

ememory

**A Leading Logic NVM
Company**

IPR Notice

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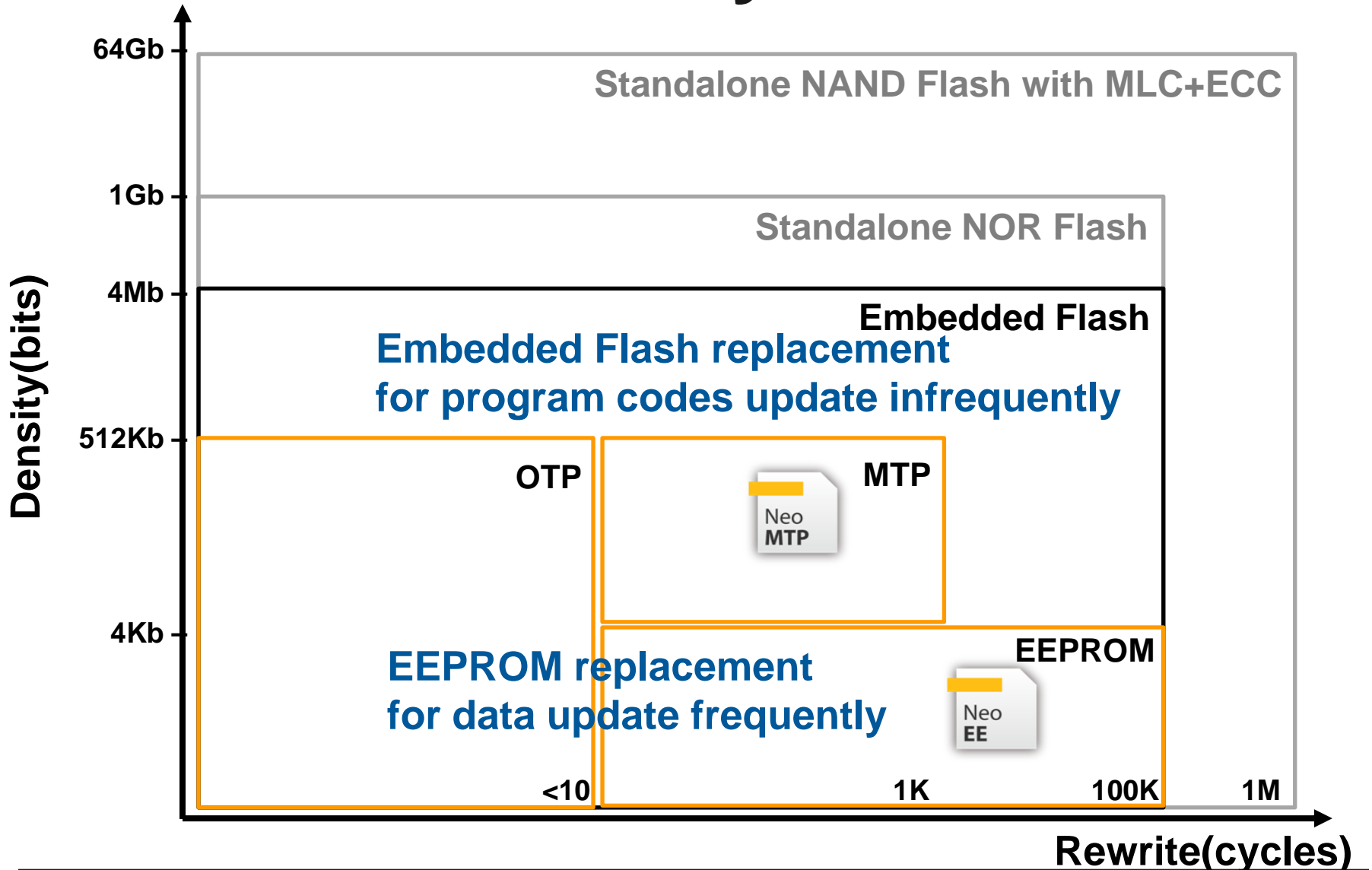
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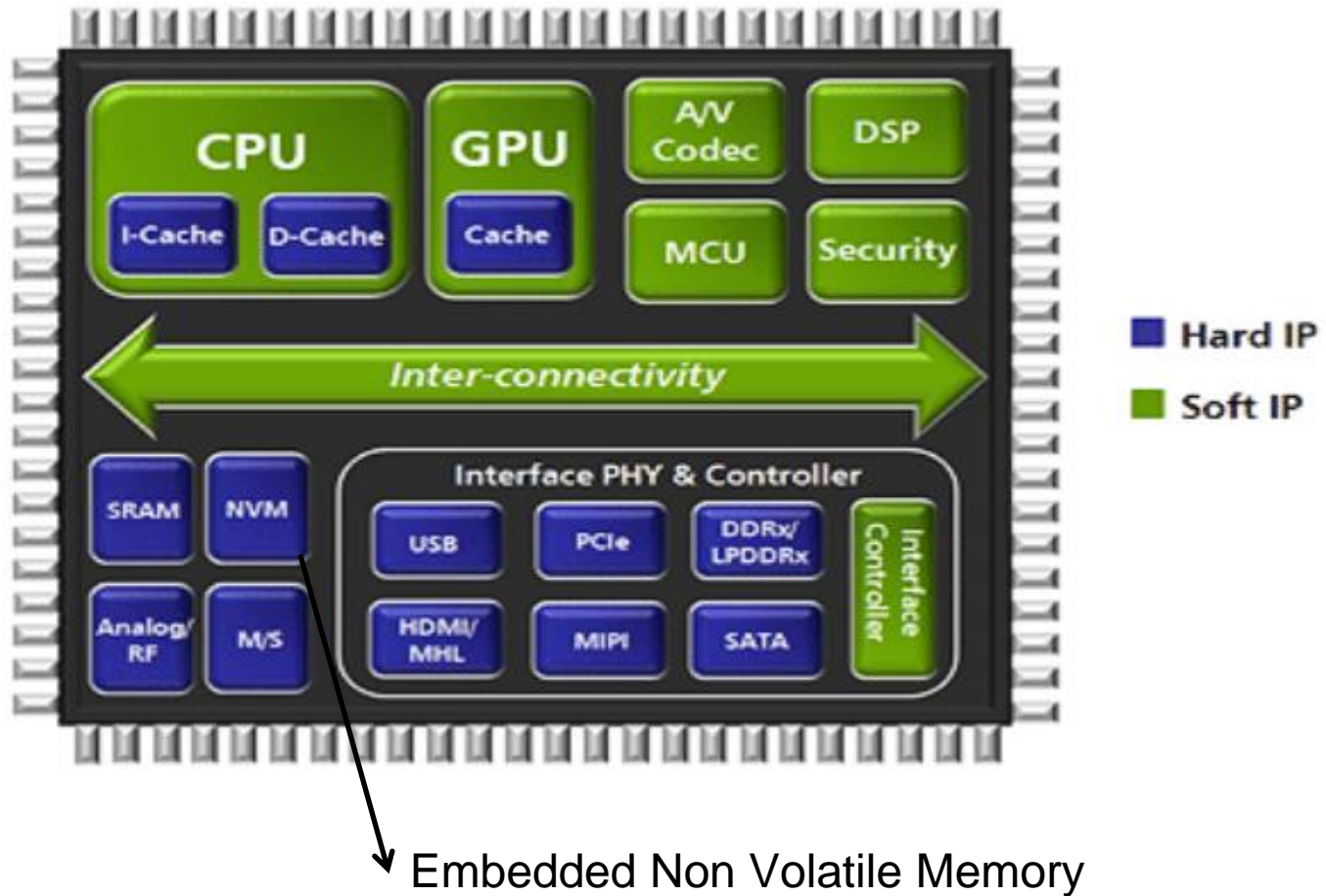
Outline

