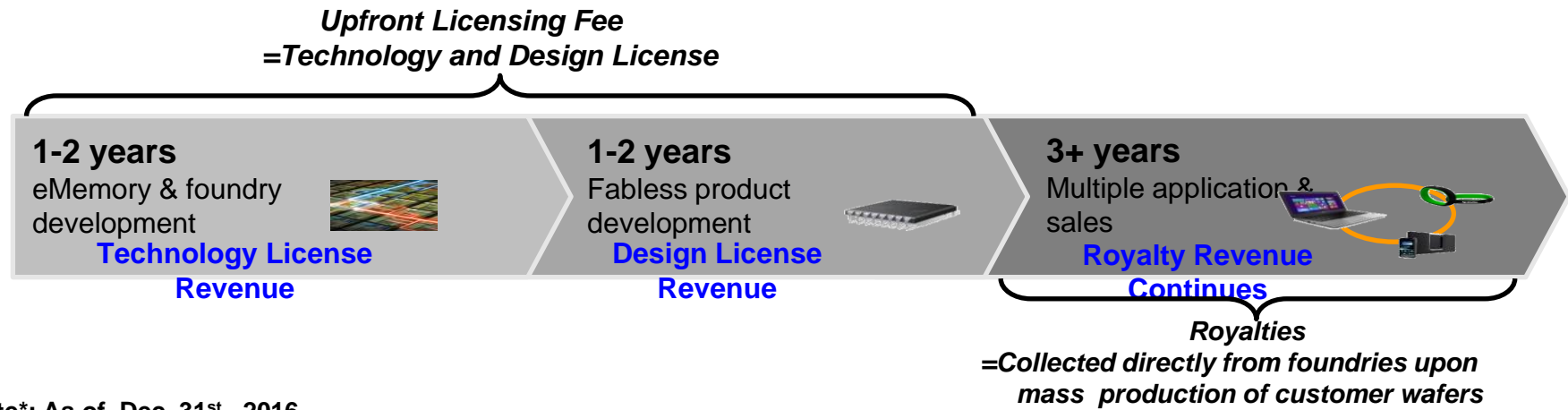


Crossing the Chasm



Business Model

- Founded in 2000. First customer engaged in 2002. Achieved profitability in 2005 and IPO in 2011. The largest logic non-volatile memory IP company, 232 employees (162 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. 31st, 2016

Worldwide Customers



Foundry



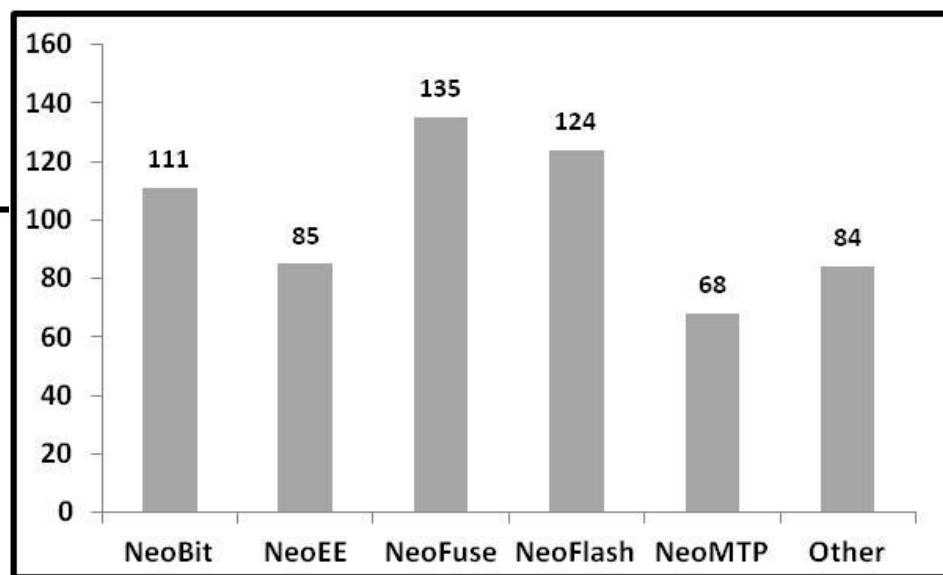
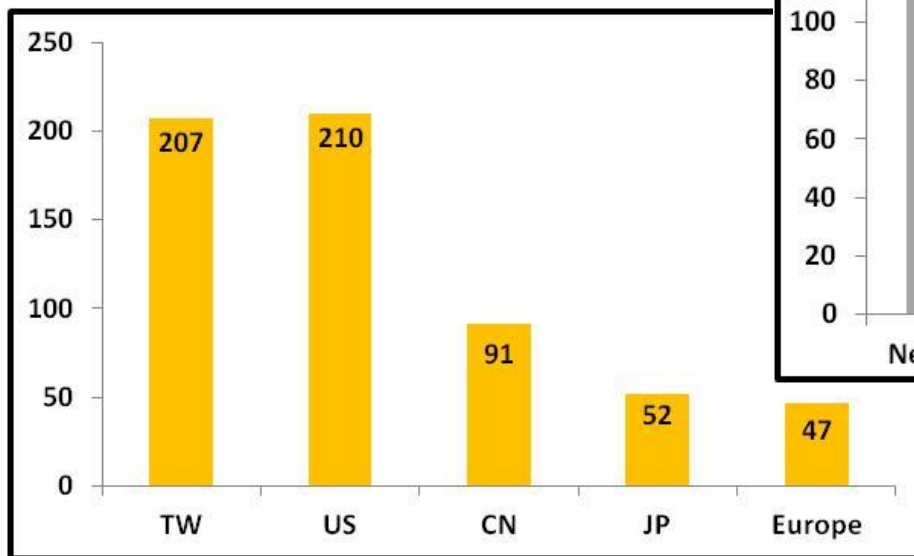
IDM



	Taiwan	China	Korea	Japan	North America	Europe	Others
Foundry	5	7	3	3	1	2	1
IDM	0	0	0	8	2	1	0
Fabless	264	496	66	51	226	111	50

Patent Portfolio

	Q3 16	Q4 16	Diff.
Pending	204	218	+ 14
Issued	371	389	+ 18
Total	575	607	+ 32

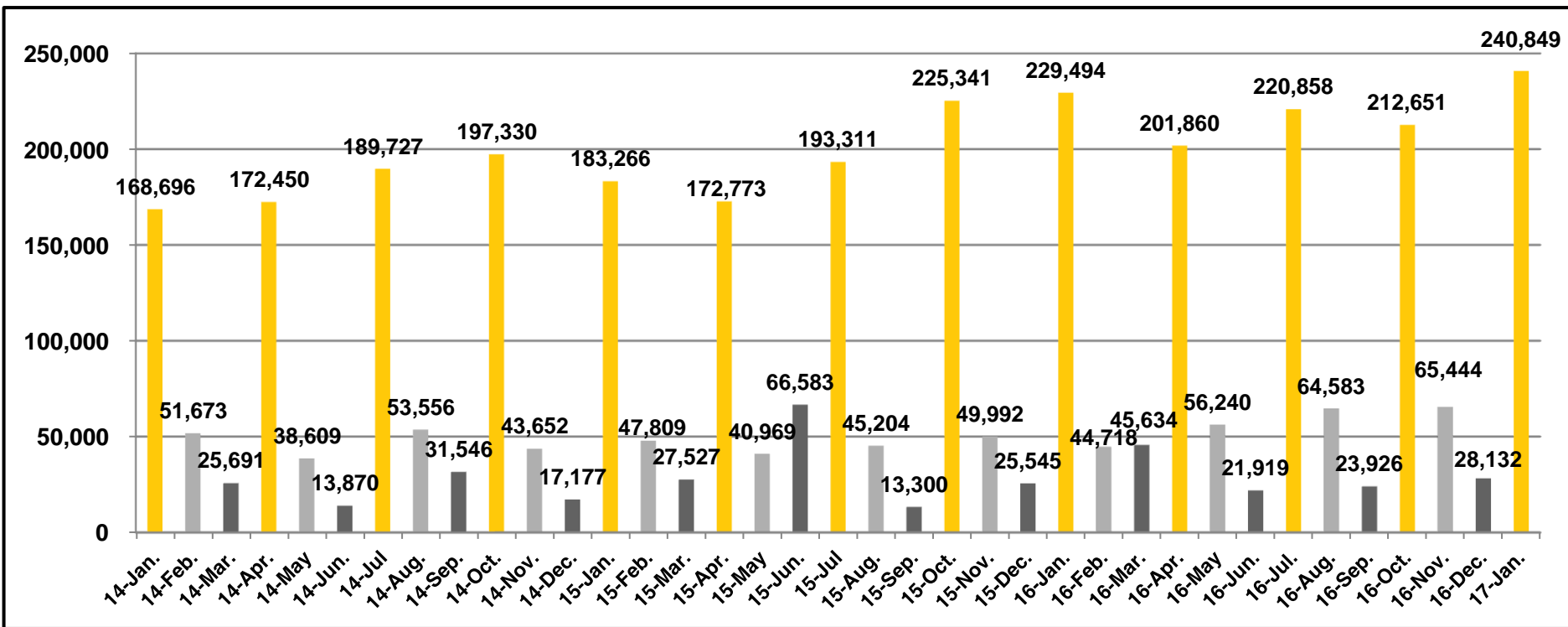


Note*: As of Dec. 31st, 2016

Quarterly Revenue Pattern

- The quarterly royalty from most of foundries are collected at first month of each quarter and from some other foundries are collected at second month, and none at third month.

