

# ememory

**A Leading Logic NVM  
Company**

# IPR Notice

**All rights, titles and interests contained in this information, texts, images, figures, tables or other files herein, including, but not limited to, its ownership and the intellectual property rights, are reserved to eMemory. This information may contain privileged and confidential information. Some contents in this information can be found in Logic Non-Volatile Memory (The NVM solutions from eMemory), published in 2014. Any and all information provided herein shall not be disclosed, copied, distributed, reproduced or used in whole or in part without prior written permission of eMemory Technology Inc.**

**eMemory, NeoBit, NeoFlash, NeoEE, NeoMTP and NeoFuse are all trademarks and/or service marks of eMemory in Taiwan and/or in other countries.**

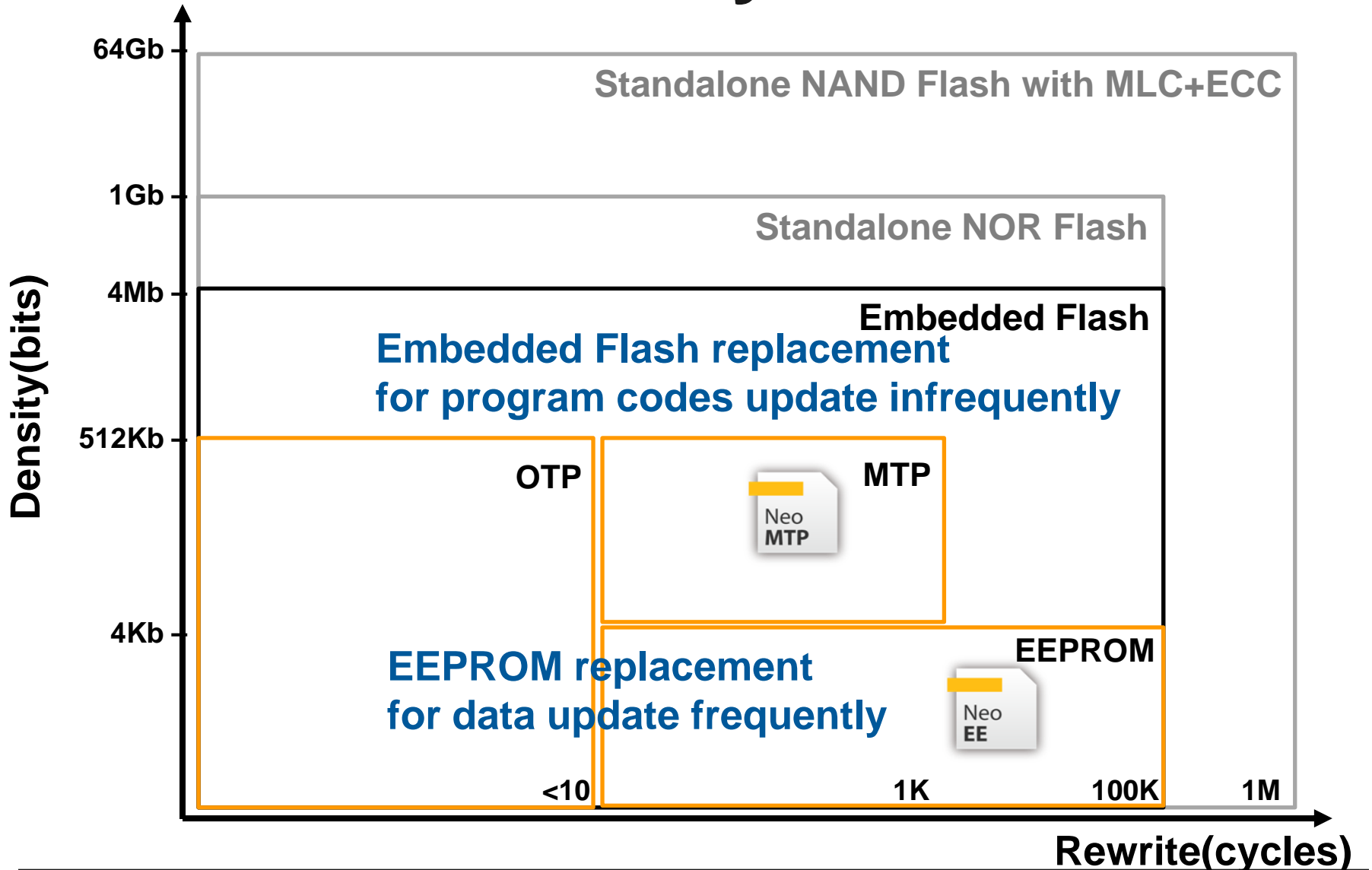
# Cautionary Statement

**This presentation contains forward-looking statements, which are subject to risk factors associated with semiconductor and intellectual property business. It is believed that the expectations reflected in these statements are reasonable. But they may be affected by a variety of variables, many of which are beyond our control. These variables could cause actual results or trends to differ materially which include, but are not limited to: wafer price fluctuation, actual demand, rapid technology change, delays or failures of customers' tape-outs into wafer production, our ability to negotiate, monitor and enforce agreements for the determination and payment of royalties, any bug or fault in our technology which leads to significant damage to our technology and reputation, actual or potential litigation, semiconductor industry cycle and general economic conditions. Except as required by law, eMemory undertakes no obligation to update or revise any forward-looking statements, whether as a result of new information, future events, or otherwise.**