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

Nonvolatile Memory Classifications



SOC Block Diagram



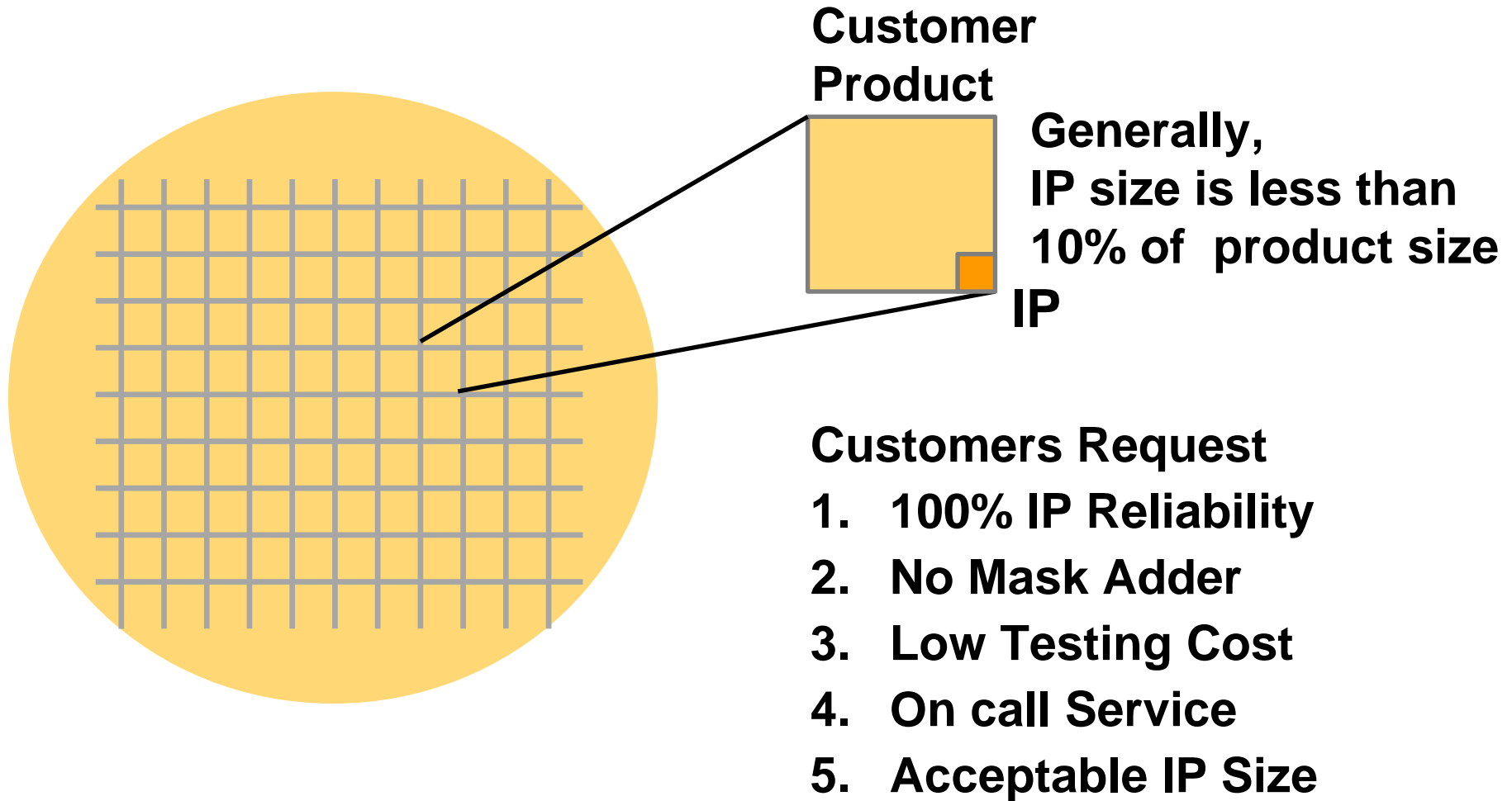
Source : tsmc

Embedded NVM Technologies

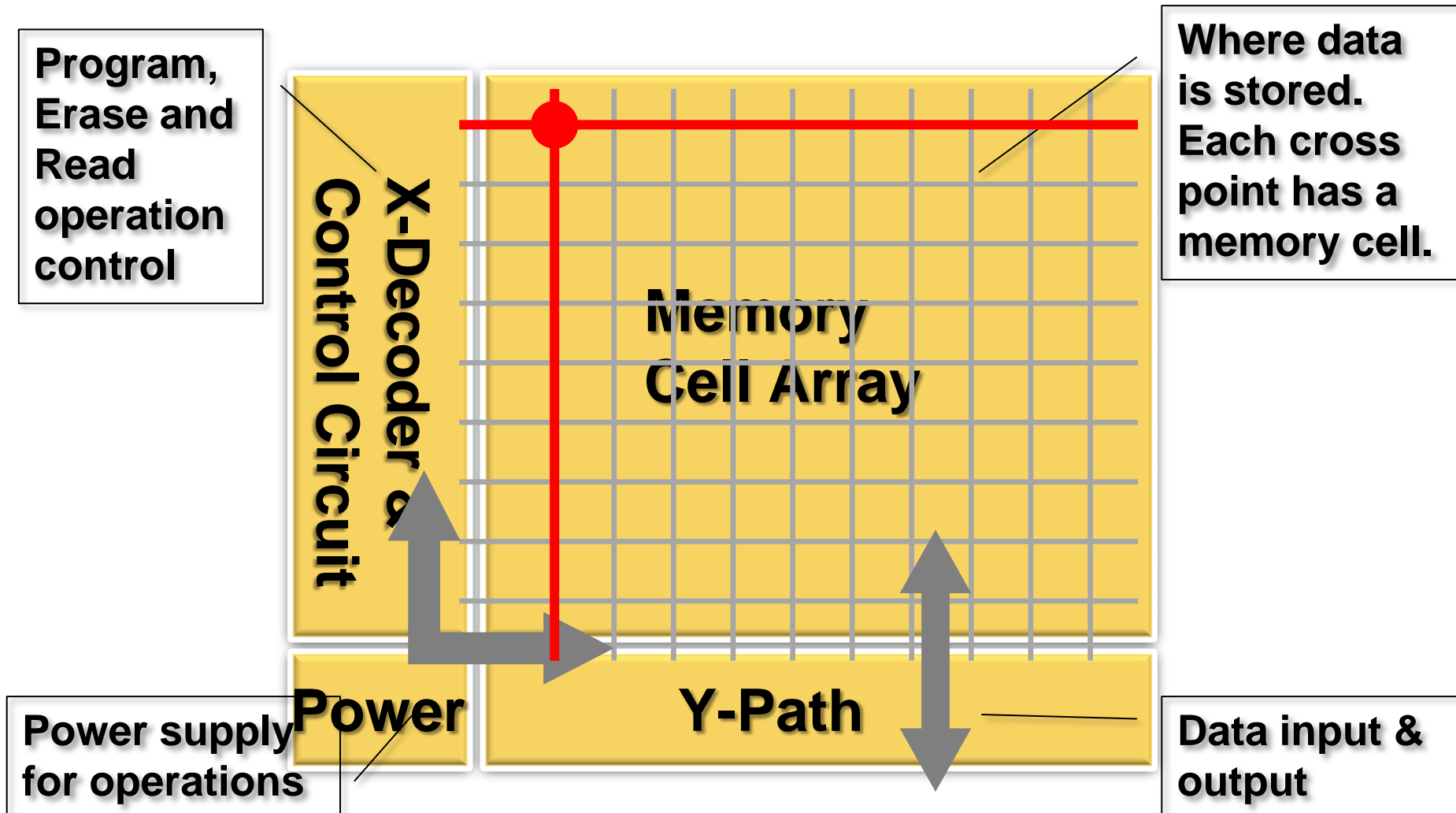
	ROM	eFuse (OTP)	Antifuse (OTP)	CMOS Floating Gate (OTP)	CMOS Floating Gate (MTP)	Embedded Flash
Cell Structure	Transistor	Poly Fuse	Antifuse	Floating Gate	Floating Gate	Floating Gate
Standard CMOS Compatible	Yes	Yes	Yes	Yes	Yes	No
Bitcell Area	< 1	50	1	2	4	1
Endurance	No	No	< 10	< 10	10K-100K	100-1000K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

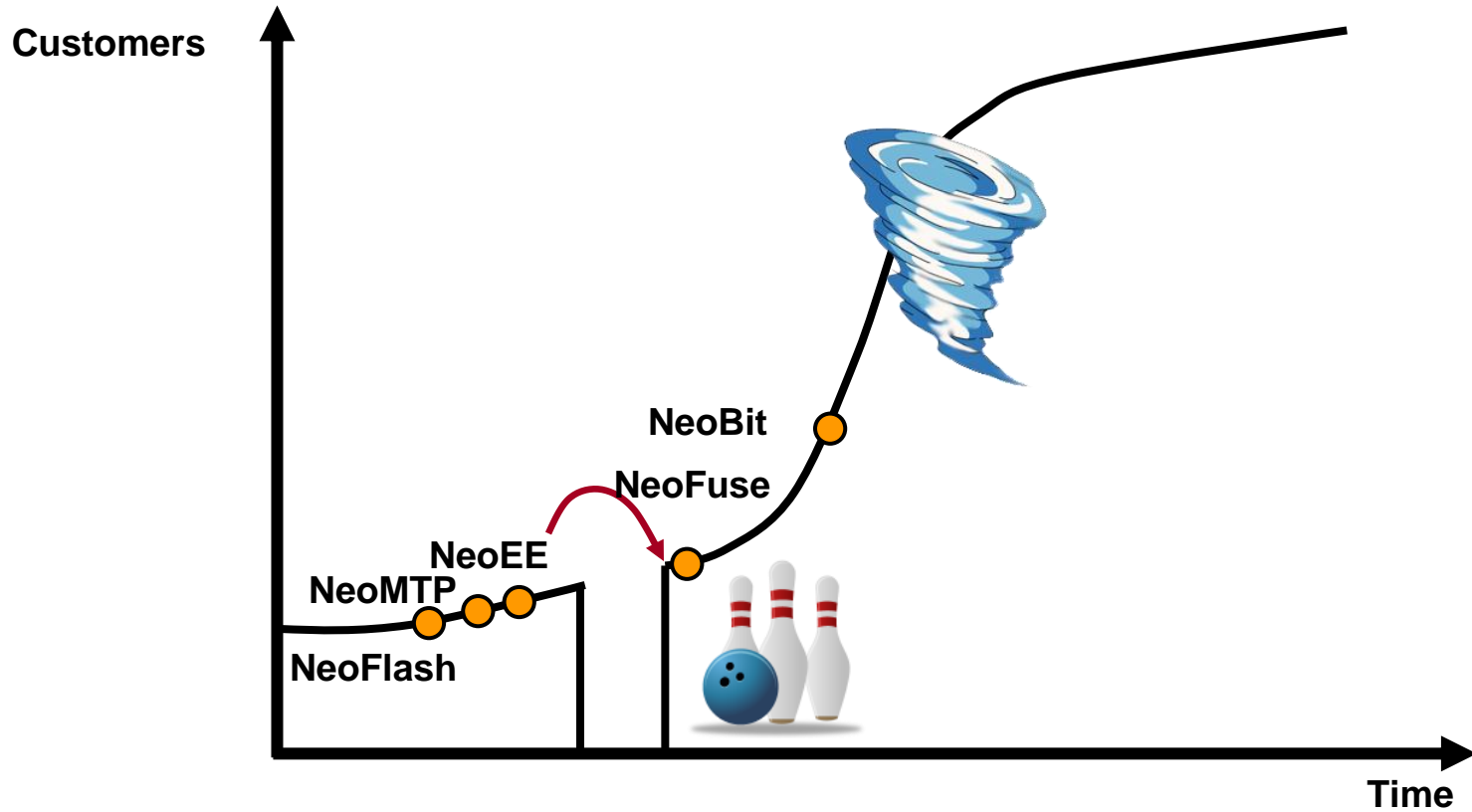
Considerations for IP Adoption



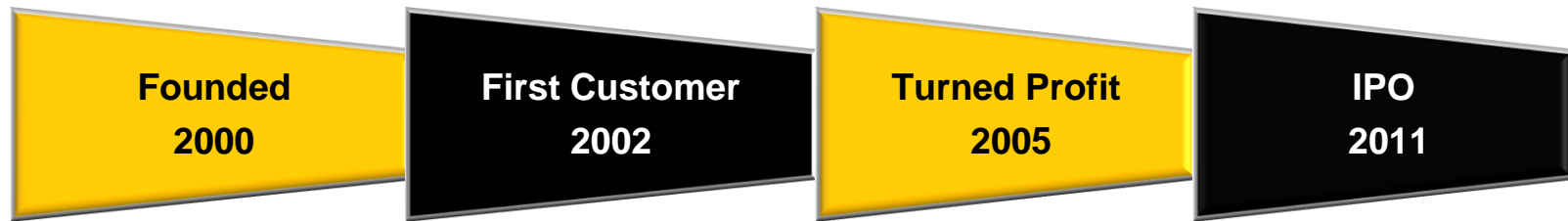
Inside Nonvolatile Memory IP



Crossing the Chasm



About eMemory



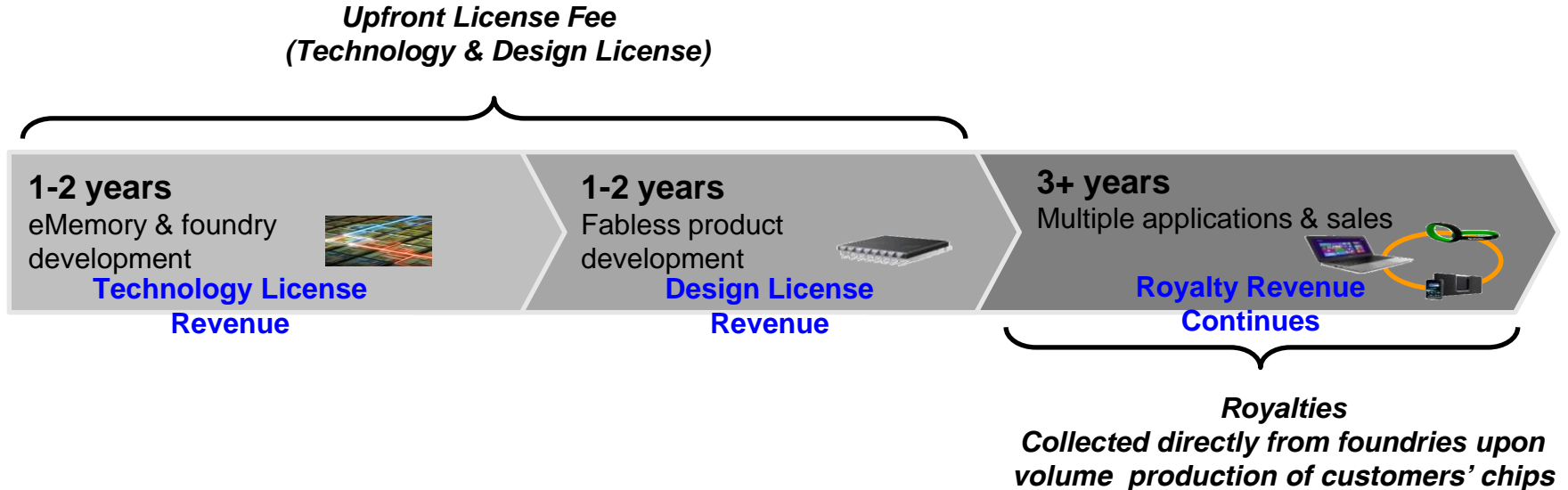
- Largest Logic Non-Volatile Memory (NVM) IP company
- 233 employees (162 R&D)*.
- No fundraising from capital markets or bank loans since IPO in 2011.
- Over 90% of earnings distributed in cash dividends.

Note*: As of Mar. 31st, 2017

Business Model

- Growth Metrics

- › No. of Embedded Platforms
- › No. of Design Licenses
- › Royalty



Worldwide Customers



Foundry



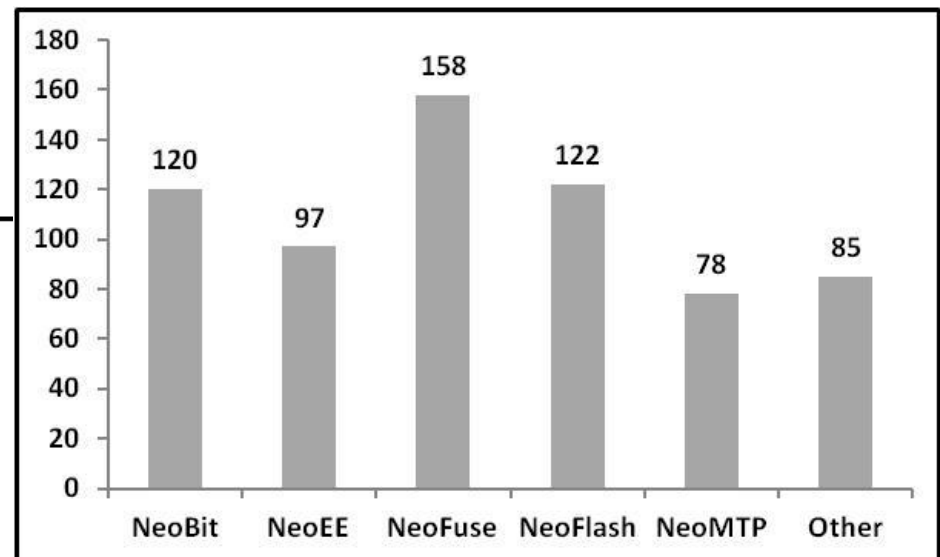
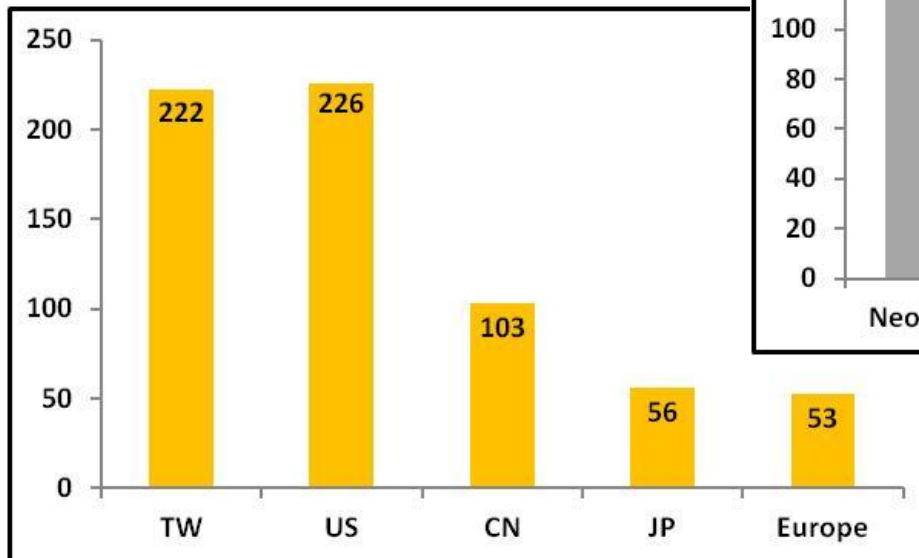
IDM