Unit : NTD Thousands



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Q4 Revenue Breakdown

Unit: NTD thousands

	Q4 2016	Q3 2016	QoQ	Q4 2015	YoY	2016	2015	YoY
Licensing	79,684	86,712	-8.10%	69,307	14.97%	330,087	267,512	23.39%
Royalty	226,543	222,655	1.75%	231,571	-2.17%	885,372	824,108	7.43%
Total	306,227	309,367	-1.01%	300,878	1.78%	1,215,459	1,091,620	11.34%

Unit: Number of contracts

		Q4 2016	Q3 2016	2016	2015
Technology Licenses		10	6	43	28
Design Licenses	NRE	12	18	56	57
	Usage	73	81	311	349

Financial Income Statement

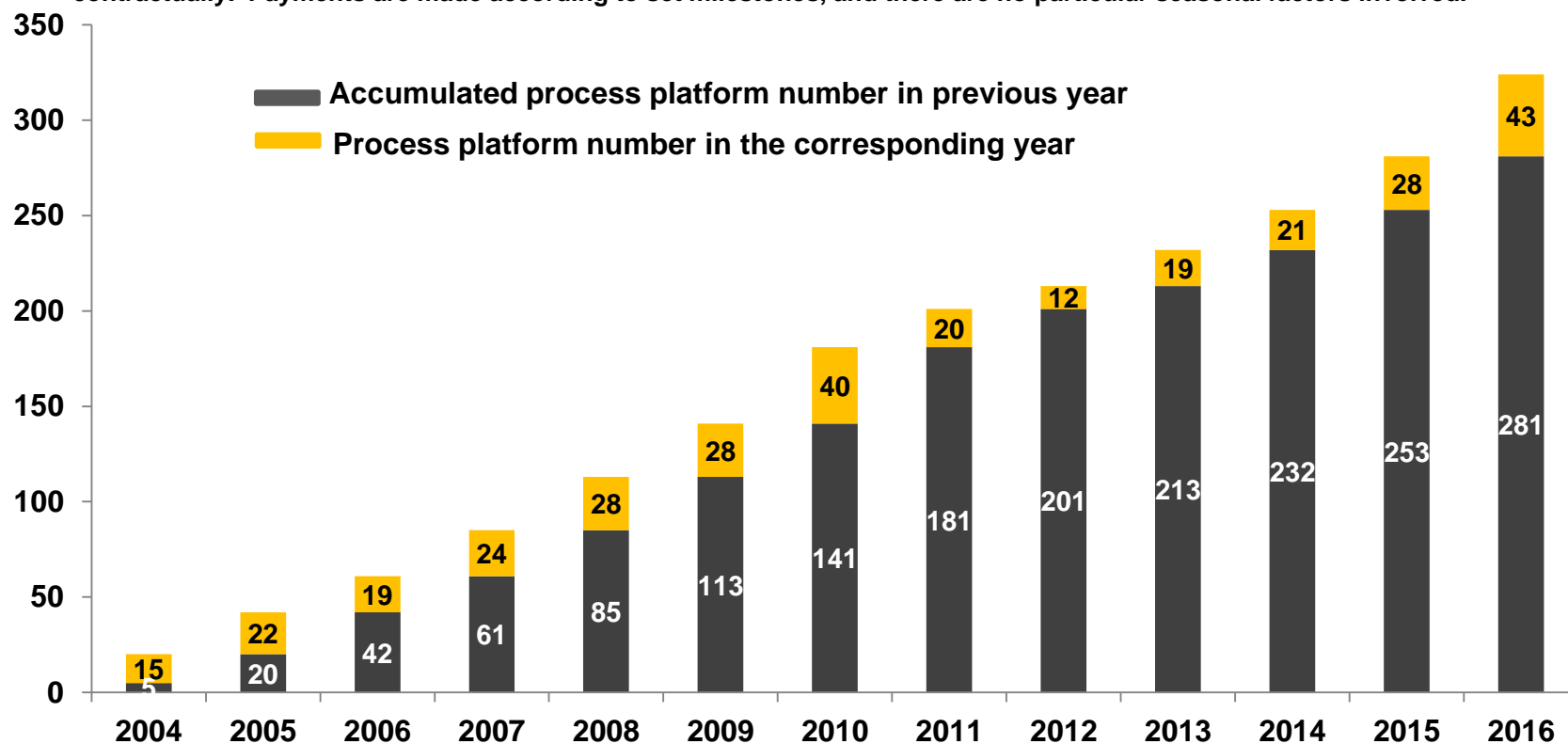
(Unit: NTD thousands)	Q4 2016	Q4 2015	% change	2016	2015	% change
Revenue	306,227	300,878	1.8%	1,215,459	1,091,620	11.3%
Gross Margin	100%	100%	-	100%	100%	-
Operating Expenses	171,681	156,216	9.9%	685,650	570,403	20.2%
Operating Margin	43.9%	48.1%	-4.2ppts	43.6%	47.7%	-4.1ppts
Net Income	132,361	128,090	3.3%	534,917	479,111	11.6%
Net Margin	43.2%	42.6%	+0.6ppts	44.0%	43.9%	+0.1ppts
EPS (Unit: NTD)	1.75	1.69	3.6%	7.06	6.32	11.7%
ROE	28.3%	28.4%	-0.1ppts	28.6%	26.6%	+2.0ppts

Technology License

Unit: Number of contract

Year	2013	2014	2015	2016
License number	19	21	28	43

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.



Current Technology Development Platforms

- Total (As of Dec.) : **104**
- **19** for NeoBit, **43** for NeoFuse, **22** for NeoEE, and **20** for NeoMTP.

	7/10nm	14/16nm	28nm	40nm	55/65nm	80/90nm	0.11~ 0.13um	0.15~ 0.18um	>0.25 um
NeoBit	-	-	-	-	-	-	6	13	
NeoFuse	2	3	8	6	10	5	6	3	-
NeoFlash	-	-	-	-	-	-	-	-	-
NeoEE	-	-	-	-	-	-	5	17	-
NeoMTP	-	-	-	-	1	2	5	12	-

Current Technology Development Platforms

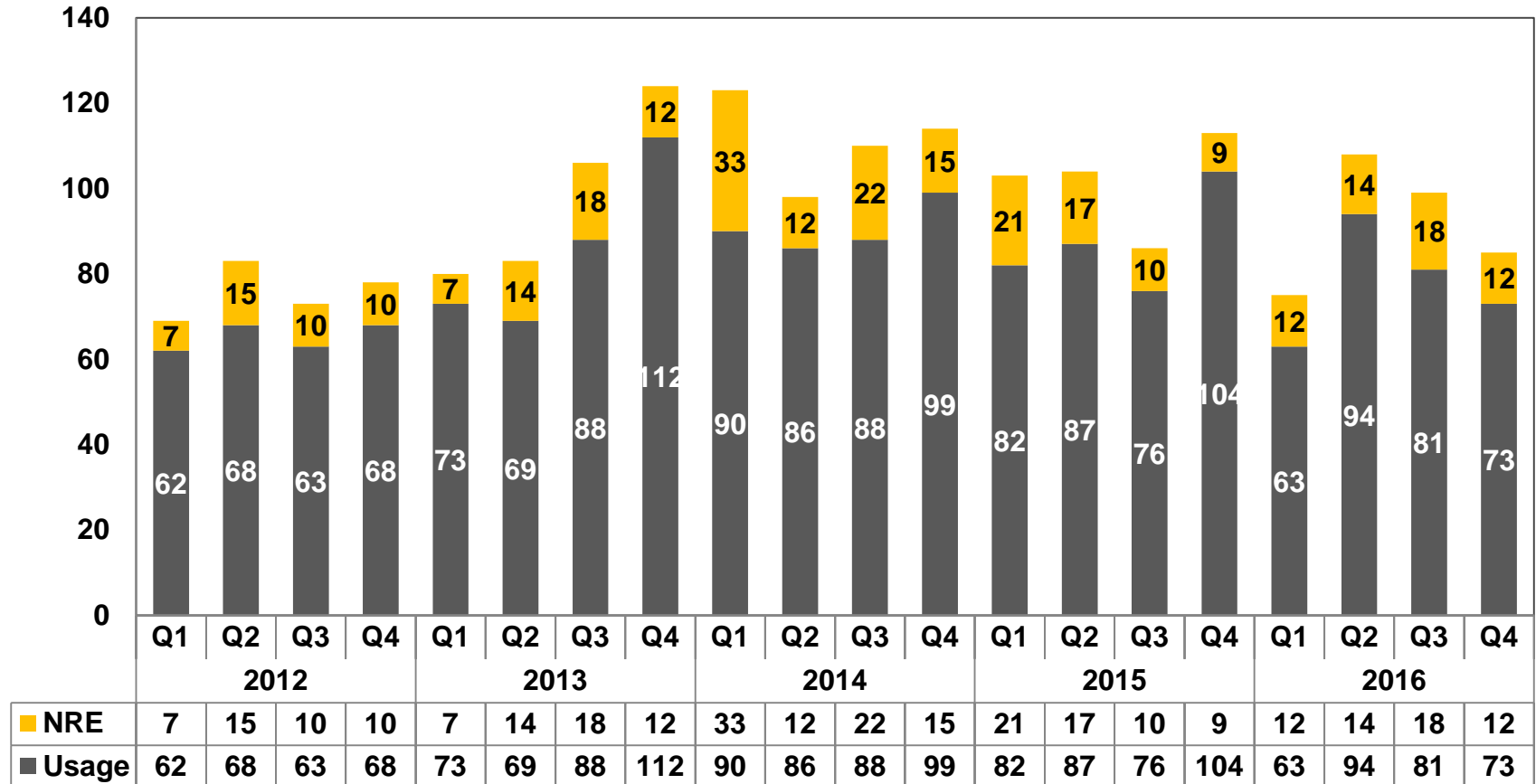
12" Fabs	Production	Development	NVM Type	Process Type
7/10nm	0	2	OTP	FF
14/16nm	1	3	OTP	FF+
28nm	6	8	OTP	LP/HPM, HLP/HPM, LPS
40nm	4	6	OTP, MTP	HV-DDI, LP
55/65nm	14	11	OTP, MTP, Flash	LP, HV-DDI, HV-OLED, DRAM, CIS
80/90nm	6	7	OTP, MTP	HV-DDI, HV-OLED, LP
0.13/0.11um	8	2	OTP, Flash	HV-DDI, BCD, Generic
0.18um	1	0	OTP	BCD

8" Fabs	Development	NVM Type	Process Type
0.13/0.11um	20	OTP, MTP, Flash	HV-DDI, BCD, LP, RF, CIS, LL
0.18/0.16/0.152um	45	OTP, MTP	Generic, LP, LL, MR, HV, Green, BCD
0.25um	0	OTP, MTP	BCD
0.35um	0	OTP	UHV