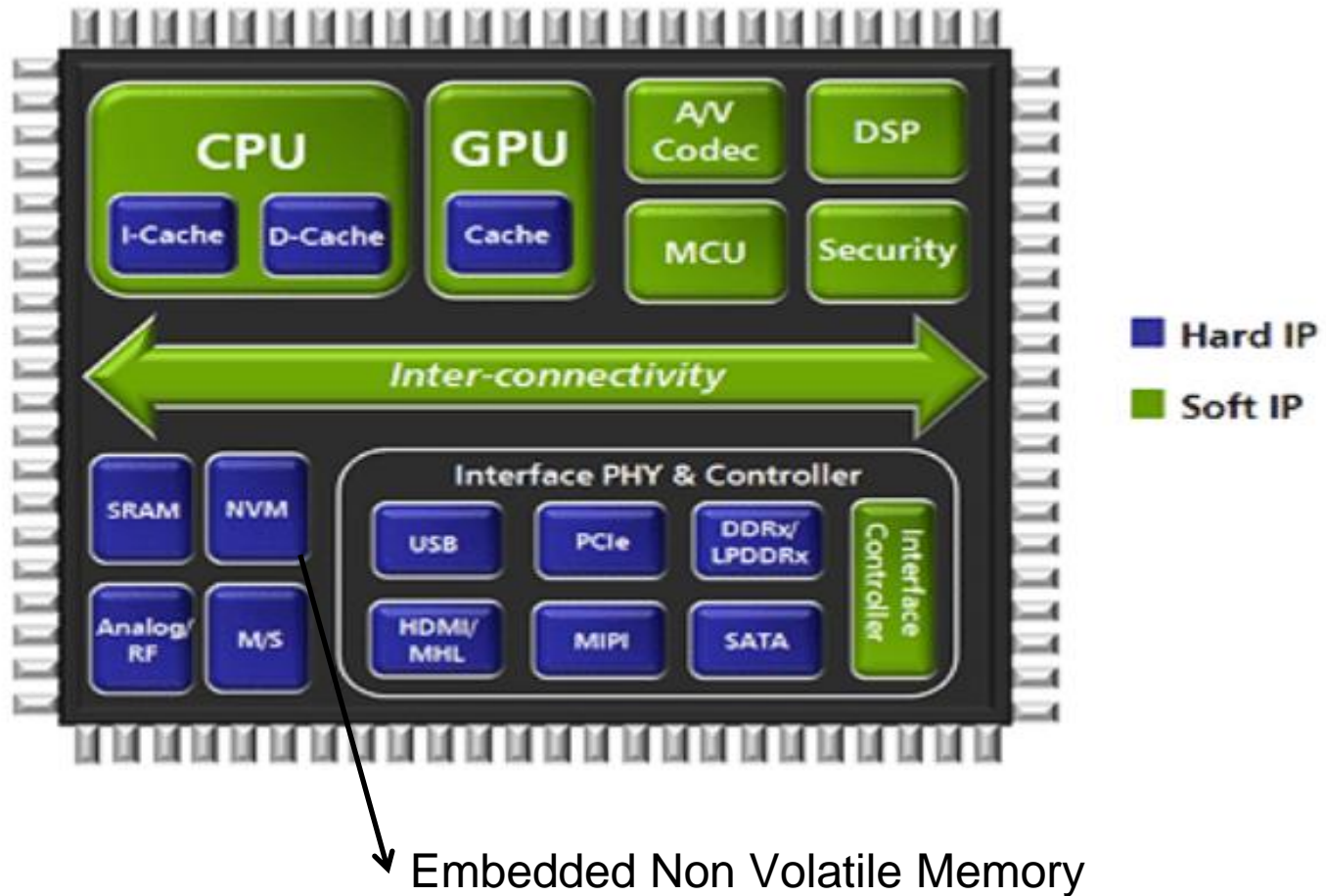
# Outline

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

# Nonvolatile Memory Classifications



# SOC Block Diagram



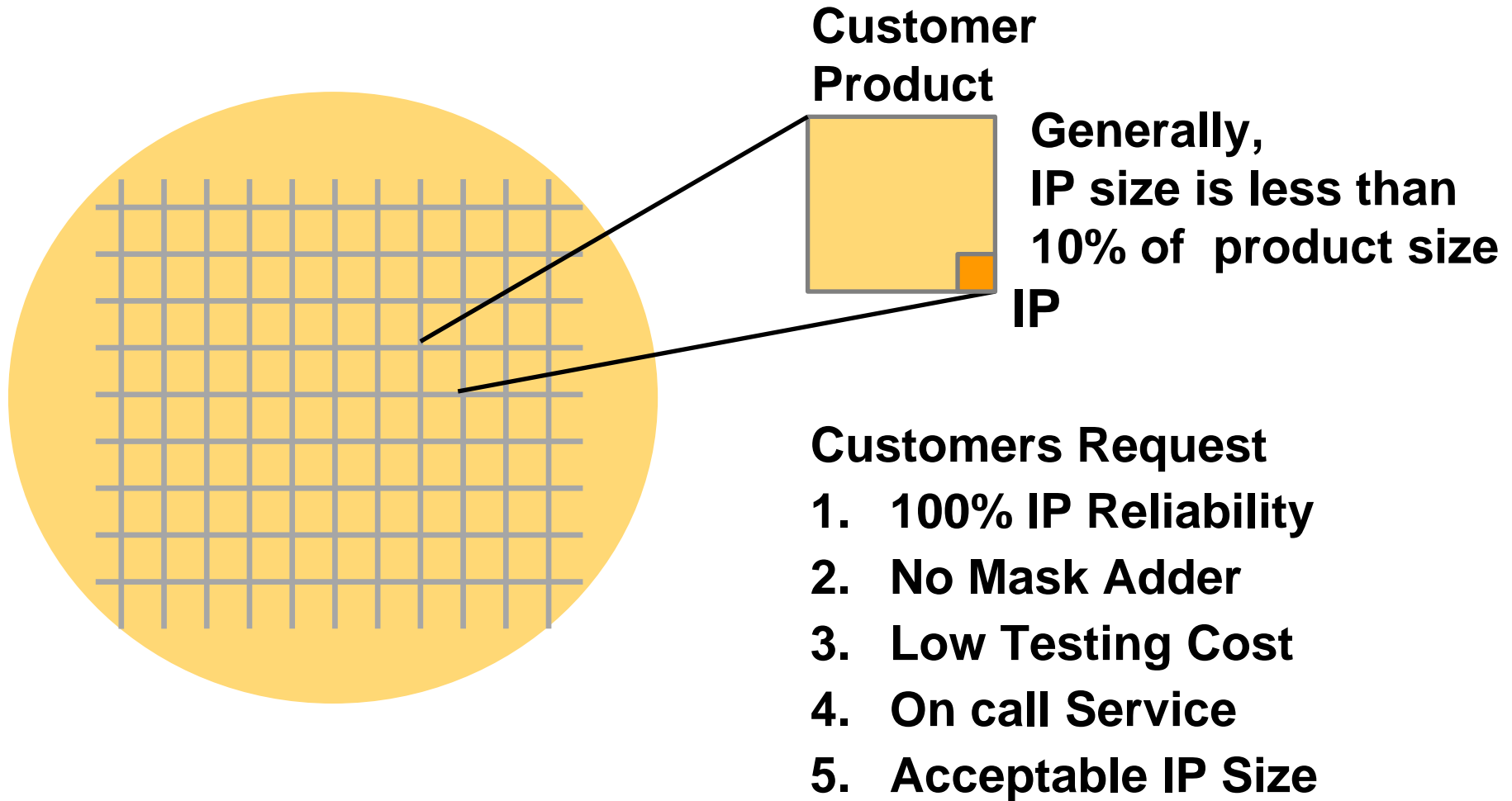
Source : tsmc