	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

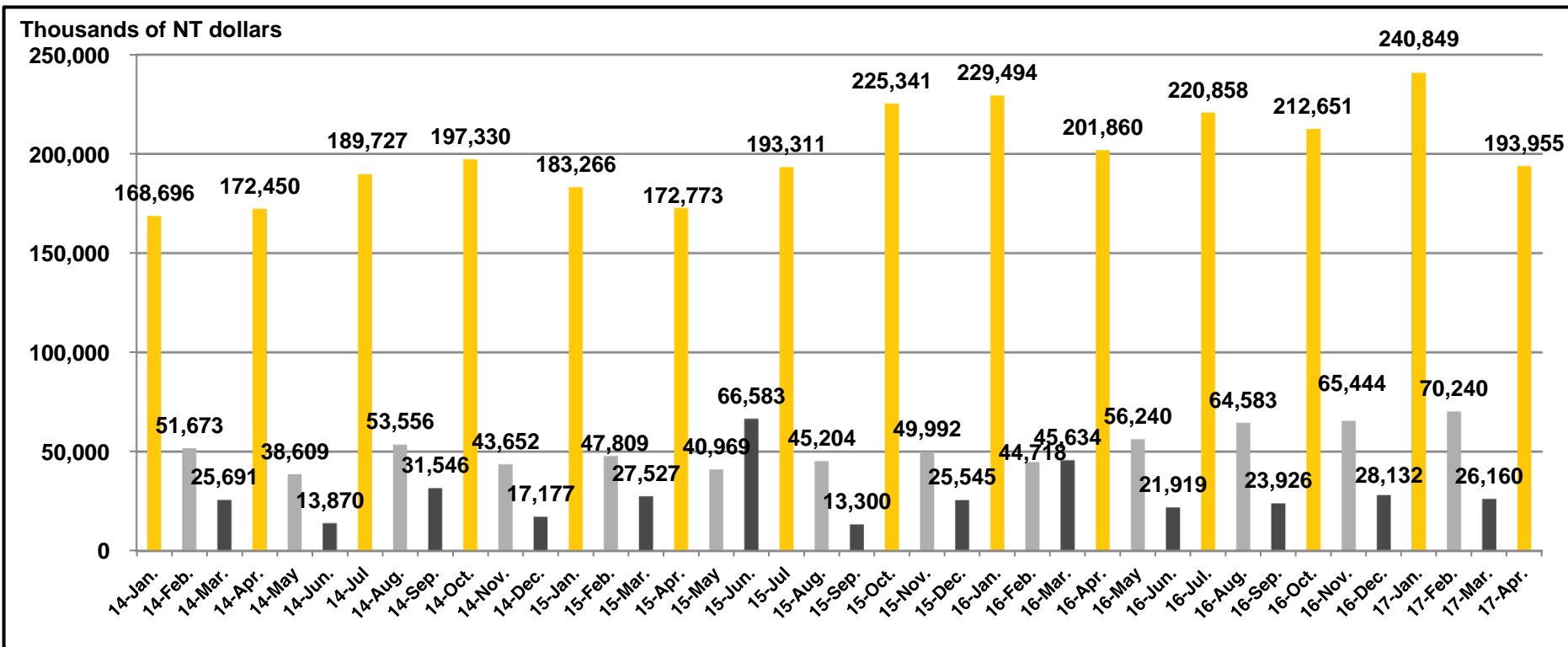
	4Q 16	1Q 17	Diff.
Pending	218	244	+ 26
Issued	389	416	+ 27
Total	607	660	+ 53



Note*: As of Mar. 31st, 2016

Quarterly Revenue Pattern

- 1st month: Receive **License Fees** of the month and **Royalty** from most foundries on previous quarter's wafer shipments
- 2nd month: Receive **License Fees** of the month and **Royalty** from other foundries
- 3rd month: **License Fees** Only.



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Q1 Revenue Breakdown

Thousands of NT dollars

	Q1 2017	Q4 2016	QoQ	Q1 2016	YoY	2016	2015	YoY
Licensing	74,146	79,684	-6.95%	85,976	-13.76%	330,087	267,512	23.39%
Royalty	263,103	226,543	16.14%	233,870	12.50%	885,372	824,108	7.43%
Total	337,249	306,227	10.13%	319,846	5.44%	1,215,459	1,091,620	11.34%

Number of Licenses

		Q1 2017	Q4 2016	2016	2015
Technology Licenses		5	10	43	28
Design Licenses	NRE	8	12	56	57
	Usage	88	73	311	349

Financial Income Statement

Amount in Thousands of NT Dollars, except margins/EPS/ROE

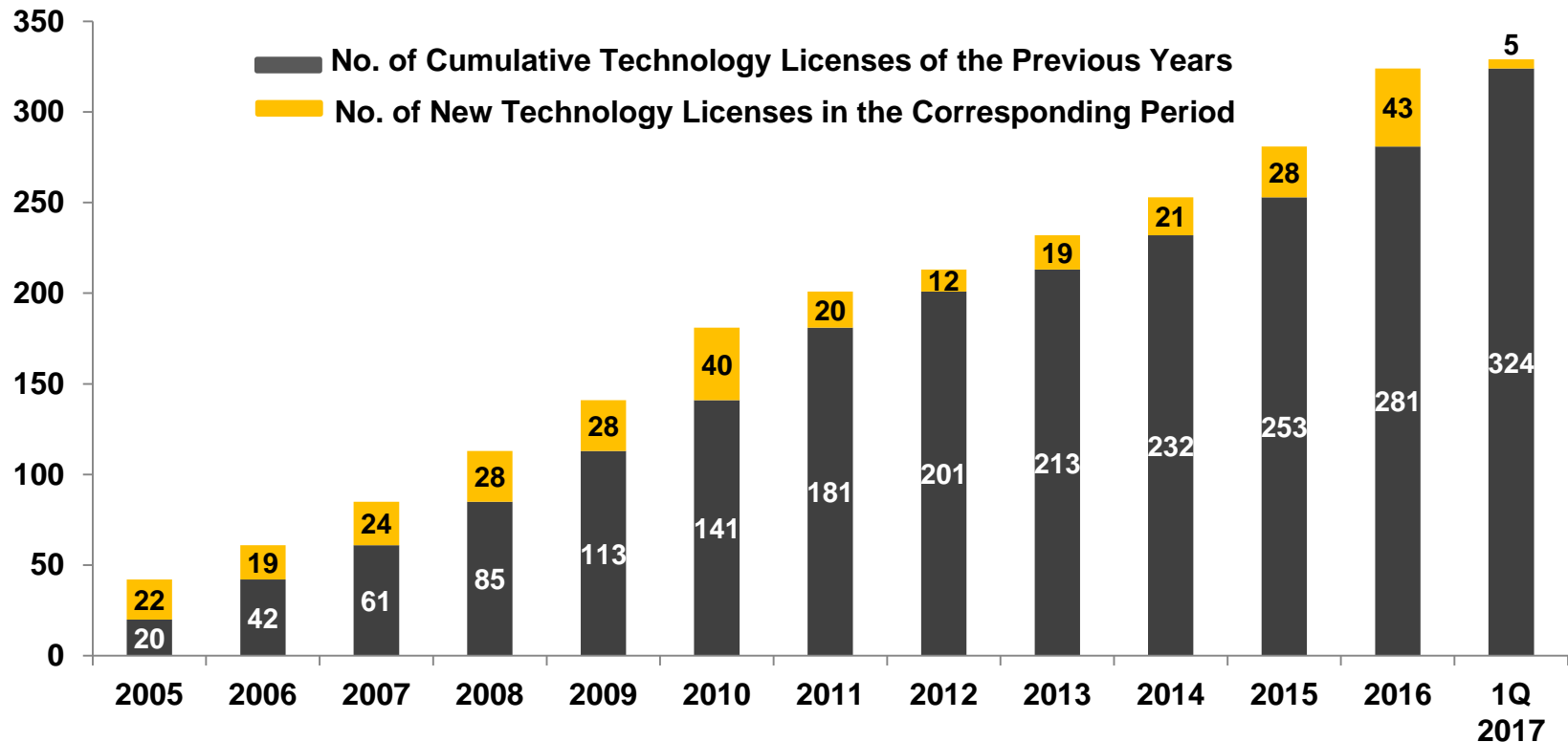
	Q1 2017	Q4 2016	Q1 2016	change (QoQ)	change (YoY)
Revenue	337,249	306,227	319,846	10.1%	5.4%
Gross Margin	100%	100%	100%	-	-
Operating Expenses	193,603	171,681	177,088	12.8%	9.3%
Operating Margin	42.6%	43.9%	44.6%	-1.3ppts	-2.0ppts
Net Income	151,378	132,361	166,012	14.4%	-8.8%
Net Margin	44.9%	43.2%	51.9%	+1.7ppts	-7.0ppts
EPS	2.00	1.75	2.19	14.3%	-8.7%
ROE	30.2%	28.3%	34.9%	+1.9ppts	-4.7ppts

Technology Licensing

Number of Licenses

Year	2014	2015	2016	1Q 2017
License	21	28	43	5

Note: 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.



New Technologies Under Development

- New technologies being developed for **111** platforms by Q1 17.
- **19** for NeoBit, **48** for NeoFuse, **24** for NeoEE, and **20** for NeoMTP.

	7/10nm	12/14/16nm	28nm	40nm	55/65nm	80/90nm	0.11~ 0.13um	0.15~ 0.18um	>0.25 um
NeoBit	-	-	-	-	-	-	6	13	
NeoFuse	3	3	10	5	10	6	6	5	-
NeoEE	-	-	-	-	-	-	5	19	-
NeoMTP	-	-	-	-	1	2	5	12	-