Note*: As of Dec. 31st, 2016

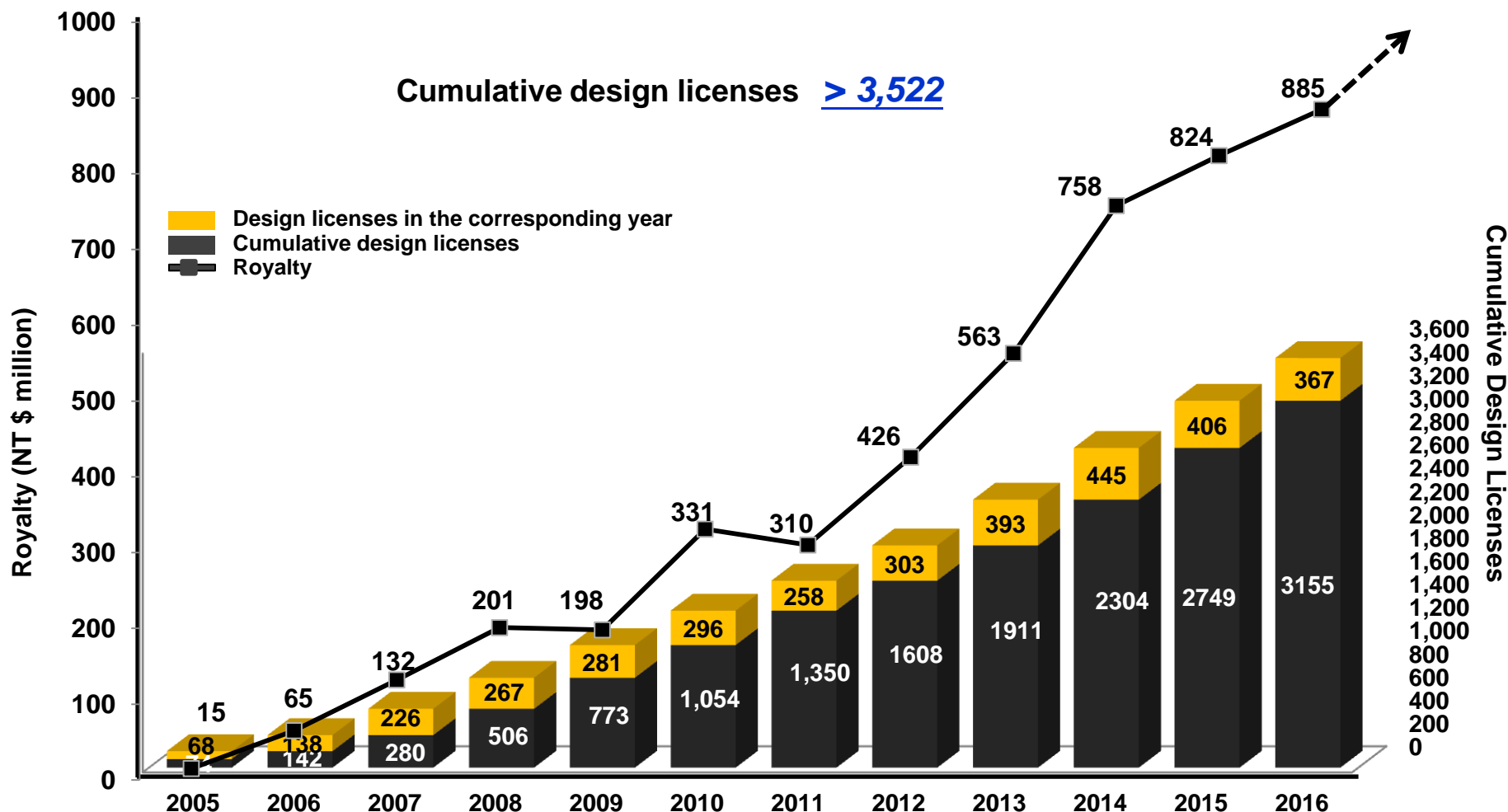
Quarterly Design Licensing (New Tape Out)

- Total **367** NTO as of 2016(**406**@2015,**445**@2014, **393**@2013, **303**@2012)



Note*: As the applications of MCU at several foundries have gradually entered mass production, and the business model of the main foundry partner which provides green process has shifted to — eMemory licenses IP cell to the foundry for it to provide direct design service to customers — as the result, the new tape out number of MCU has been affected, but the royalty coming from IP cell usage continues to roll in.
In summary, even the new tape out number of MCU is lower than before; the corresponding wafer output and royalty continue to grow.

Cumulative Licenses Drive Future Royalties

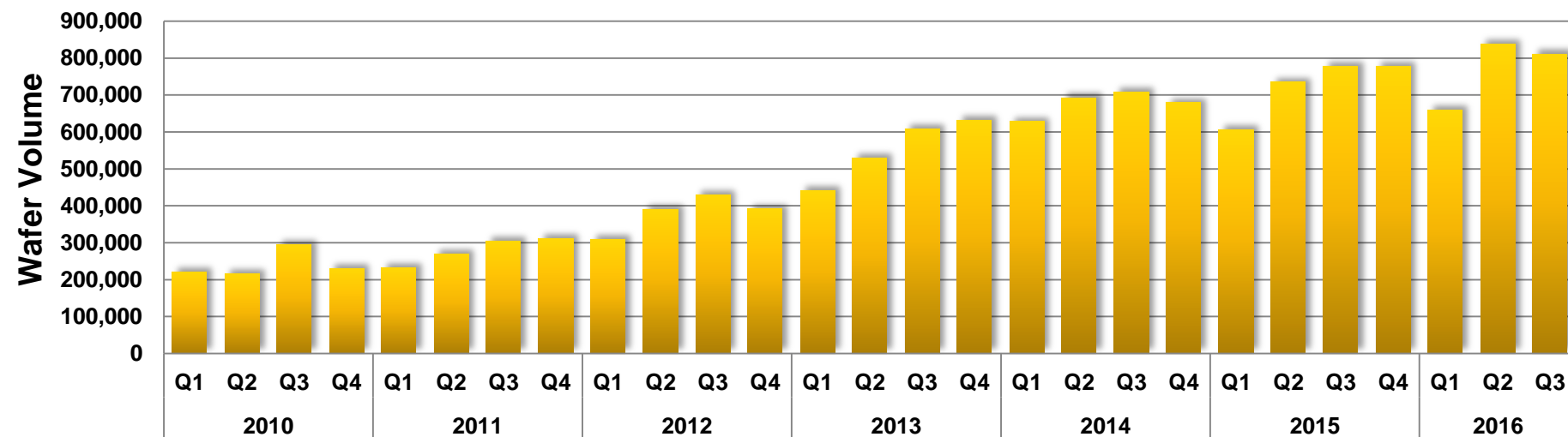


note 1: Due to the 2009 recession, royalty income was down annually 1.5%.

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%.

Wafer Production Volume



embedded eMemory IP in T Company (\$revenue); * % of Process node in T company total revenue in Q4 2016

	Process node	*% of T	Q4 16	Q3 16	2016	2015
8"	0.25/0.35	2%	26.80%	26.44%	28.15%	33.49%
	0.15/0.18	10%	10.93%	13.07%	12.43%	8.73%
	0.11/0.13	2%	58.06%	40.96%	42.61%	29%
12"	90nm	5%	14.8%	3.83%	12.50%	19.85%
	65nm	11%	3.9%	3.85%	3.59%	0.55%
	40/45nm	12%	0	0	0.00%	0%
	28nm	24%	0.70%	0.61%	0.55%	0.05%
	16/20nm	33%	0%	0	0.00%	0%
8"		15%	18.60%	20.1%	18.86%	16.64%
12"		85%	1.56%	0.87%	1.44%	1.87%
Total		100%	4.12%	3.95%	4.27%	4.76%

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eMemory's NVM Technologies

- **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

Applications by Technology

12"

8"

7nm	10nm	16nm	28nm	40nm	55/65nm	80/90nm	110/130nm	160/180nm	250nm	350nm
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NeoBit