# 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       |

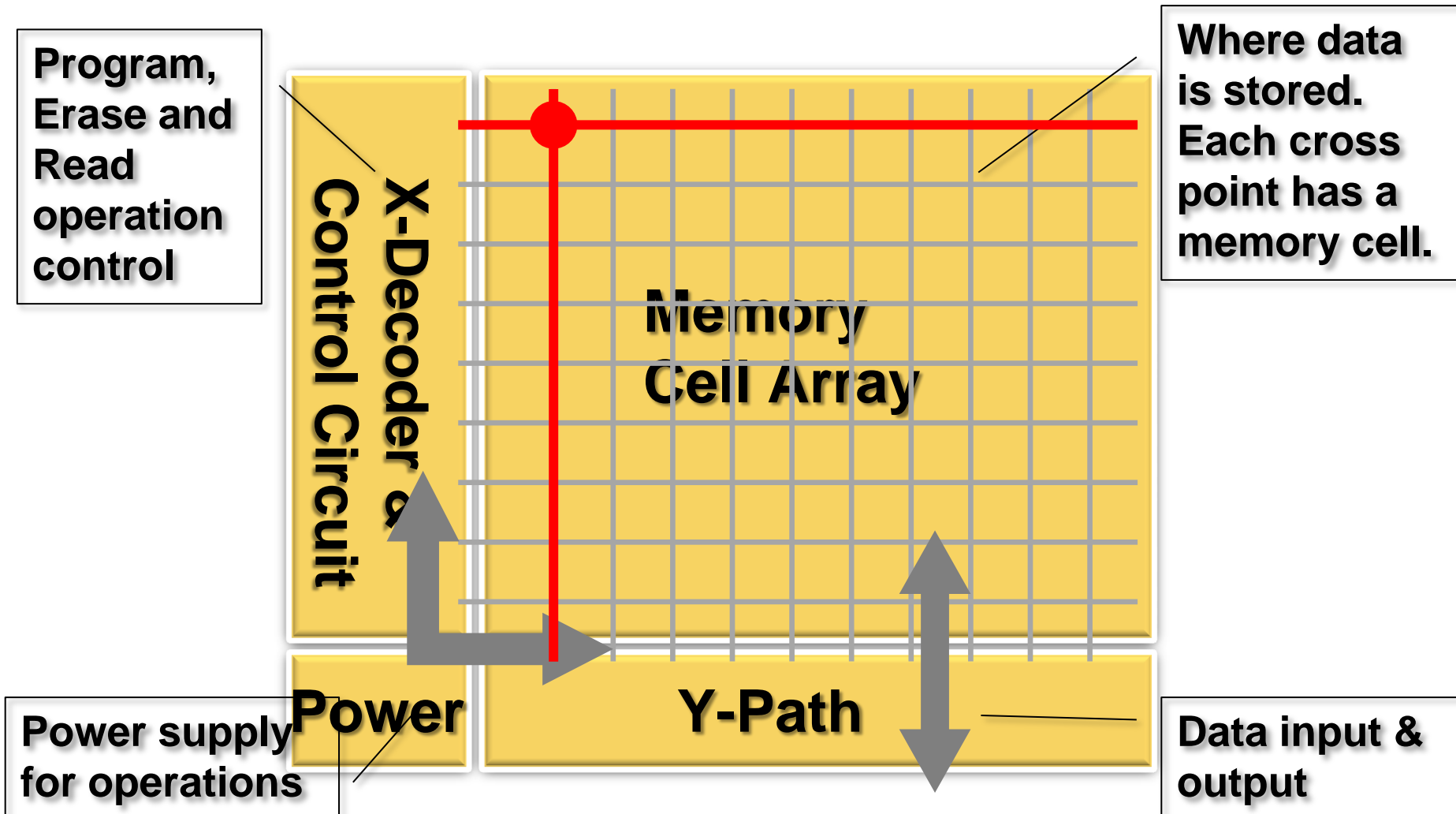
- ROM not programmable, eFuse cannot scale beyond 16Kb, embedded flash expensive and cannot scale after 40 nm
- eMemory's IPs: OTP (antifuse, floating gate) and MTP (floating gate)