Note: As of Mar. 31st, 2017

Technology Developments by Processes

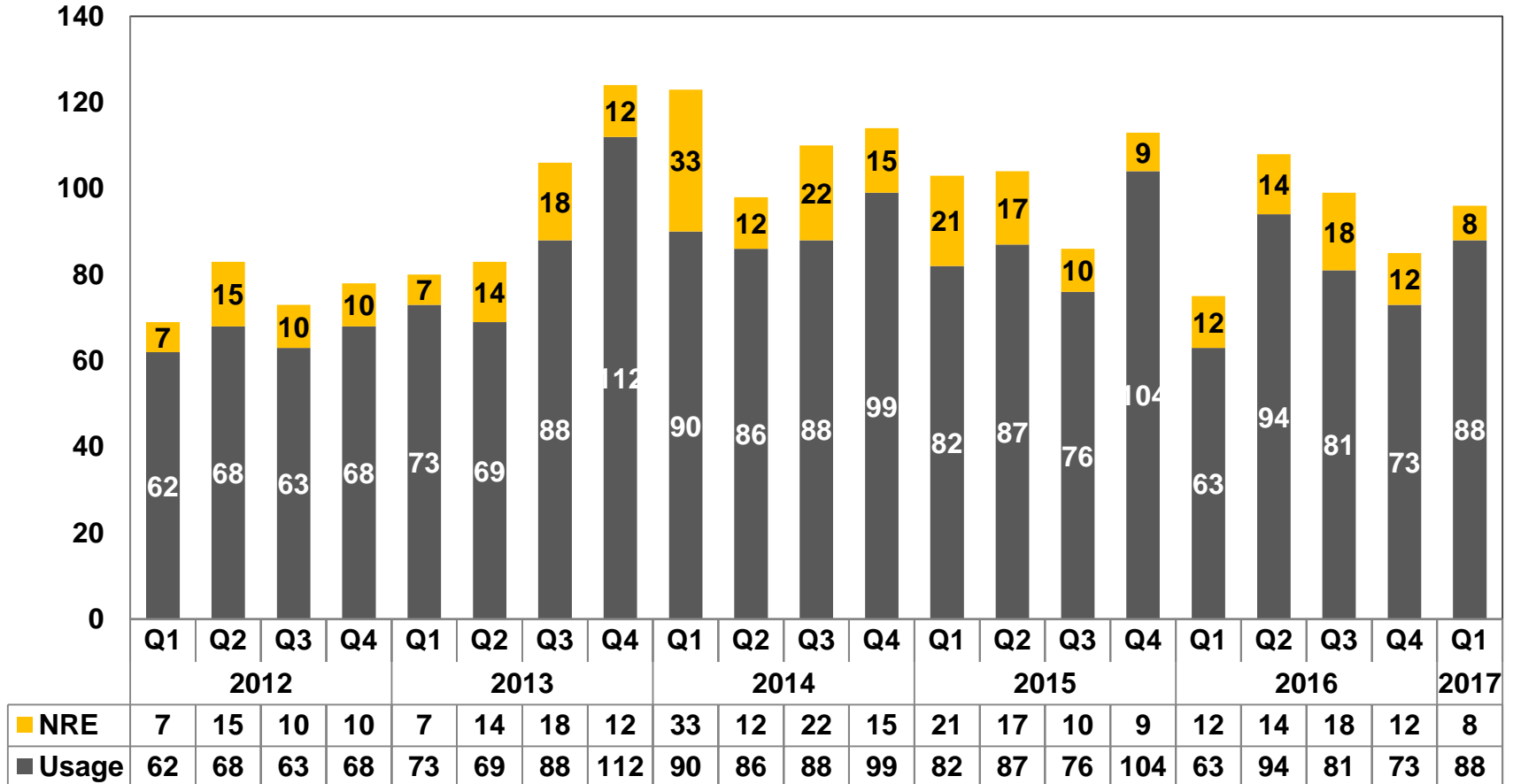
12" Fabs	Production	Developing	NVM Type	Process Type
7/10nm	0	3	OTP	FF
14/16nm	2	3	OTP	FF+
28nm	6	10	OTP	LP/HPM, HLP/HPM, LPS
40nm	6	5	OTP, MTP	HV-DDI, LP
55/65nm	14	11	OTP, MTP, Flash	LP, HV-DDI, HV-OLED, DRAM, CIS
80/90nm	6	5	OTP, MTP	HV-DDI, HV-OLED, LP
0.13/0.11um	8	2	OTP, Flash	HV-DDI, BCD, Generic
0.18um	1	0	OTP	BCD
Total	43	39		

8" Fabs	Developing	NVM Type	Process Type
90nm	3		
0.13/0.11um	20	OTP, MTP, Flash	HV-DDI, BCD, LP, RF, CIS, LL
0.18/0.16/0.152um	49	OTP, MTP	Generic, LP, LL, MR, HV, Green, BCD
0.25um	0	OTP, MTP	BCD
0.35um	0	OTP	UHV
Total	72		Note: As of Mar. 31 st , 2017

Confidential

Design Licensing (New Tape-Out)

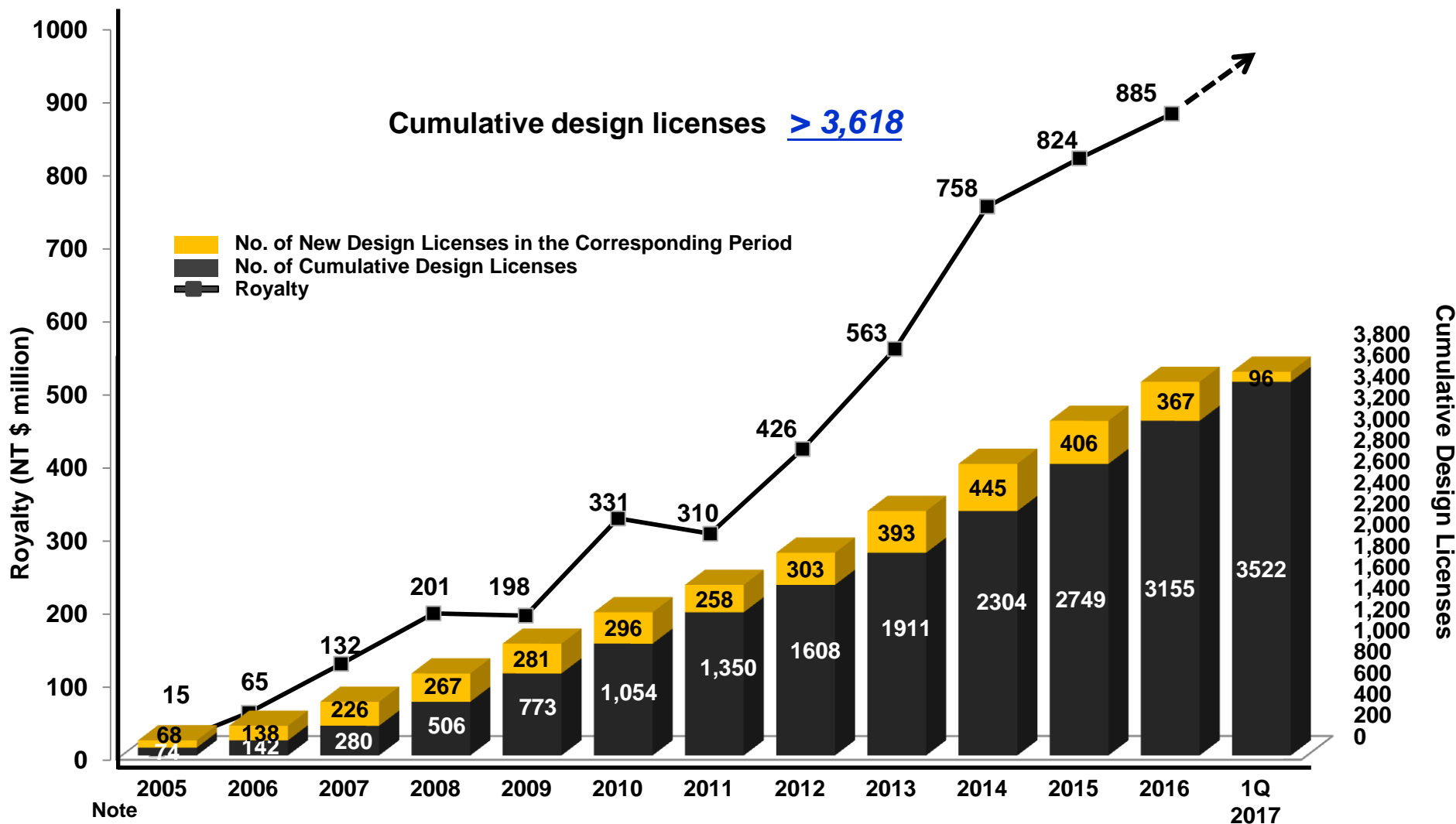
- A total **96** NTO in 1Q 2017 (**367**@2016,**406**@2015,**445**@2014, **393**@2013)



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.

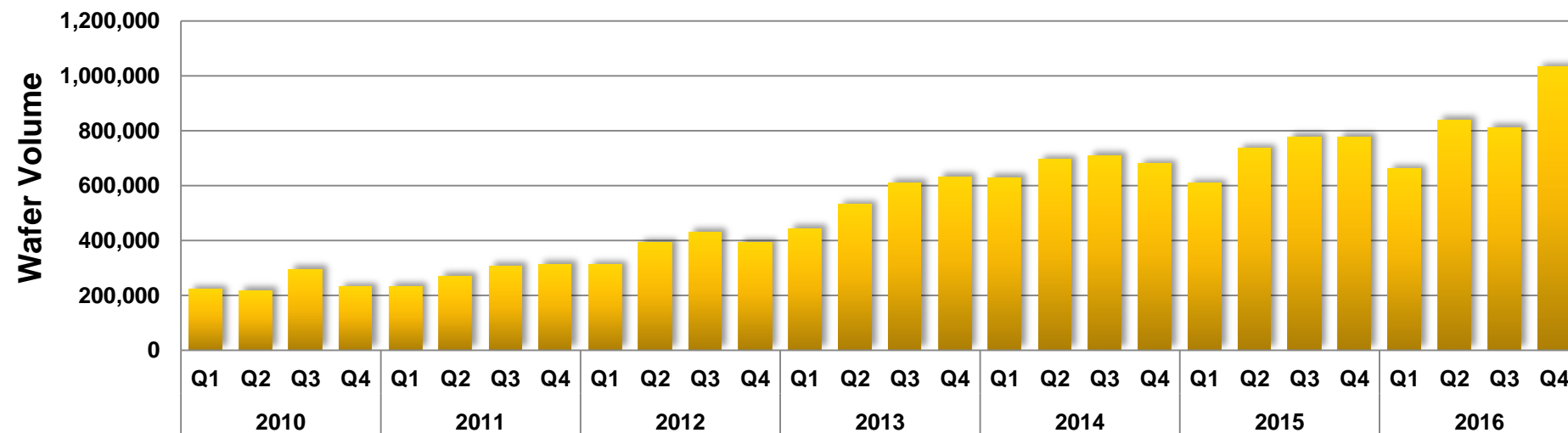
Cumulative Licenses Drive Future Royalties



Note

- 1: Due to the 2009 recession, royalty income was down 1.5% from the previous year.
- 2: Prepaid royalty from a single customer contributed to 2010 annual growth of 67%, followed by a drop of 6.3% in 2011.
- 3: CAGR for 2009-2013 was 30%.

Wafer Production Volume



Ememory IP's Penetration Rates in T Company (in US\$revenue)

	Process node	*% of T	Q1 17	Q4 16	2016	2015
8"	0.25/0.35	2%	37.05%	26.80%	28.15%	33.49%
	0.15/0.18	11%	9.10%	10.93%	12.43%	8.73%
	0.11/0.13	2%	41.92%	58.06%	42.61%	29%
12"	90nm	4%	10.96%	14.8%	12.50%	19.85%
	65nm	11%	3.50%	3.9%	3.59%	0.55%
	40/45nm	13%	0%	0%	0.00%	0%
	28nm	25%	0.56%	0.70%	0.55%	0.05%
	16/20nm	31%	0%	0%	0.00%	0%
8"		16%	16.13%	18.60%	18.86%	16.64%
12"		84%	1.15%	1.56%	1.44%	1.87%
Total		100%	3.54%	4.12%	4.27%	4.76%

* T company's Q1 2017 revenues broken down by process nodes

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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

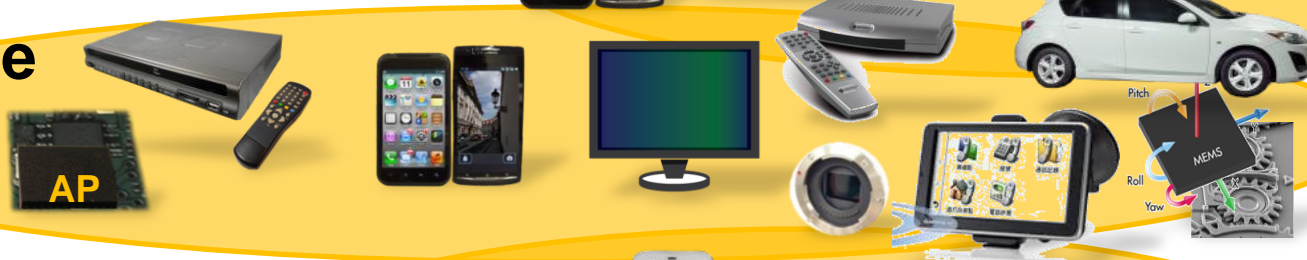
Applications by Technology

12"							8"			
7nm	10nm	12/14/16nm	28nm	40nm	55/65nm	80/90nm	110/130nm	160/180nm	250nm	350nm