NeoFuse

NeoFlash

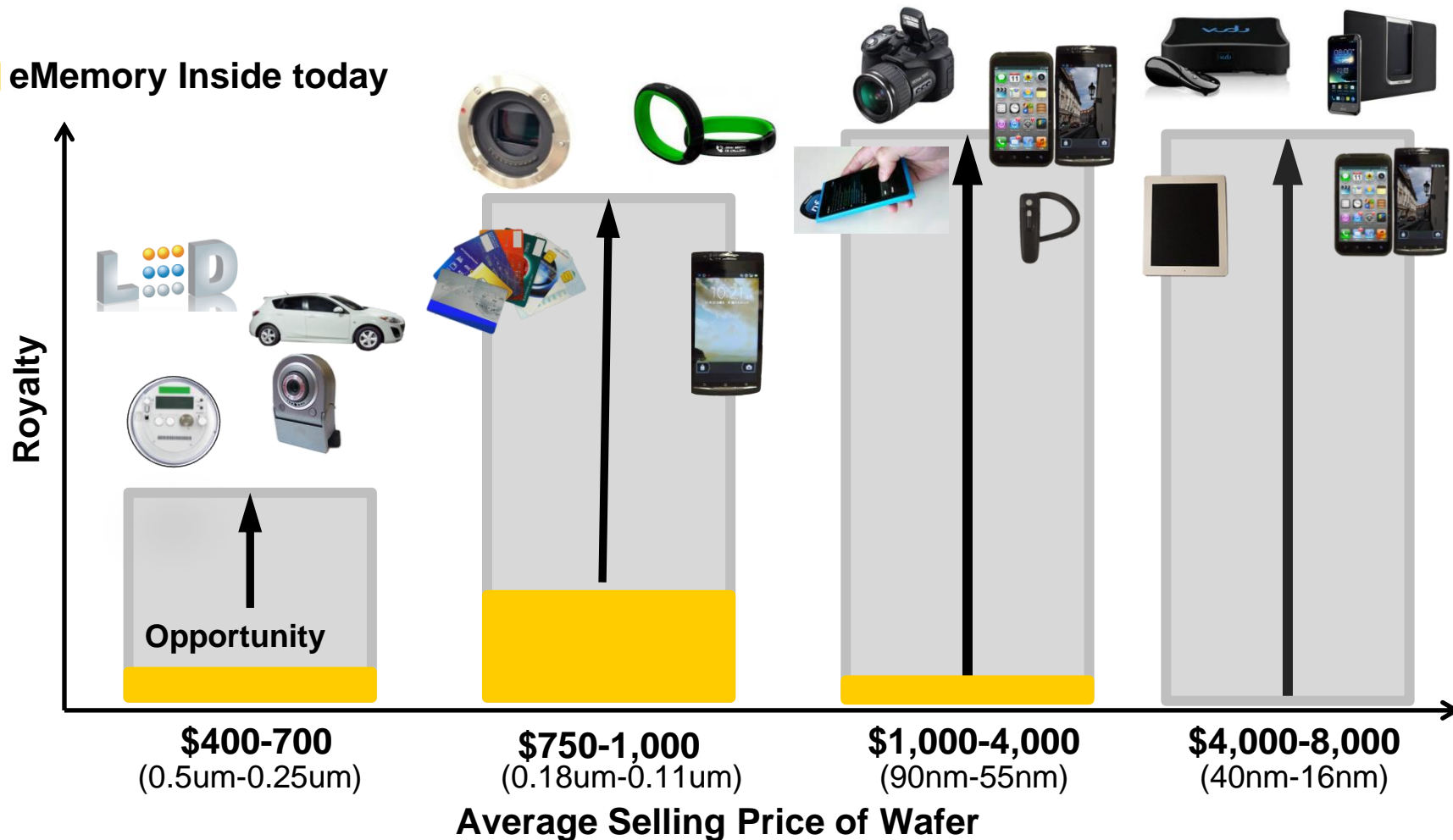
NeoEE

NeoMTP



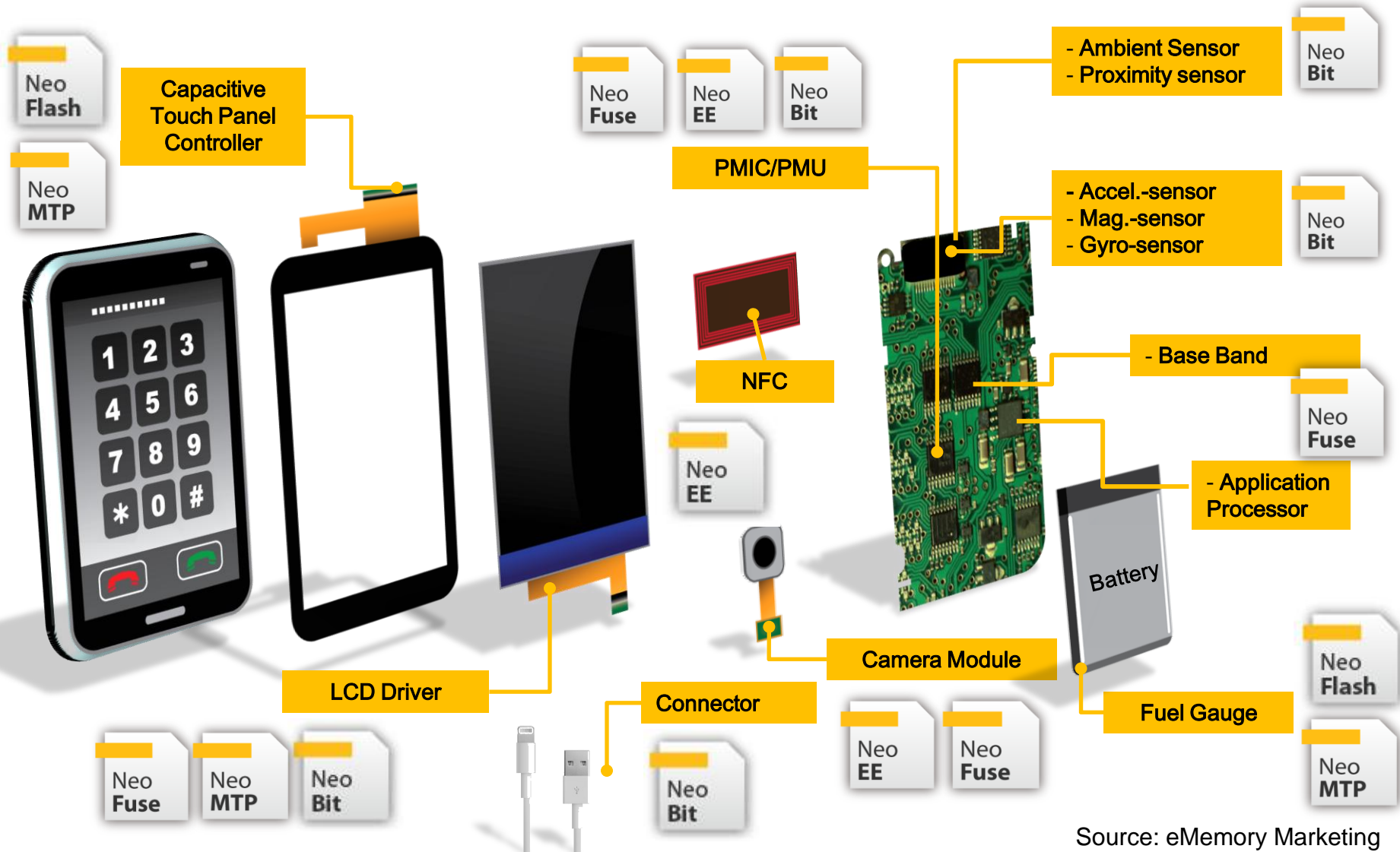
Opportunity at all Price Points

 eMemory Inside today



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

eMemory IP in Smart Phone



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

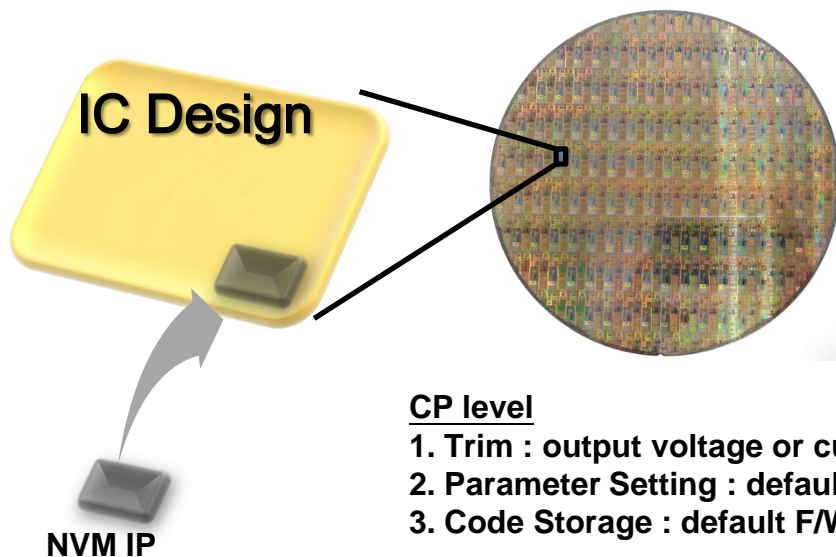
Package/FT level

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



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

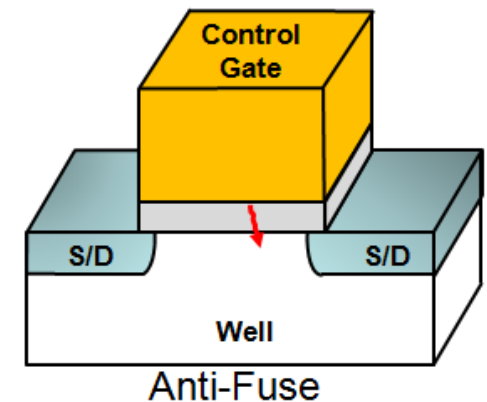
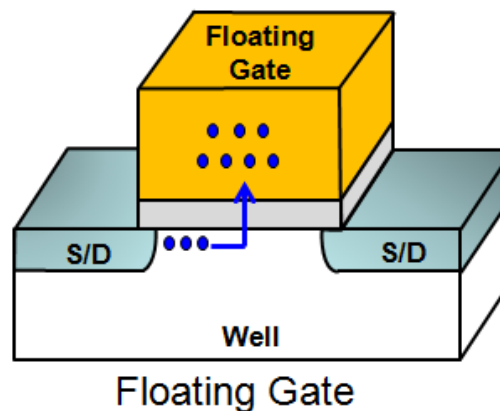
Invisibility for Security