# Considerations for IP Adoption

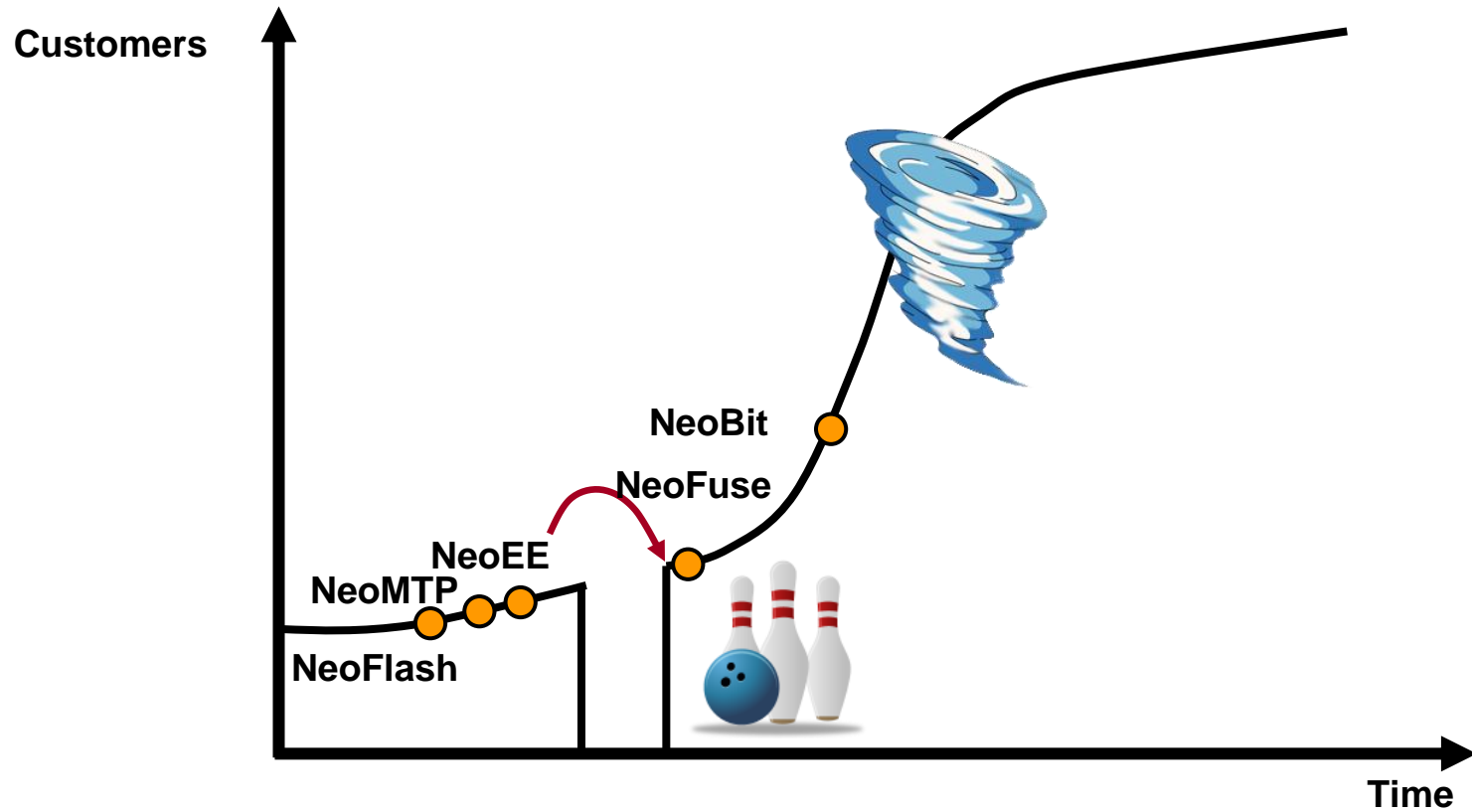




# Inside Nonvolatile Memory IP

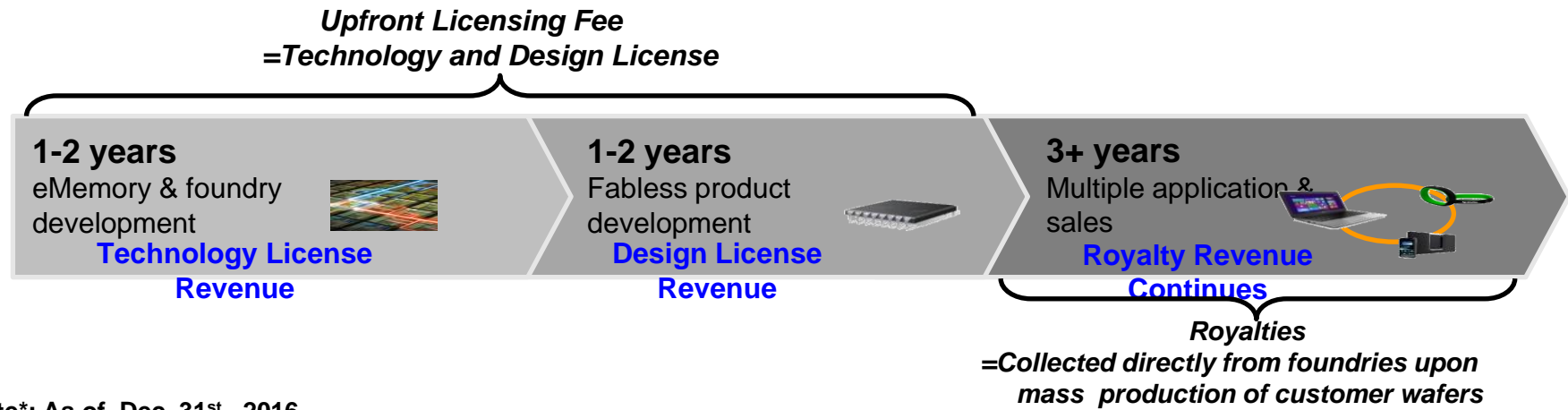


# Crossing the Chasm



# 