NeoBit



NeoFuse



NeoFlash



NeoEE

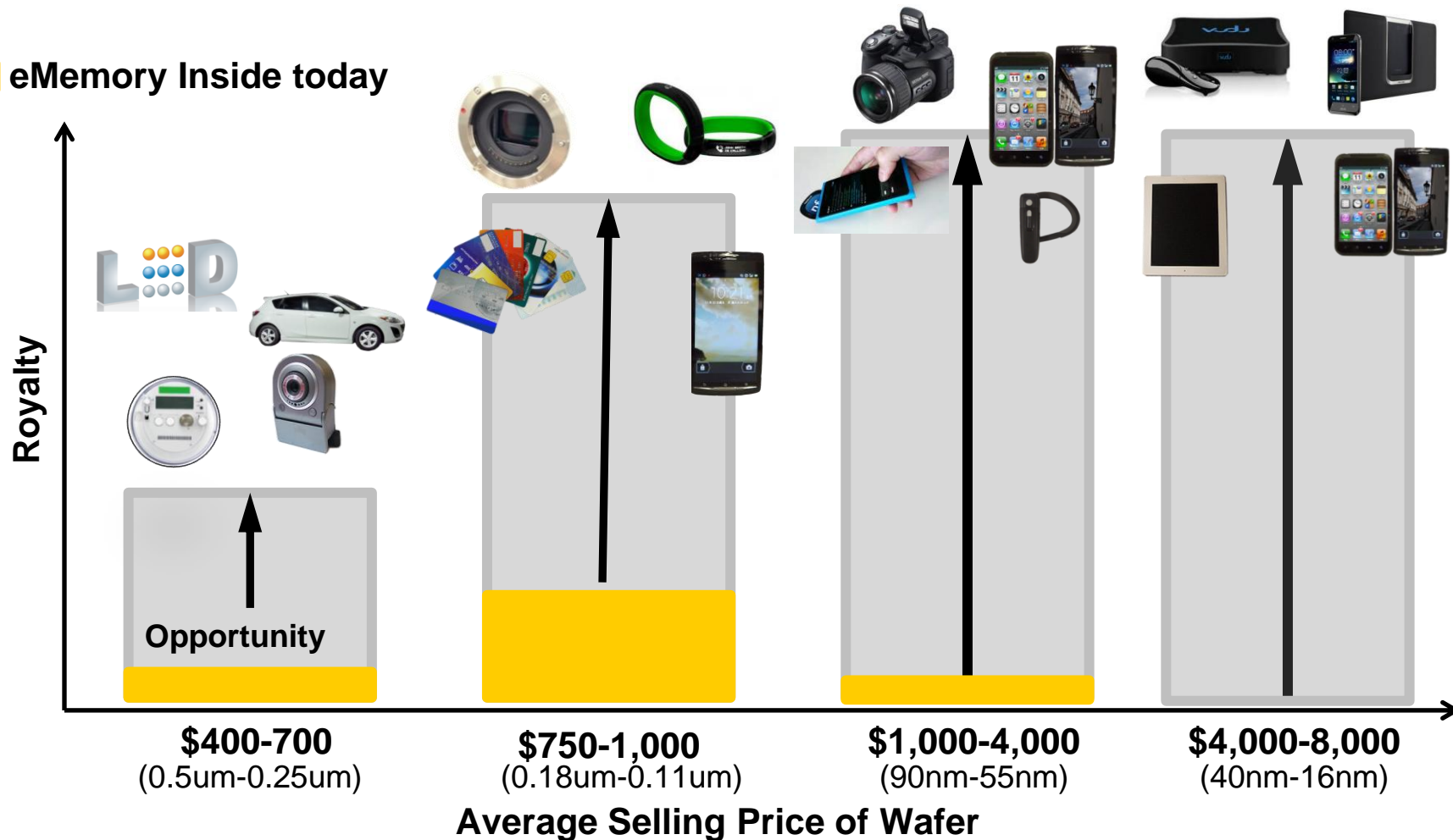


NeoMTP



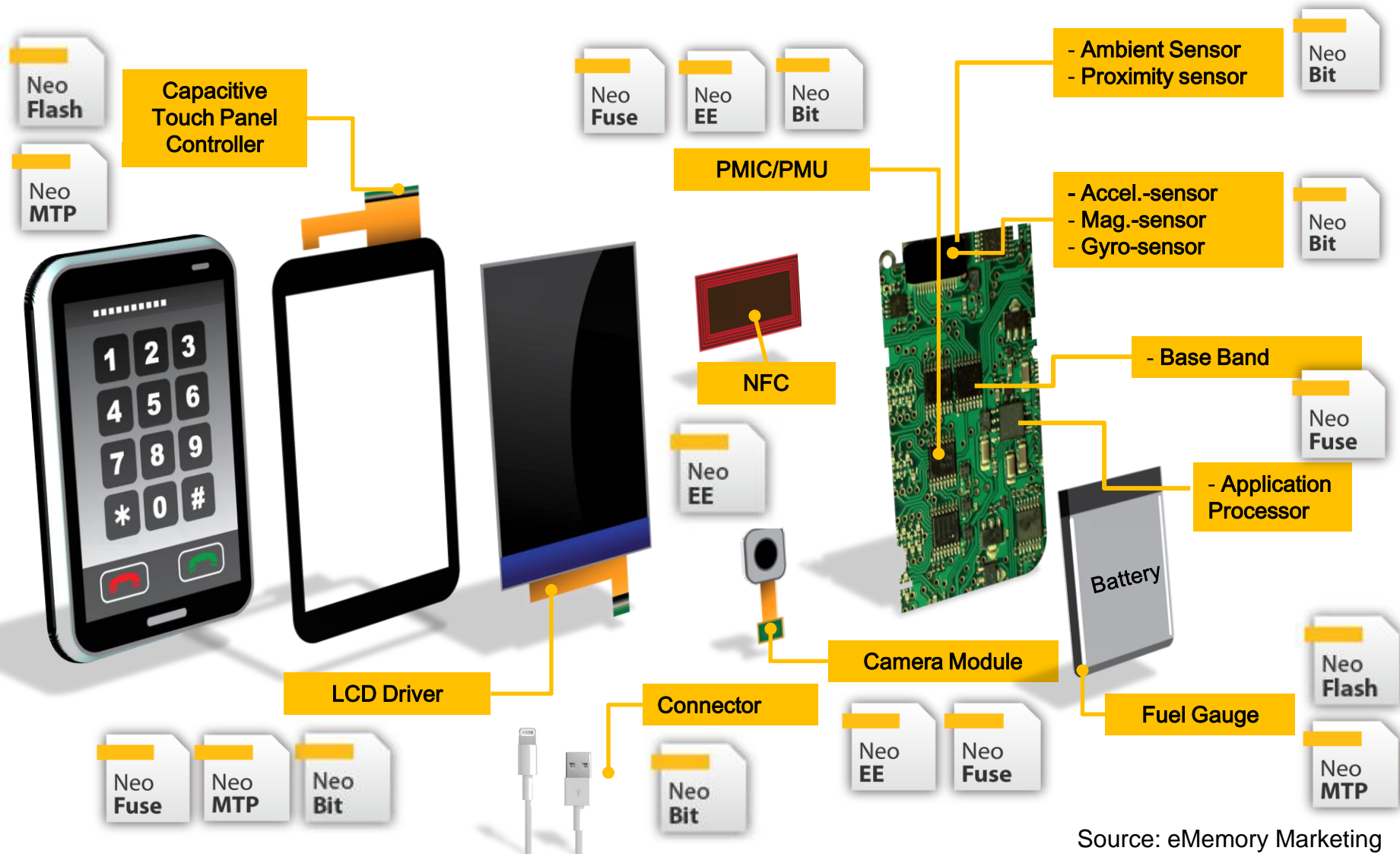
Opportunity at all Price Points

 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

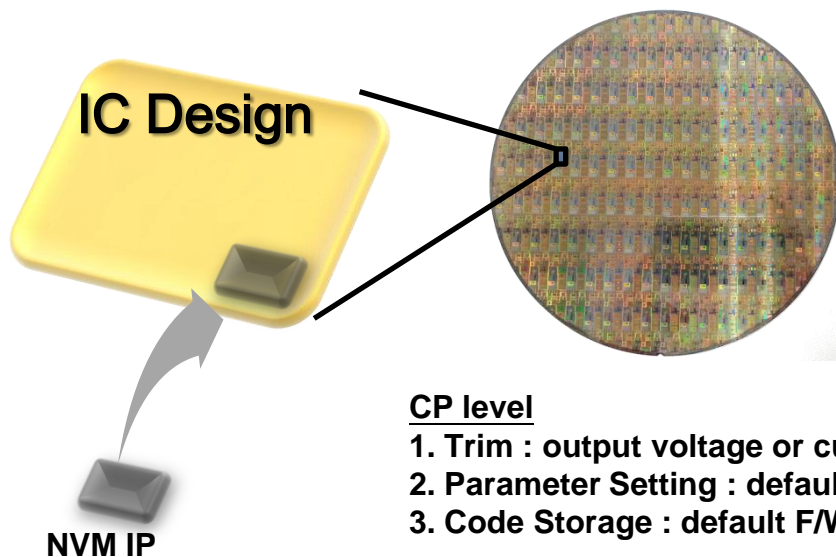
Package/FT level

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

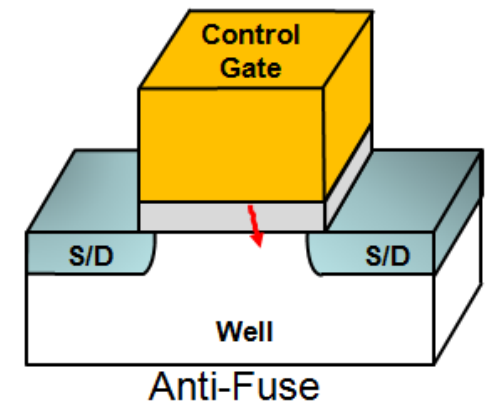
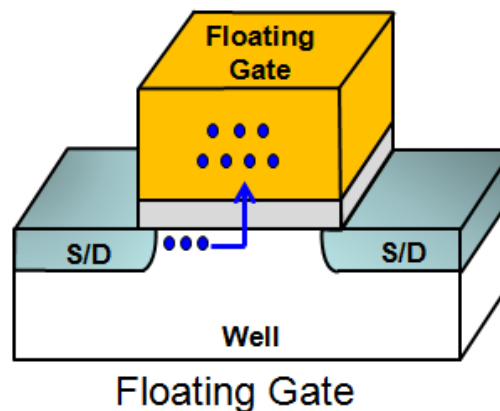
Invisibility for Security