- 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



Security & Protection

Authorized Product



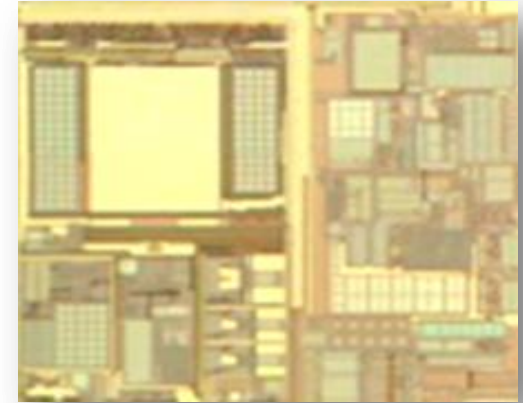
reverse
copy

re-produce



without protection

Fake Product

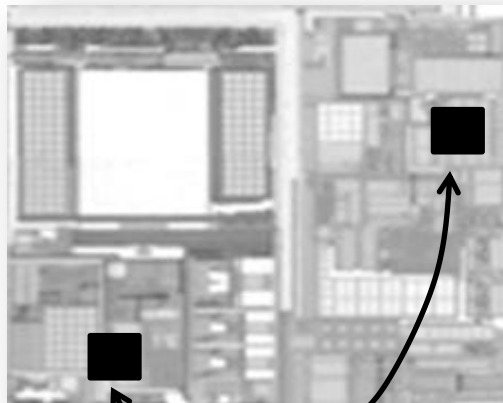


reverse
copy

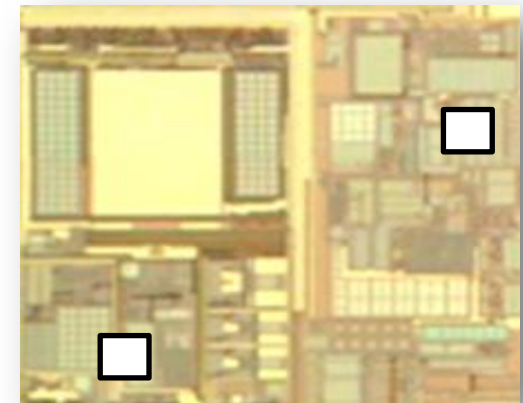
re-produce



with protection

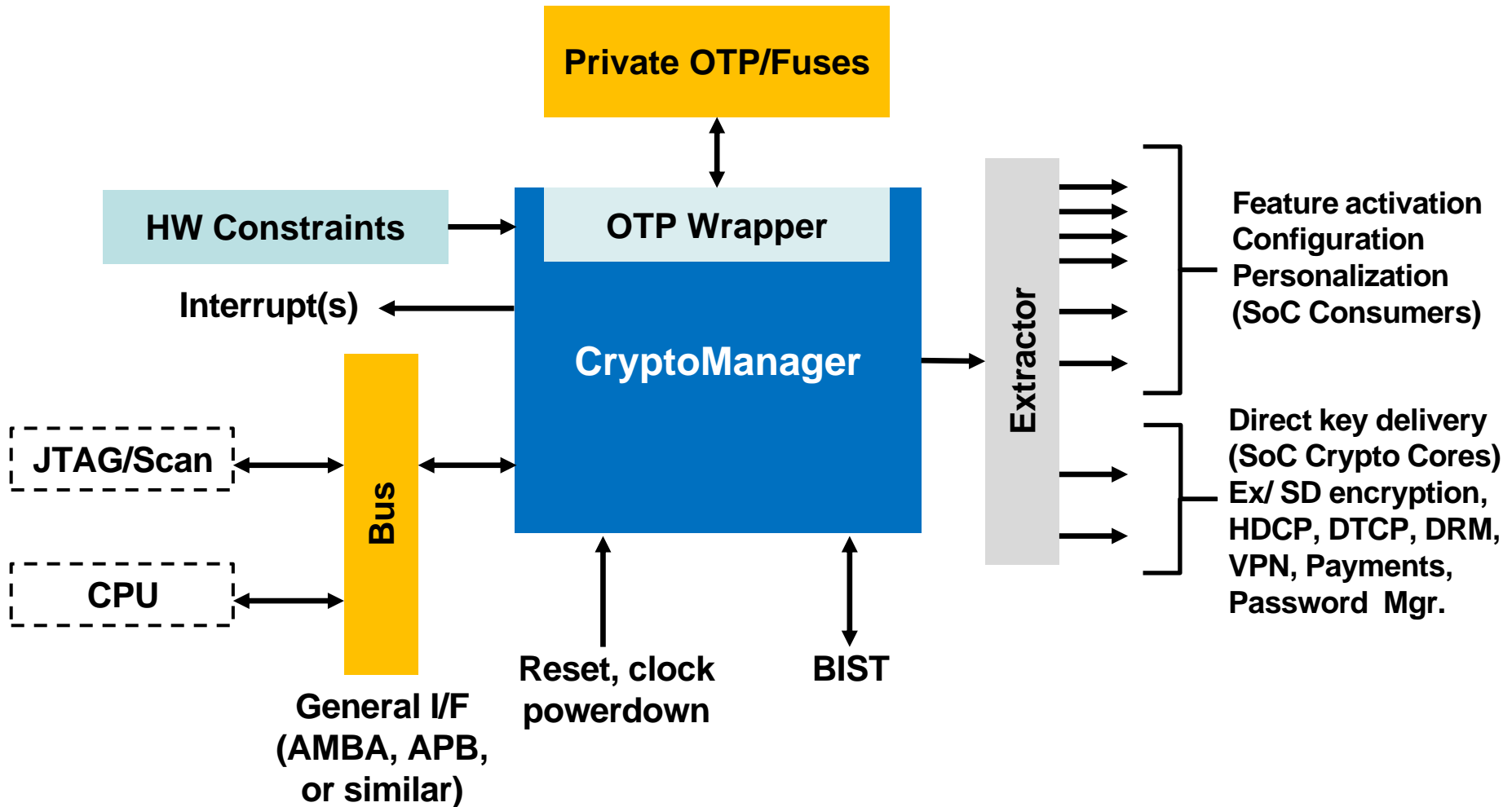


Security IP/Code by
Authorized Use



Can NOT Work w/o
Security IP/Code