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. 31<sup>st</sup>, 2016

# Worldwide Customers



## Foundry



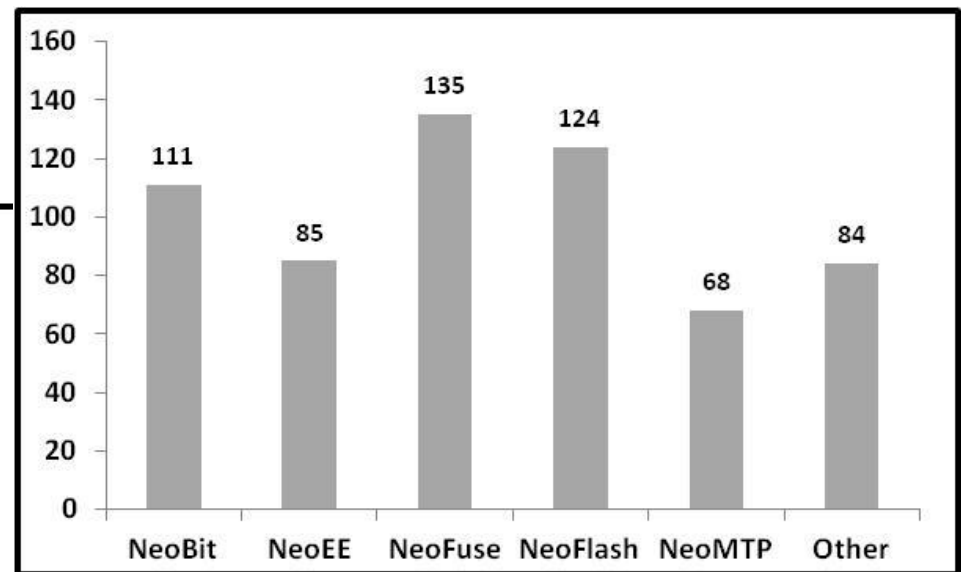
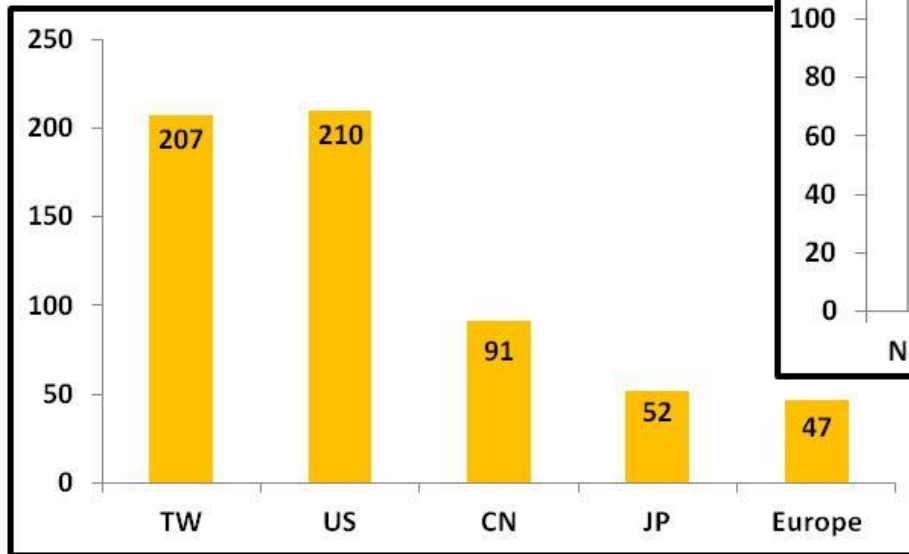
## IDM