- 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



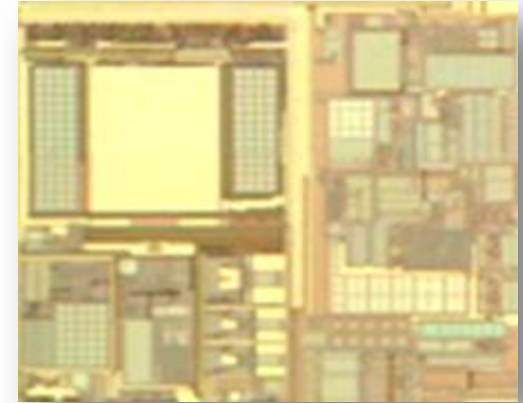
reverse
copy

re-produce



without protection

Fake Product

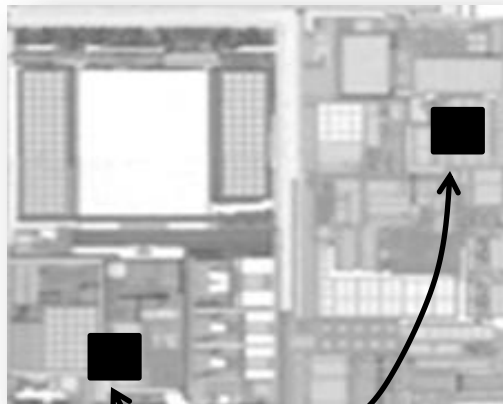


reverse
copy

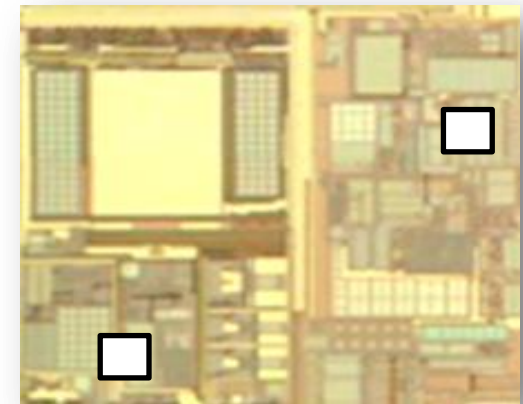
re-produce



with protection

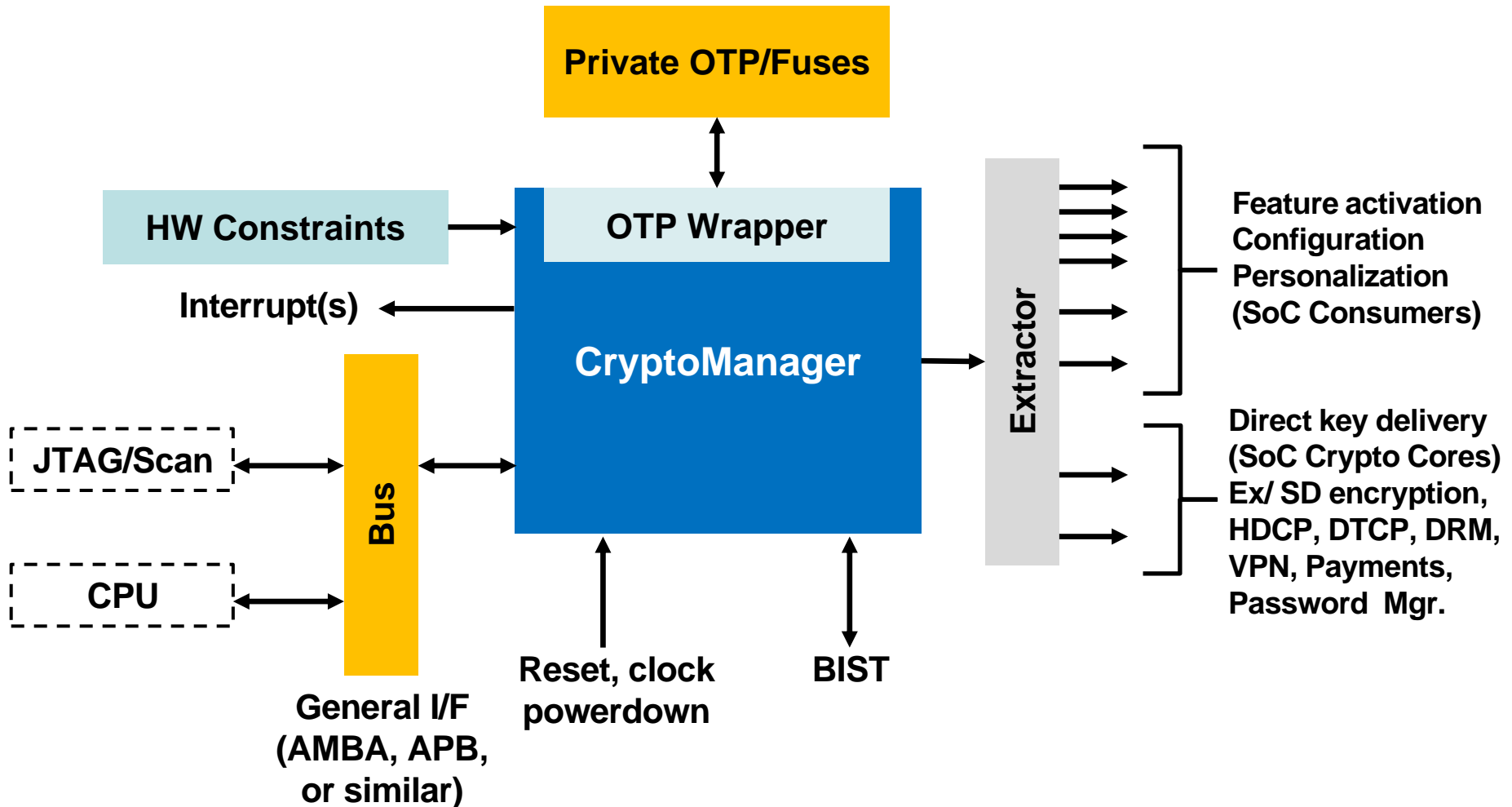


Security IP/Code by
Authorized Use



Can NOT Work w/o
Security IP/Code

OTP for security storage

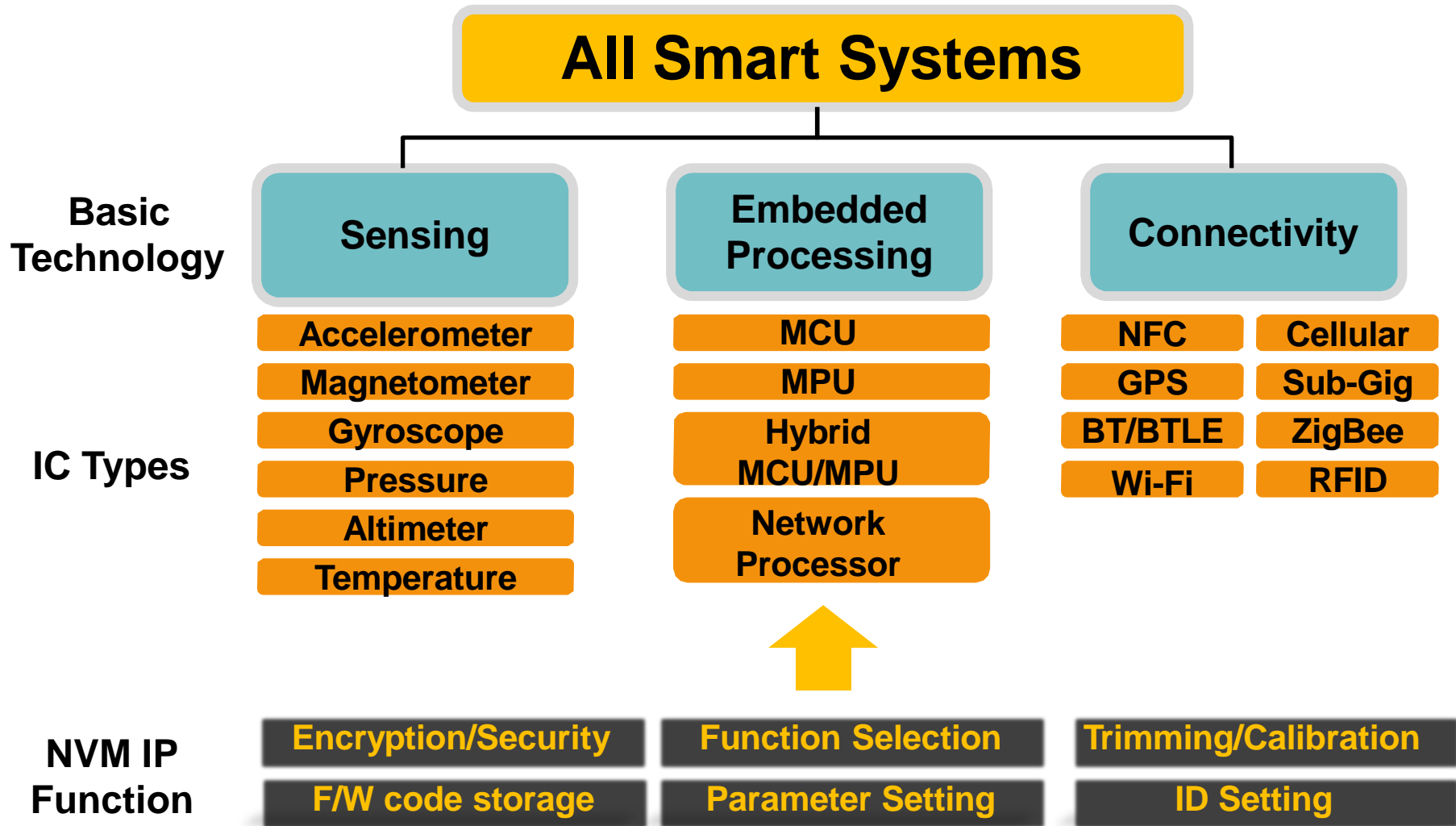


Source : Rambus crypto manager platform

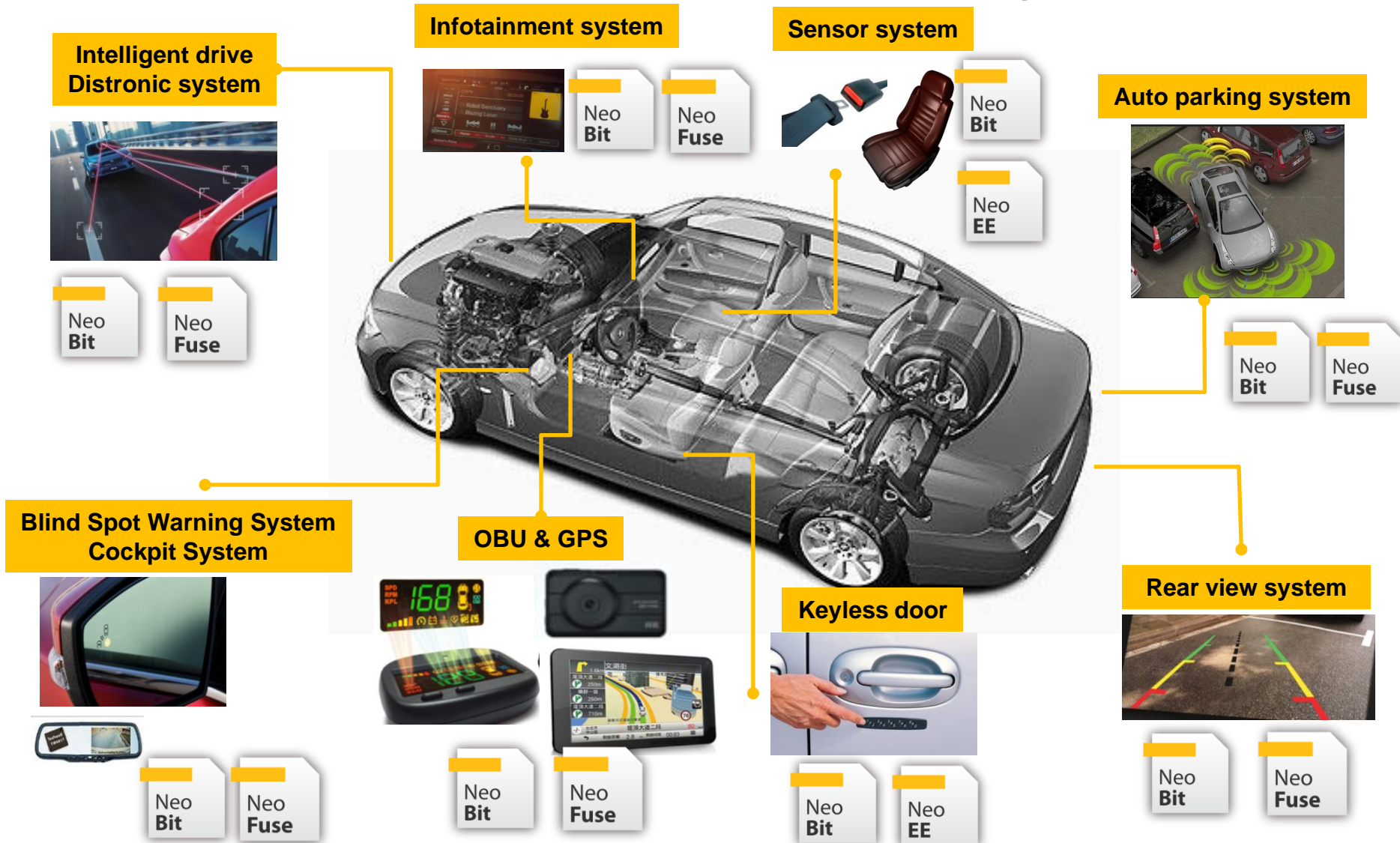
Security with eMemory IPs



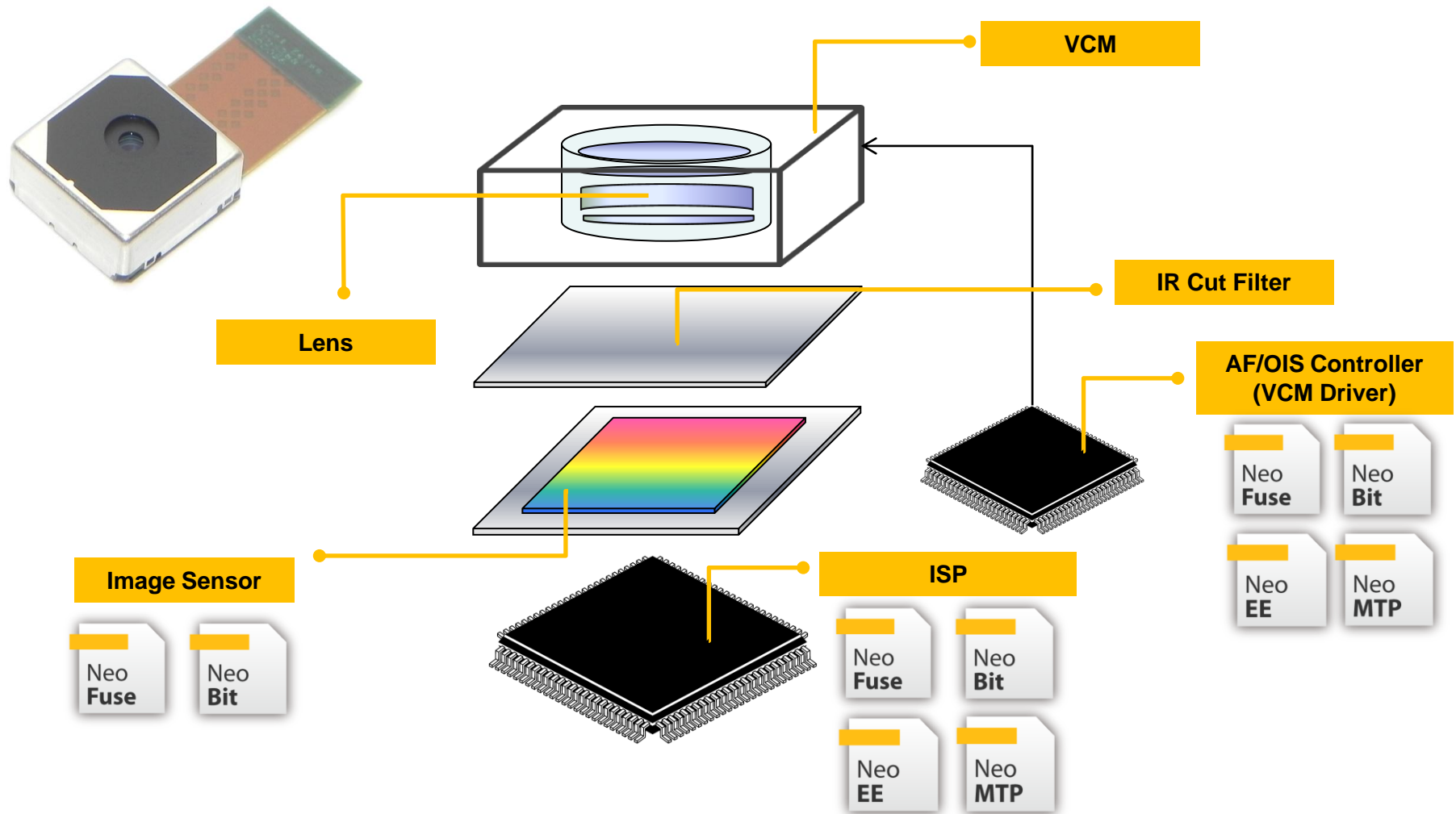
NVM IP Demand in IoT



Autotronics with eMemory IPs

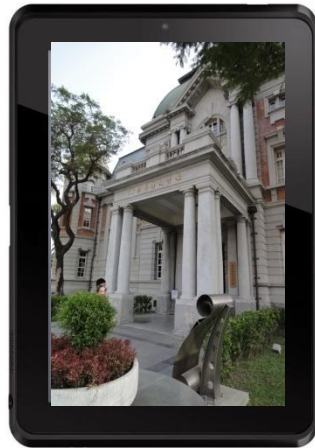


Imager Module with eMemory IPs



Advanced LCD Driver ICs

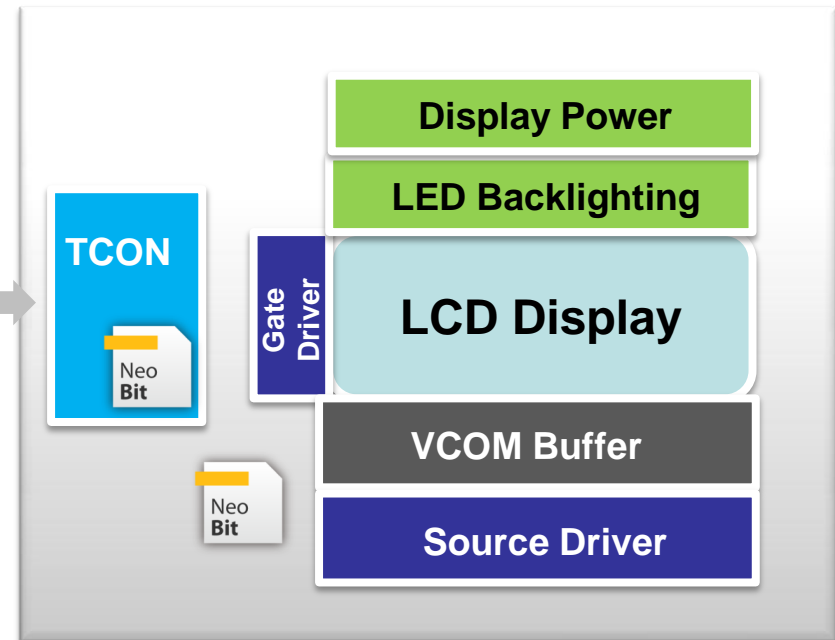