OTP for security storage

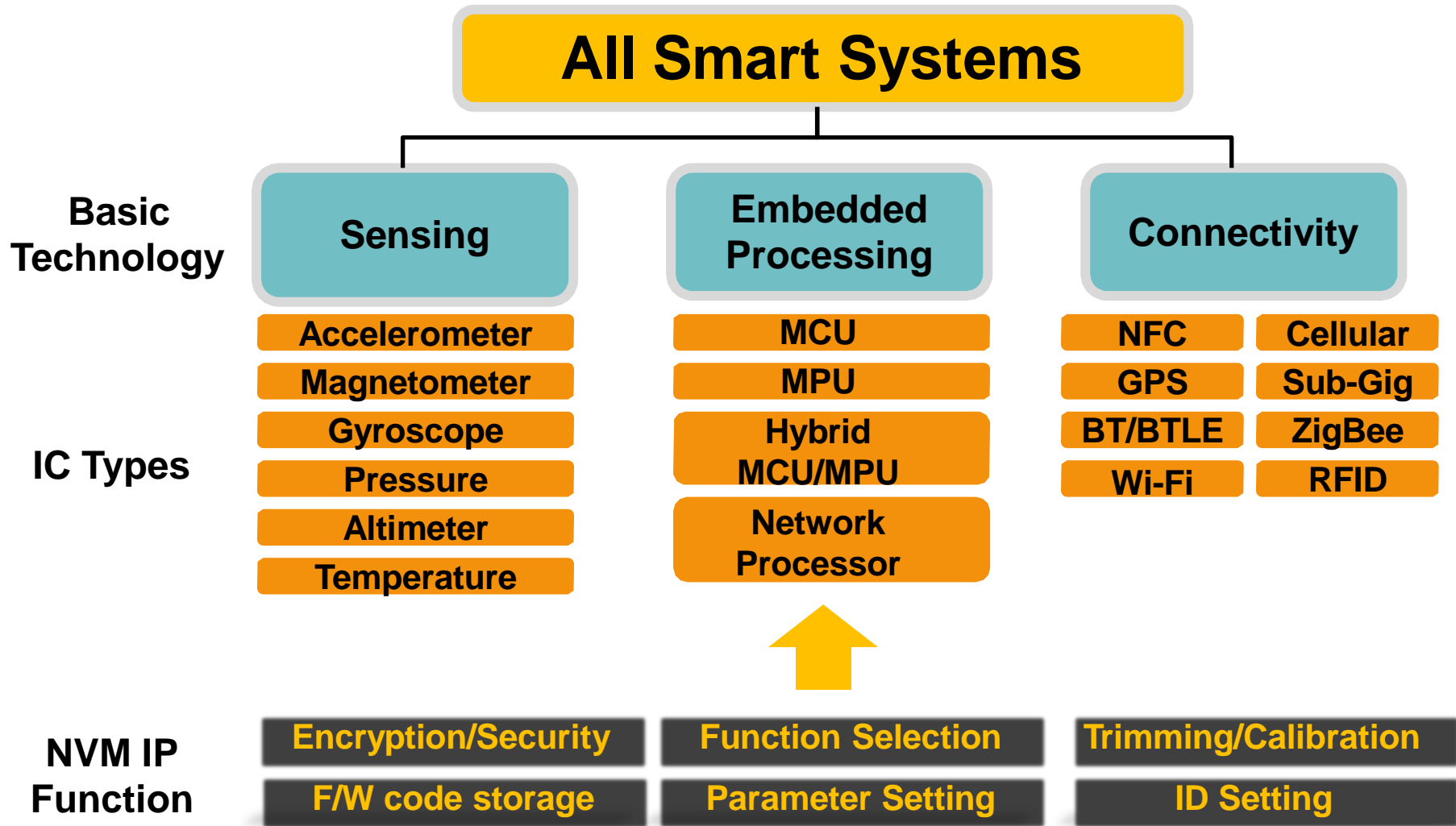


Source : Rambus crypto manager platform

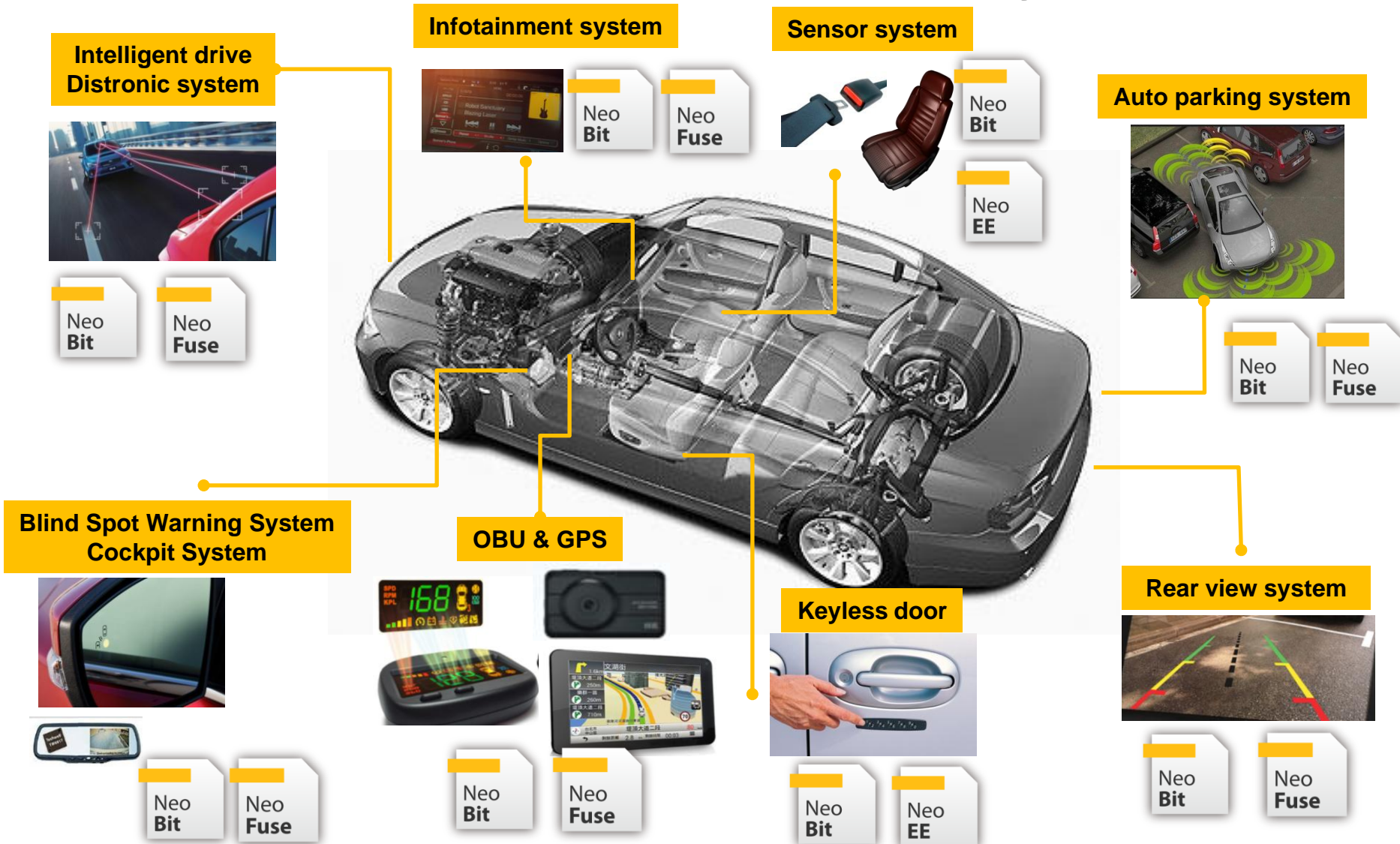
Security with eMemory IPs



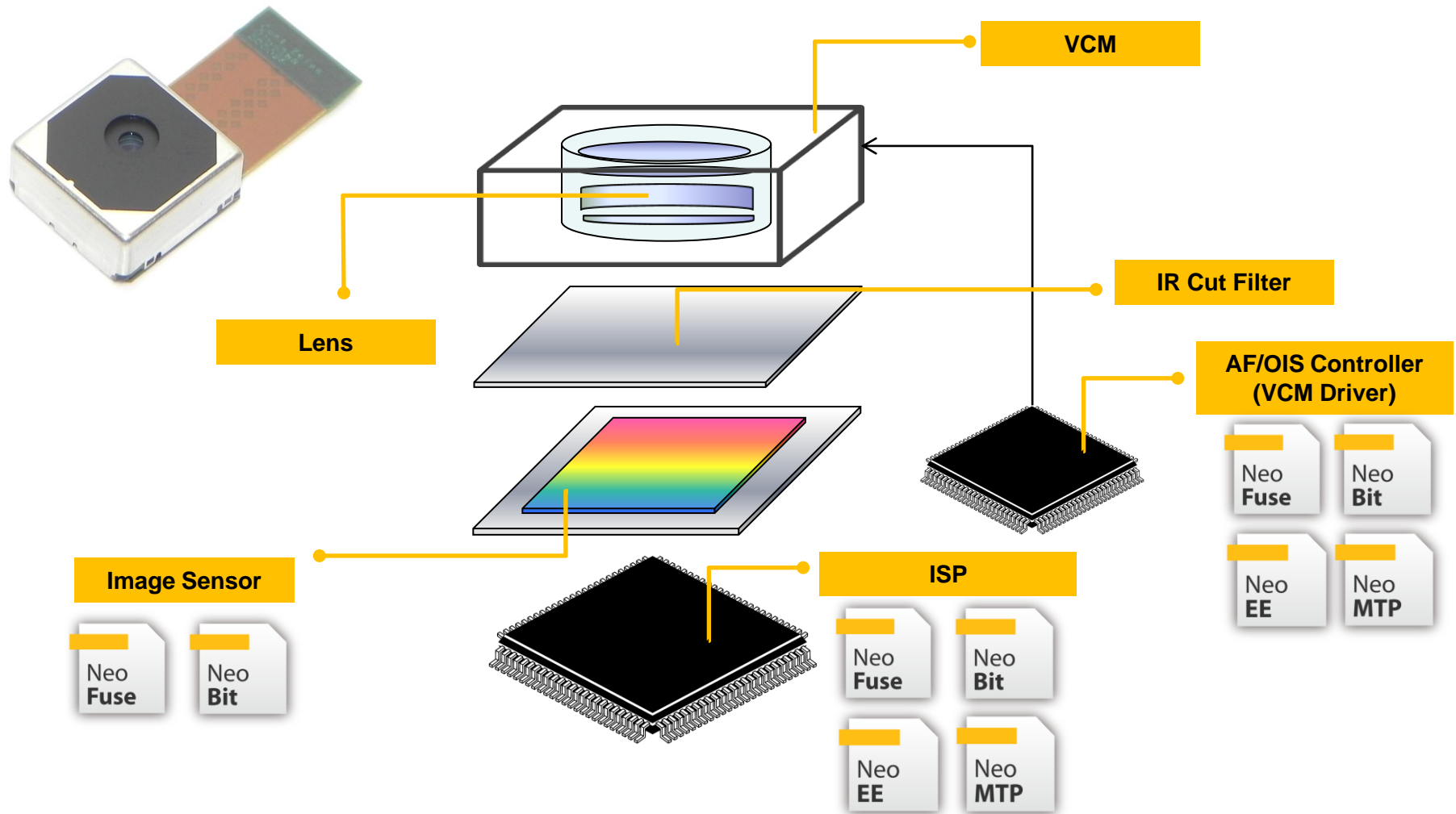
NVM IP Demand in IoT



Autotronics with eMemory IPs

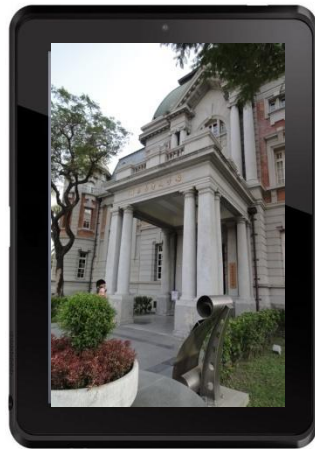


Imager Module with eMemory IPs



Advanced LCD Driver ICs

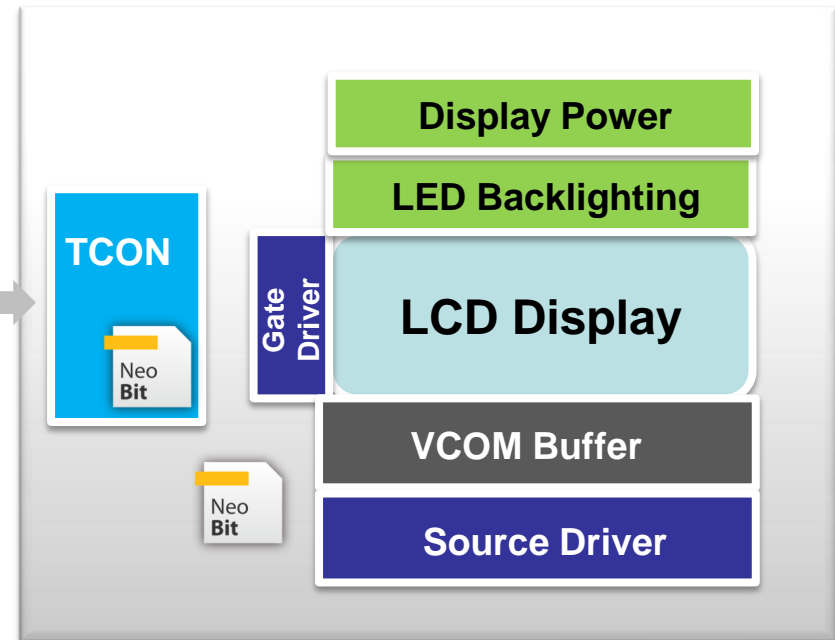
Process Technology : 0.11um HV/80nm HV/55nm HV