|         | 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  |

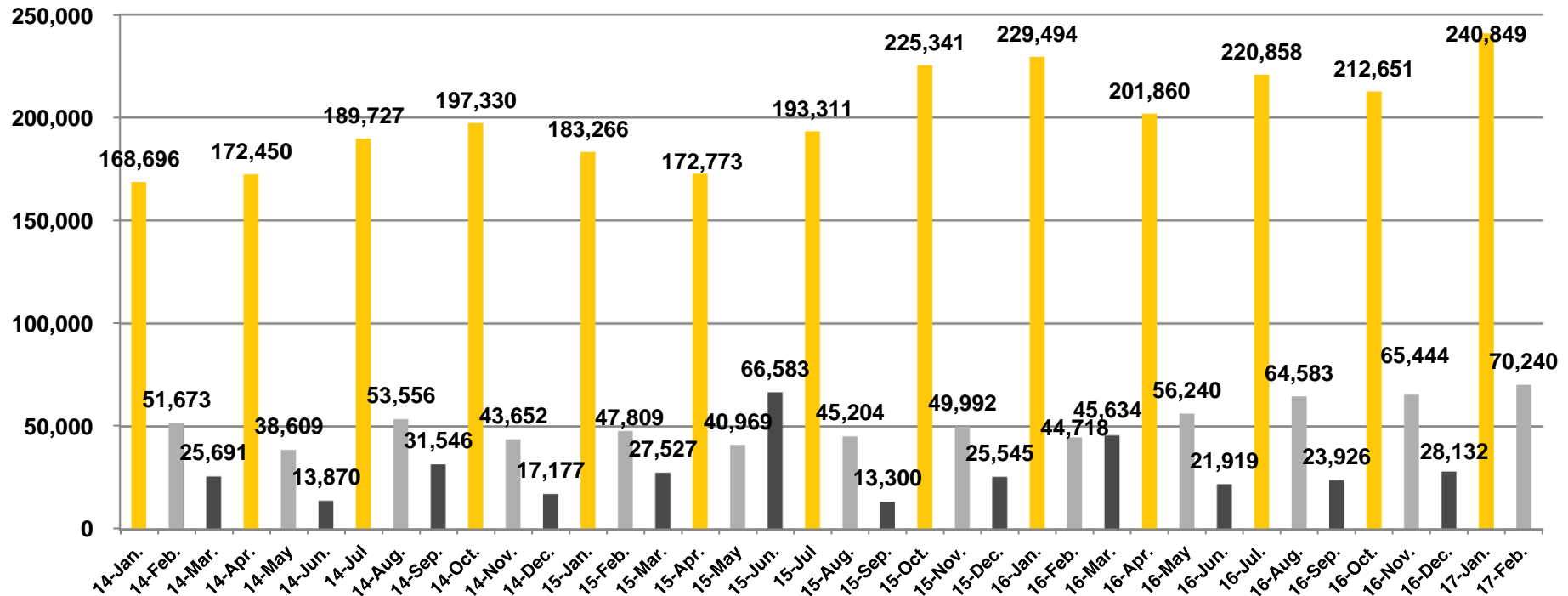


Note\*: As of Dec. 31<sup>st</sup>, 2016

# 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



# Outline

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

# 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

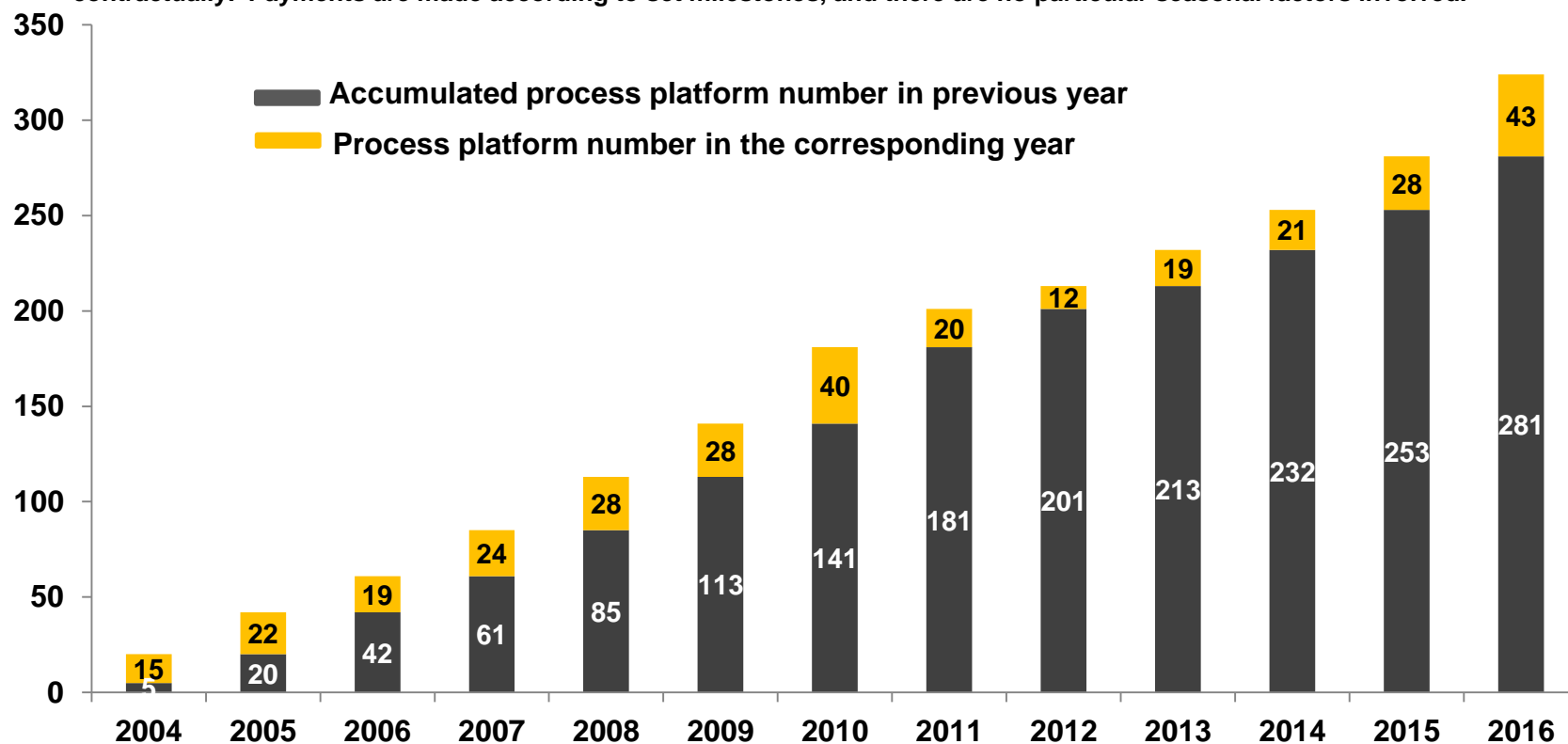
| (Unit: NTD thousands) | Q4 2016 | Q4 2015 | % change | 2016      | 2015      | % change |
|-----------------------|---------|---------|----------|-----------|-----------|----------|
| Revenue               | 306,227 | 300,878 | 1.8%     | 1,215,459 | 1,091,620 | 11.3%    |