Process Technology : 0.11um HV/80nm HV/55nm HV



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



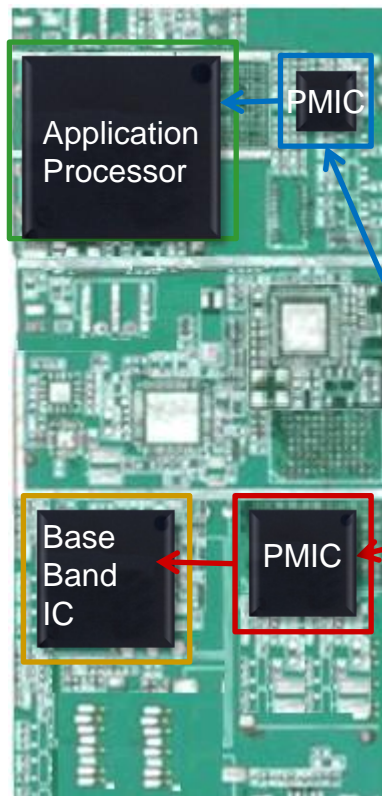
DDI



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

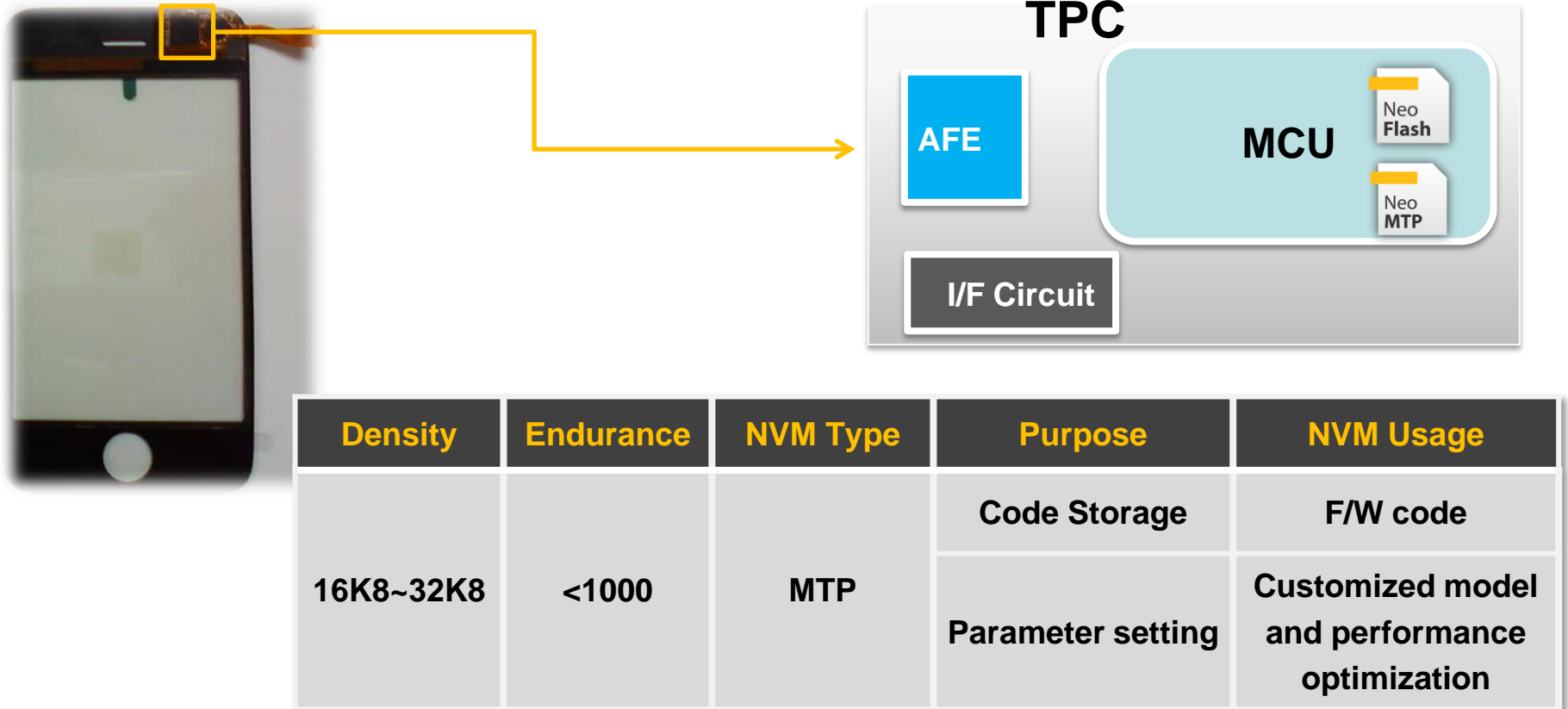


Density	NVM Type	Purpose	NVM Usage
2Kb~4Kb	OTP	Trimming	DC/DC, Bandgap
		Parameter Setting	Design flexibility & Performance optimization
		Code Storage	Start-up behavior & smart power saving algorithm



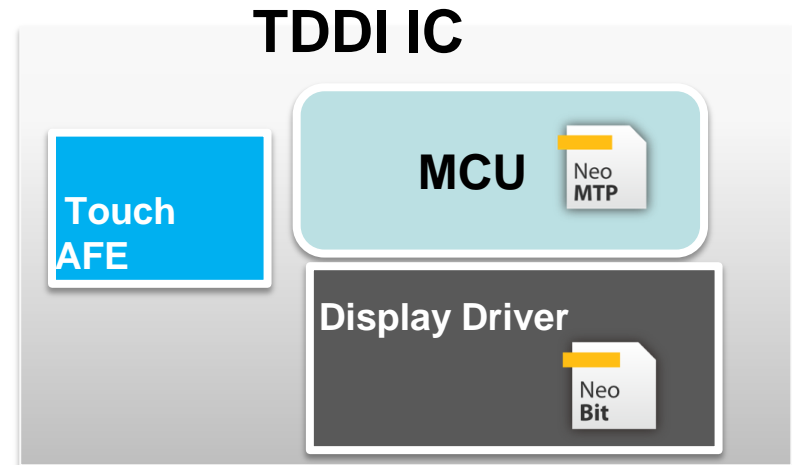
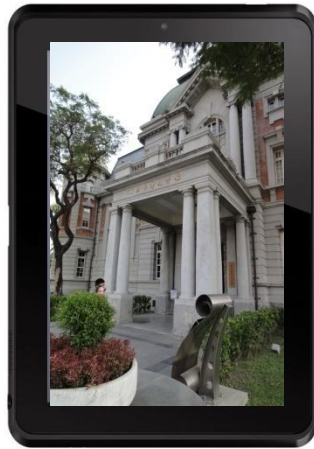
Touch Panel Controller ICs

Process Technology : 0.16um HV/0.11um G



In-Cell Touch Panel Controllers ICs

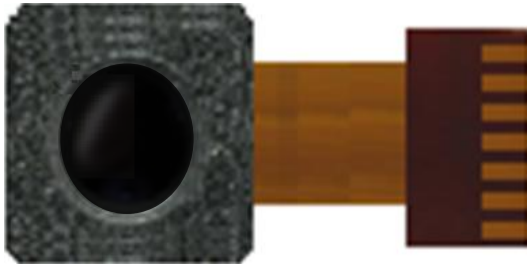
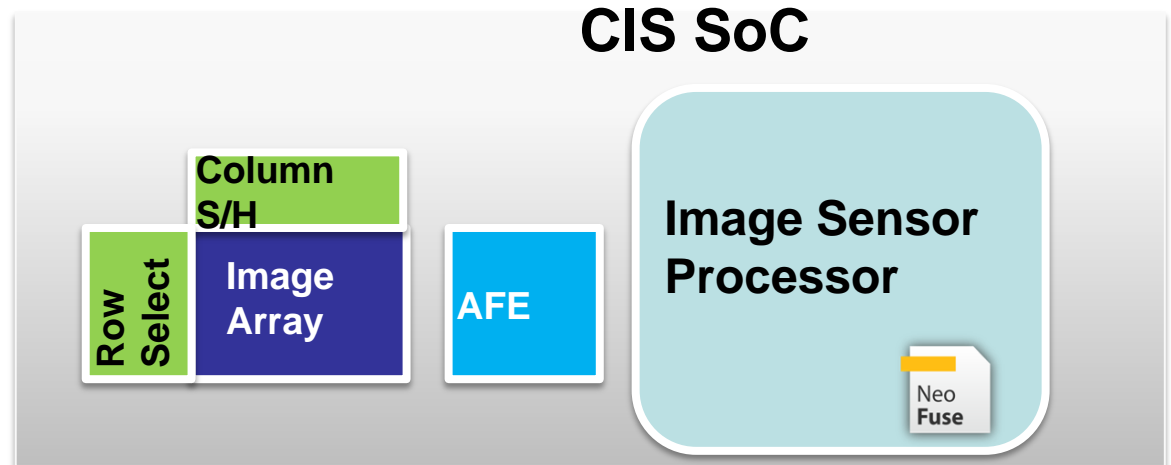
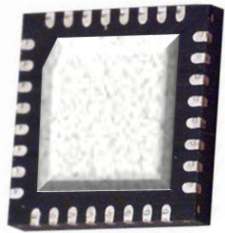
Process Technology : 0.11um HV/80nm HV/55nm HV