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



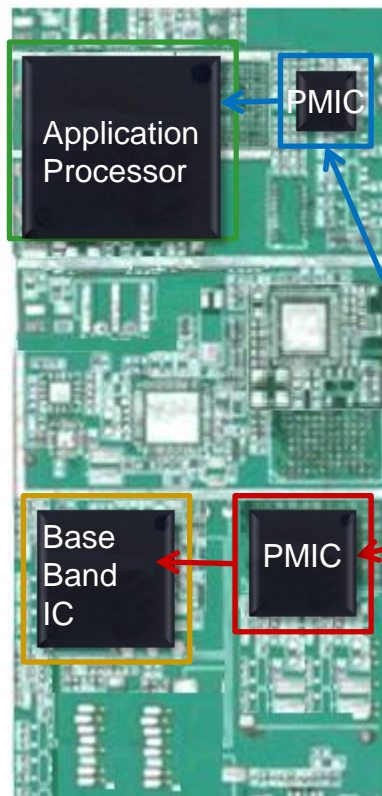
DDI



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

Power Management ICs for Baseband and Application Processor

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

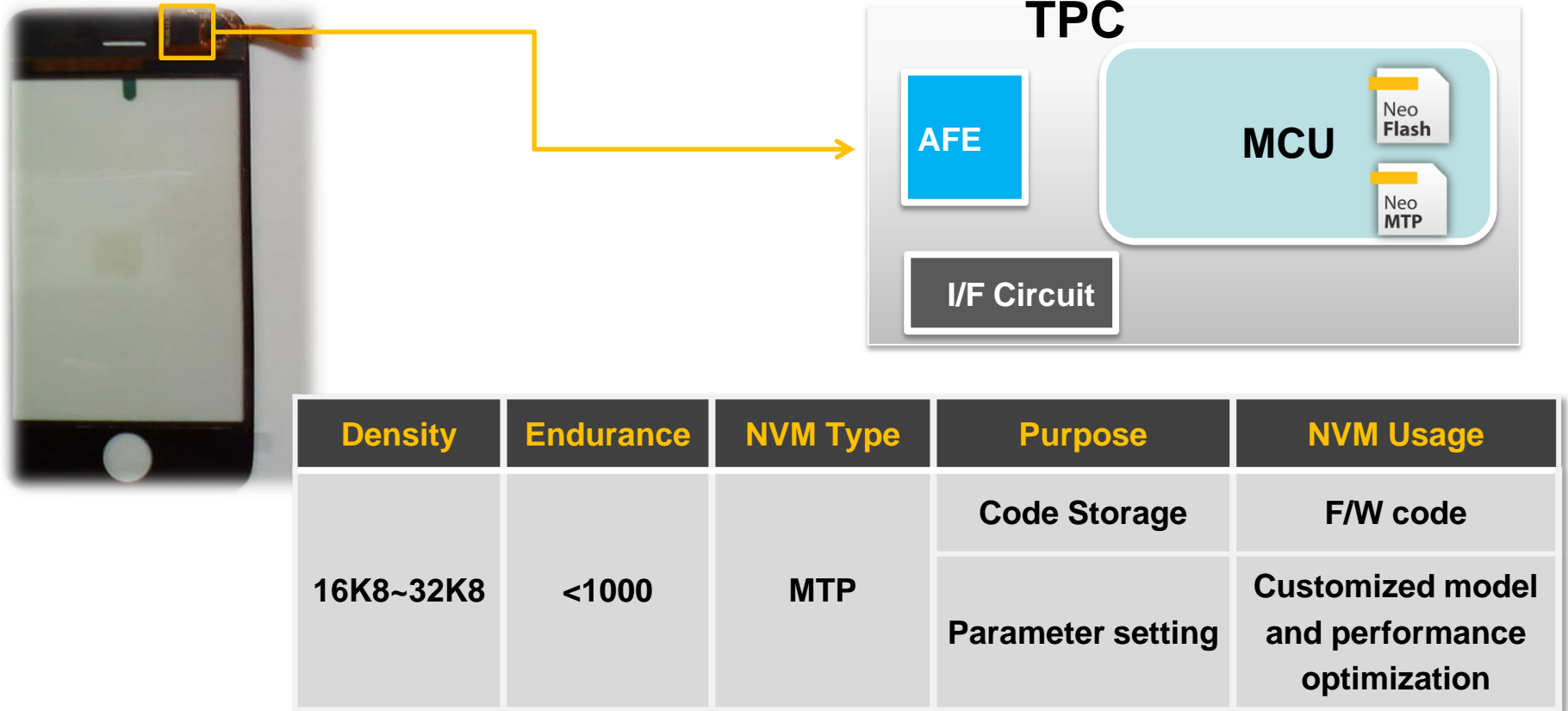


Density	NVM Type	Purpose	NVM Usage
2Kb~4Kb	OTP	Trimming	DC/DC, Bandgap
		Parameter Setting	Design flexibility & Performance optimization
		Code Storage	Start-up behavior & smart power saving algorithm



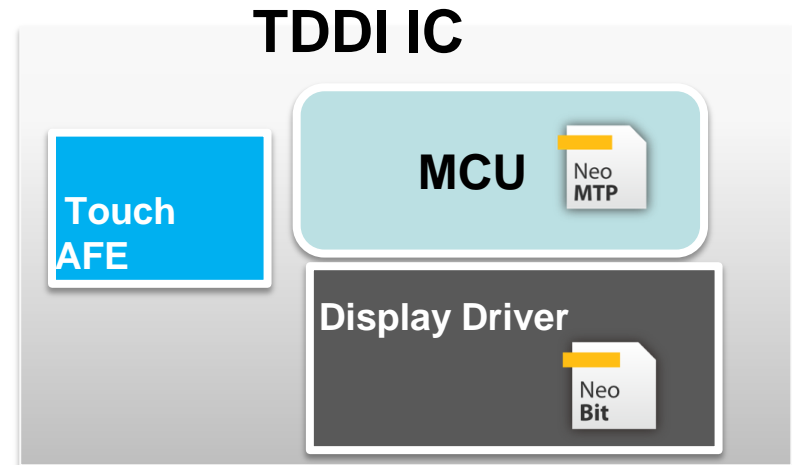
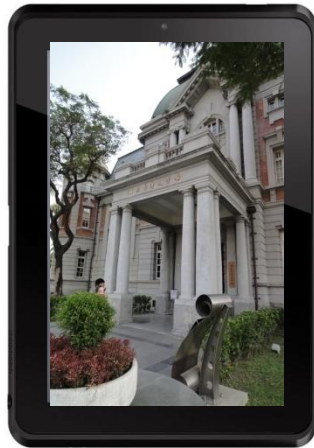
Touch Panel Controller ICs

Process Technology : 0.16um HV/0.11um G



In-Cell Touch Panel Controllers ICs

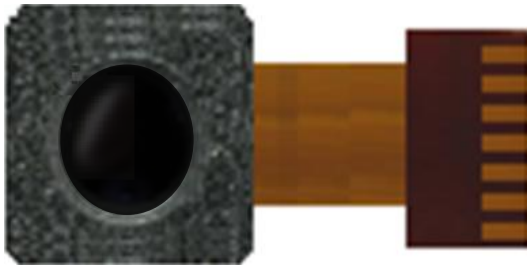
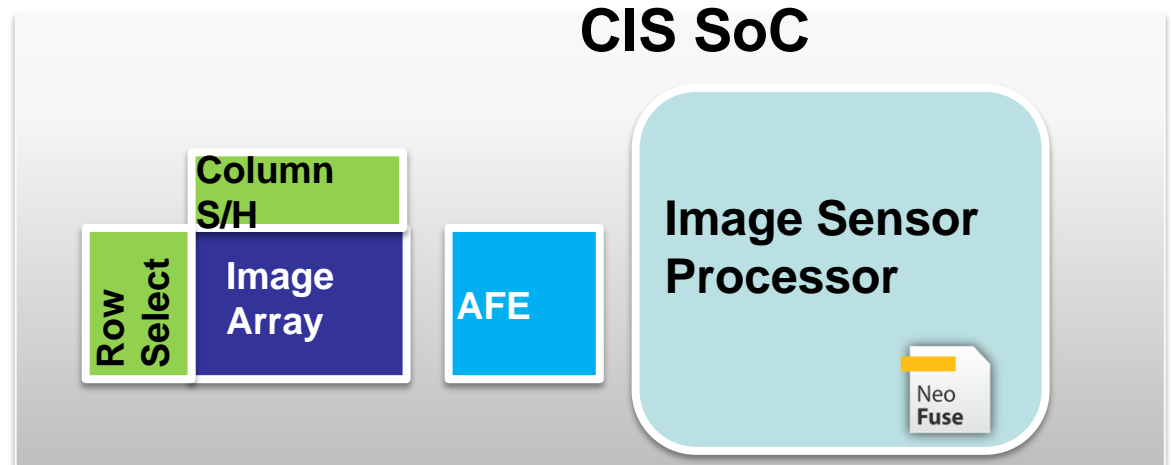
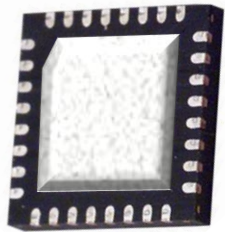
Process Technology : 0.11um HV/80nm HV/55nm HV



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 Image Sensor

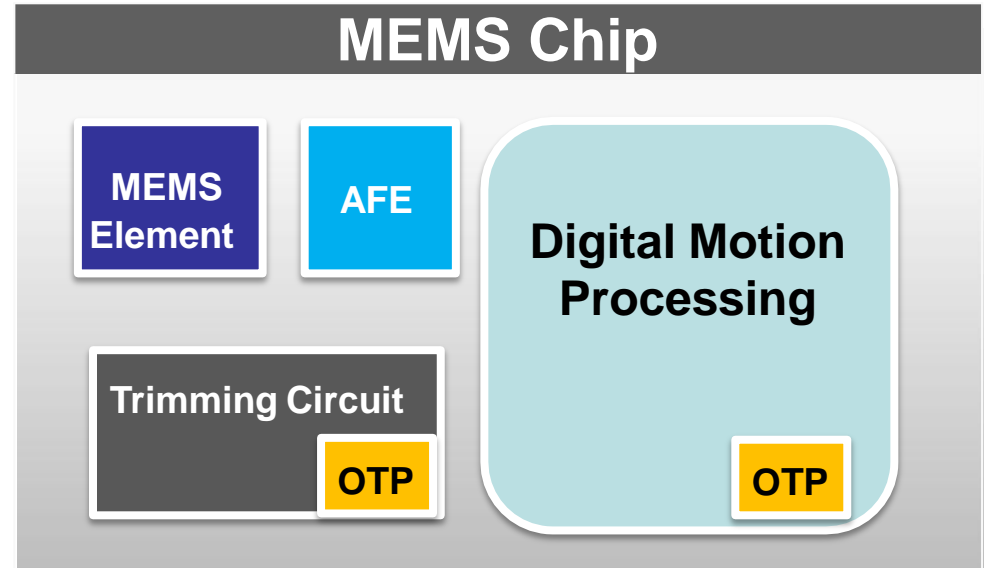
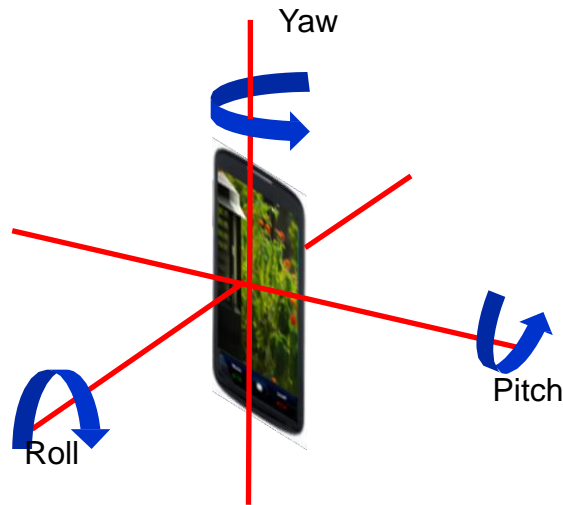
Process Technology : 0.11um CIS/90nm CIS/65nm CIS