| Gross Margin          | 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~<br>0.13um | 0.15~<br>0.18um | >0.25<br>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

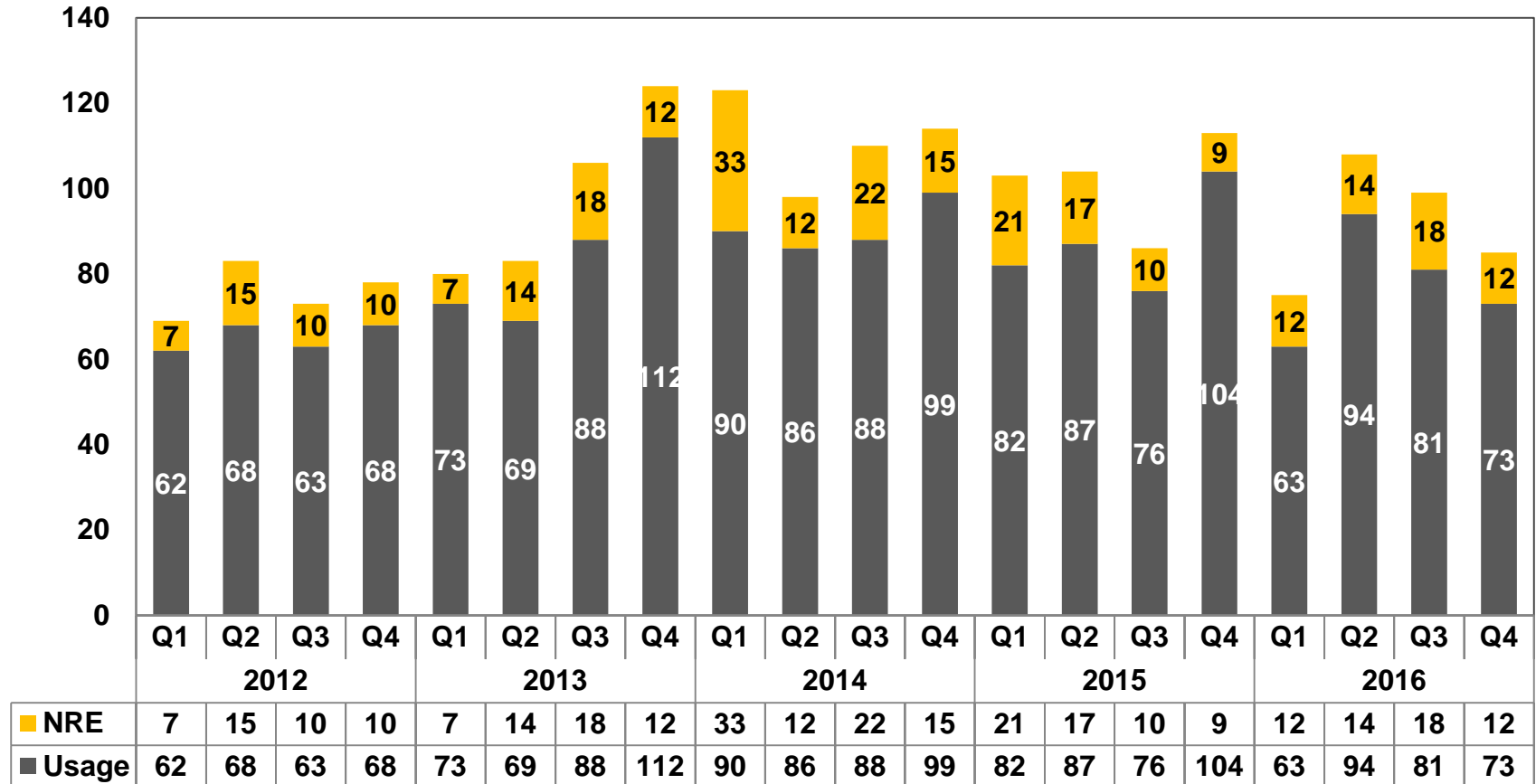
| 12" Fabs    | Production | Development | NVM Type        | Process Type                   |
|-------------|------------|-------------|-----------------|--------------------------------|
| 7/10nm      | 0          | 2           | OTP             | FF                             |
| 14/16nm     | 1          | 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. 31<sup>st</sup>, 2016