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

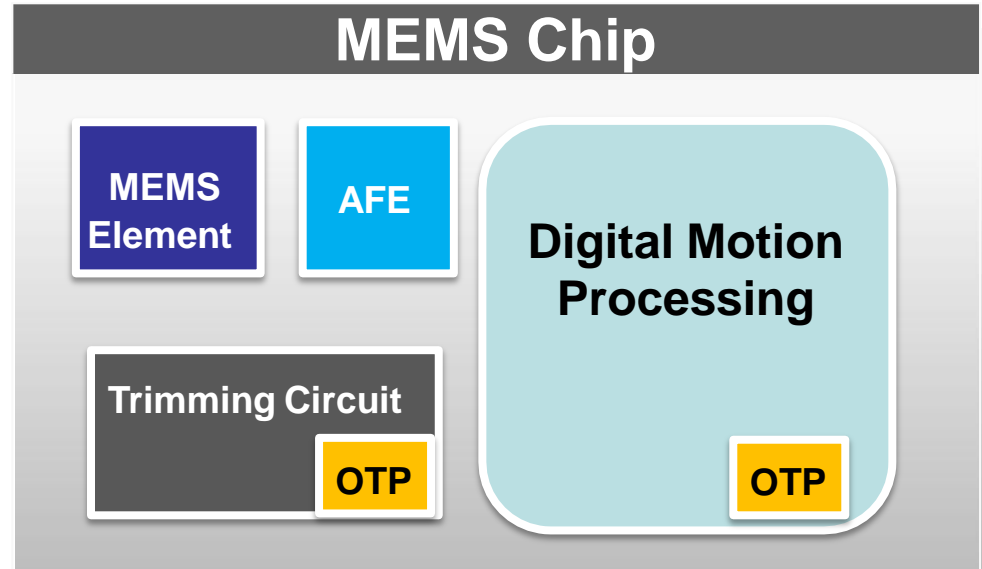
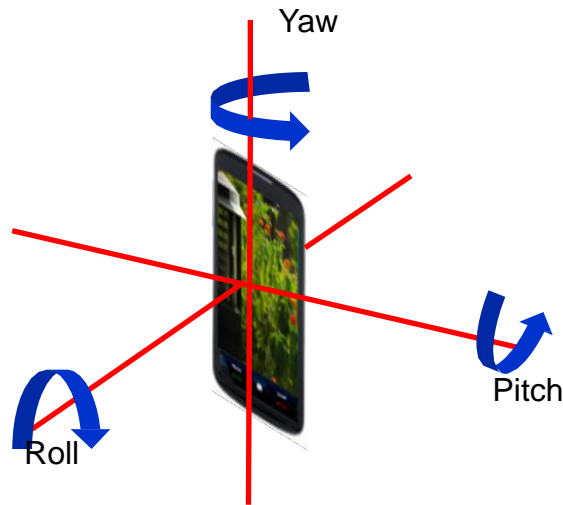
Process Technology : 0.11um CIS/90nm CIS/65nm CIS



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

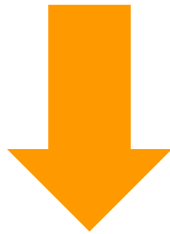


Density	NVM Type	Purpose	NVM Usage
2Kb~4Kb	OTP	Trimming	Factory trimming
		Parameter Setting	Signal filtering
		Code Storage	Geometric computation

Replacement of Embedded Flash for Competitiveness Improvement

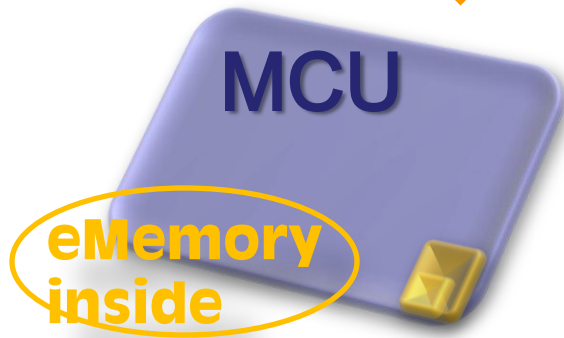


product design & manufacturing by
embedded Flash
Logic Process + 10 Masks



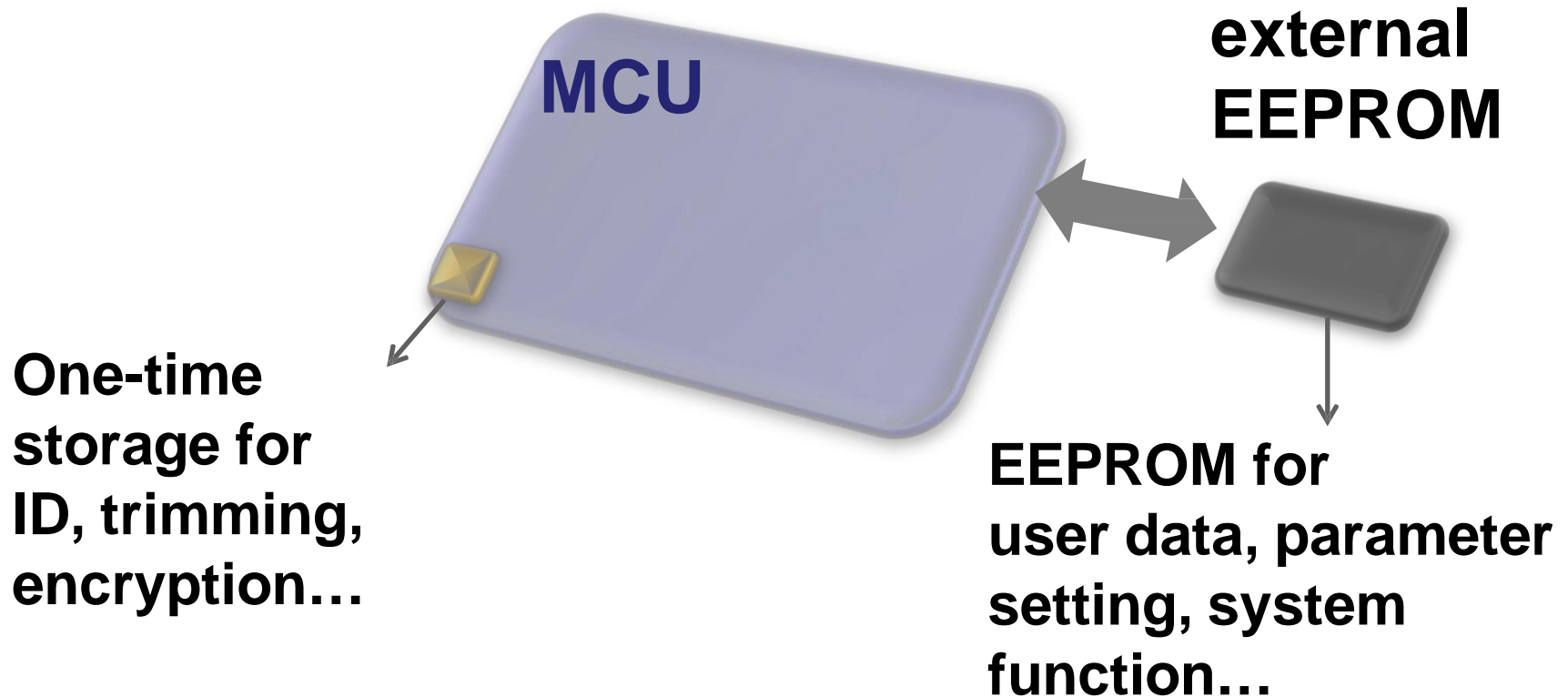
*30% more
cost reduction*

*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 Q2 and beyond

We anticipate our revenue growth will accelerate in the second half of this year.

- **On licensing revenues:**

- › **Our technology and design license revenues are expected to grow on the continuing expansion of our IP libraries, and on the demand for building advanced processes and MTP platforms among our worldwide foundry partners.**

- **On royalty revenues :**

- › **Royalty from fingerprint sensors will grow significantly as more customers start volume production.**

Outlook for Q2 and beyond

- **PMIC related royalty will maintain the growth momentum with content increase on new smartphones and the ramp of new products by our largest US customer in second half of 2017.**
- **High-end DDI and TDDI applications will continue volume production in the second half of the year, which will contribute to our royalty growth.**
- **Royalty from 28nm is set to increase with more product tape-outs in 2017.**

Outlook for Q2 and beyond

- **On our R&D results**

- **Our client will have a new product tape-out at 12nm fab in August. The 7nm IP first taped out in March at one foundry, and one more tape-out expected in August at another foundry.**
- **Our new IP, NeoPUF is expected to be integrated to chip design by the end of this year.**
- **Automotive applications have been successfully built and customers have started volume production on a small scale.**

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.

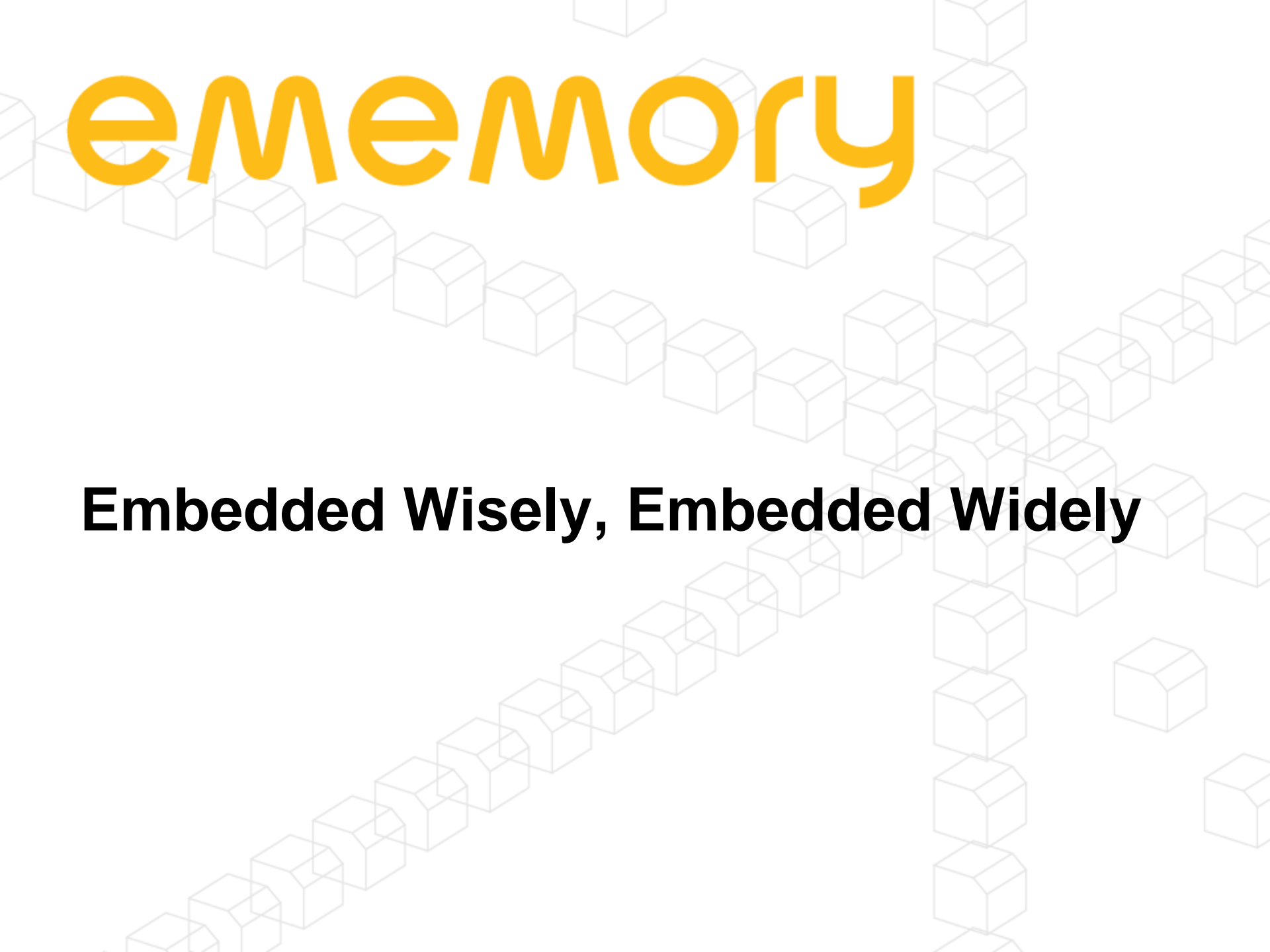
Growth in advanced technology

- 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