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

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

Replacement of Embedded Flash for Competitiveness Improvement

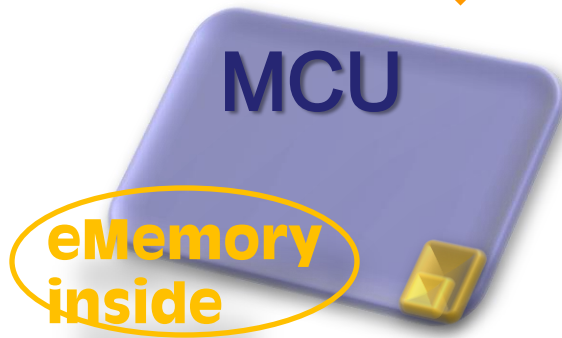


product design & manufacturing by
embedded Flash
Logic Process + 10 Masks



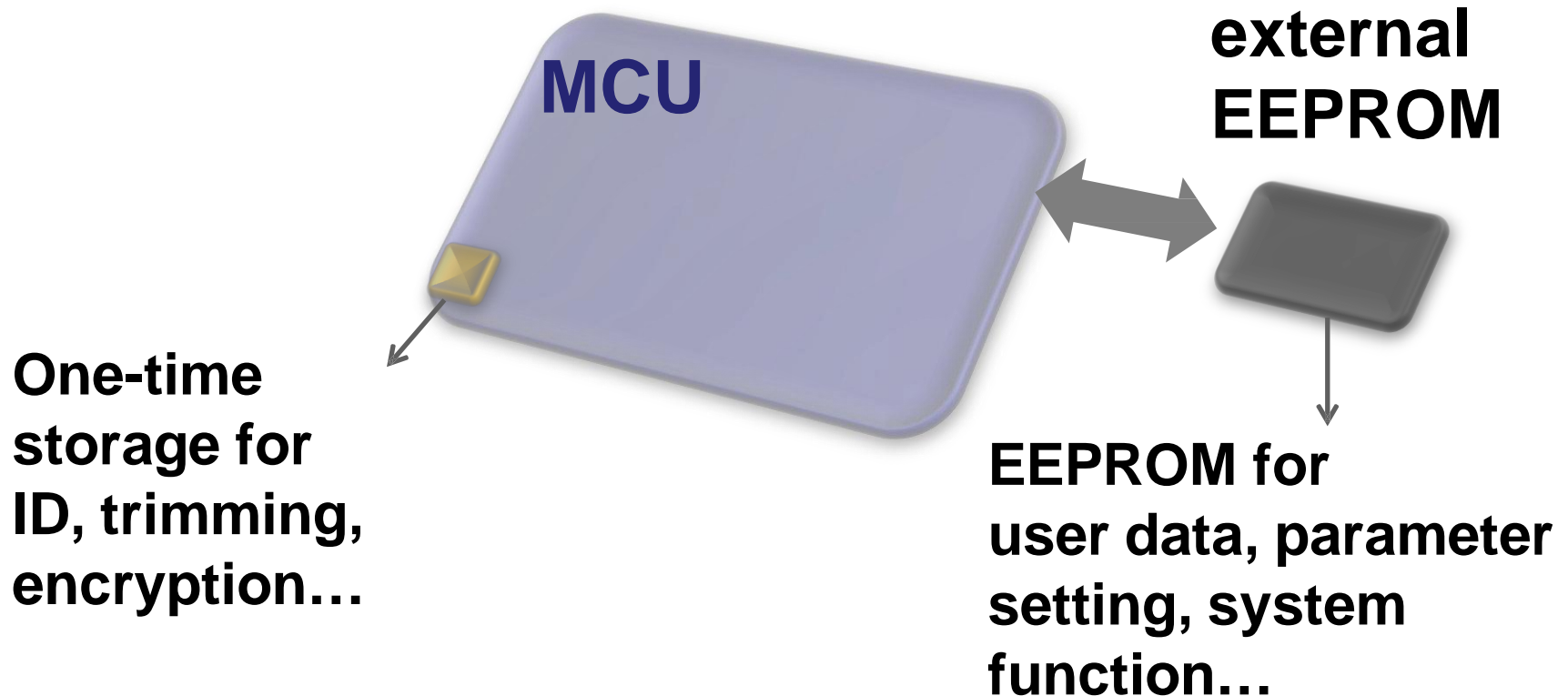
*30% more
cost reduction*

*wafer cost &
testing time*



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

MCU Applications with EEPROM



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**

Wafer Demand by IC Type

IC Type	Equa to 8-inch wafer (K)
AP	4926
PMU	4508
Smart card controller	3667
Base Band controller	2429
CIS sensor	1975
LCD driver (int with TCON)	1892
Fingerprint	744
Gauge IC	670
Touch panel controller (C)	581
TV controller	579
Connectivity (Combo)	437
STB controller	330
Wifi controller	293
DC-DC/AC-DC	190
LED driver	141
BT controller	132
Light sensor	123
Accelerator sensor controller	114
TAG IC	100
ISP	98
Gyroscope sensor controller	90
MCU (8bits, pure 5V)	65
P-Gamma	40
MCU (8bits, LV/3.3V)	39
NB CAM controller	36
Pressure sensor controller	21
PC CAM controller	8
TCON (w/o driver)	3

2016 Q3 updated

Outlook for 2017

- **In license revenues :**

- **Strong demand for building advanced process and MTP platform in worldwide foundry partners will increase technology license and design license revenues.**

- **In royalty revenues :**

- **8" wafer royalty will grow further due to multiple fingerprint customers are ramping up production and more customers will start volume production later this year.**
- **PMIC related royalty will increase due to new chips in fast charger
、 wireless charger, and our largest US customer ramping up their new generation of PMIC in second half of 2017.**
- **Automotive platforms have been successfully built and customers already start small volume production**

Outlook for 2017

- For 12" wafer royalty, the volume production of TDDI, OLED, STB/ DTV, CIS and security have continuously increased.
- We had first 16nm tape-out in 2016. The 10nm IP have been successfully verified and 7nm test chip is expected to tape out in Feb. All these will increase our penetration rate in 12" fab.

Key Growth Drivers

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.

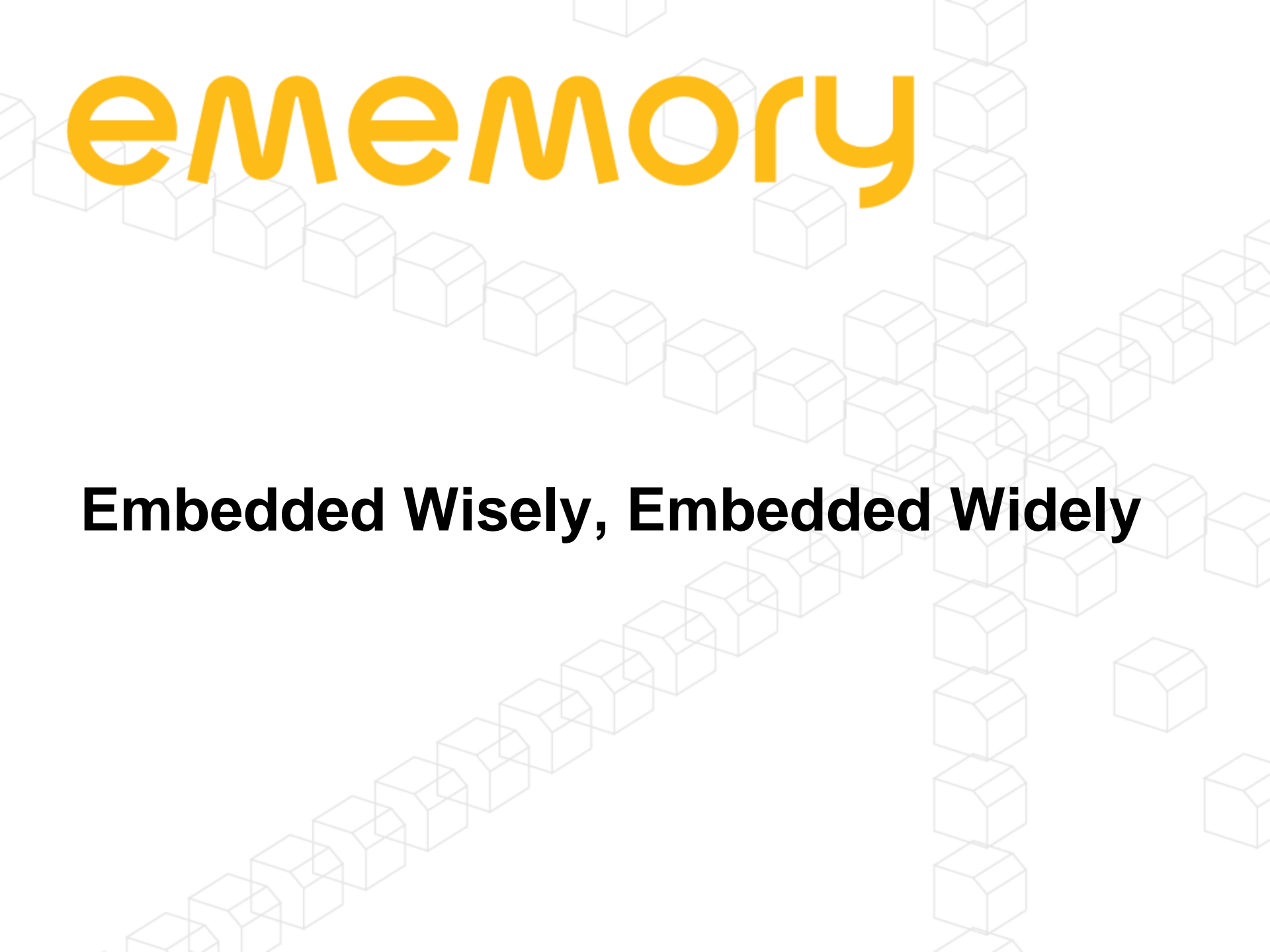
Growth in advanced technology

- 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