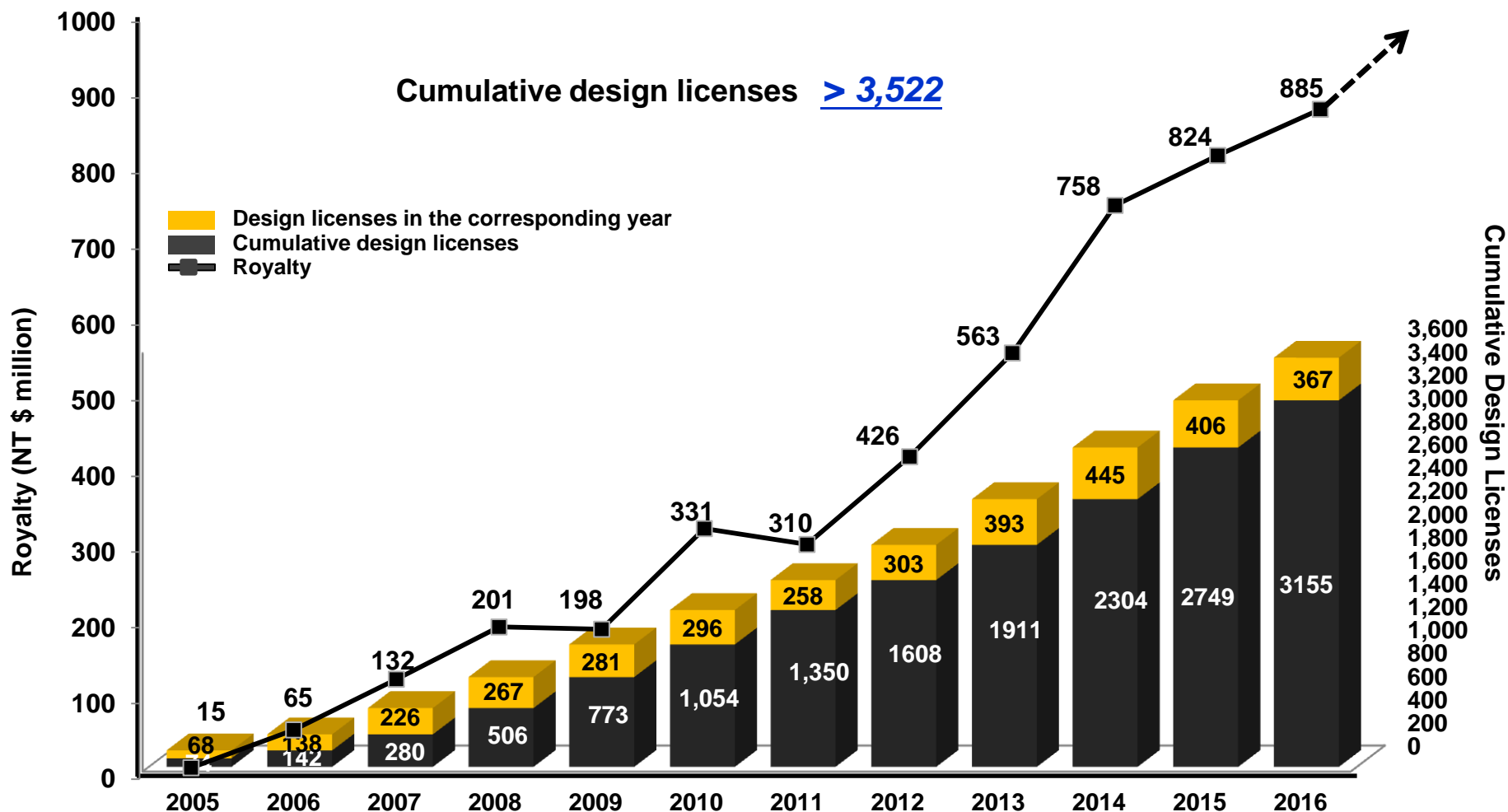
# Quarterly Design Licensing (New Tape Out)

- 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

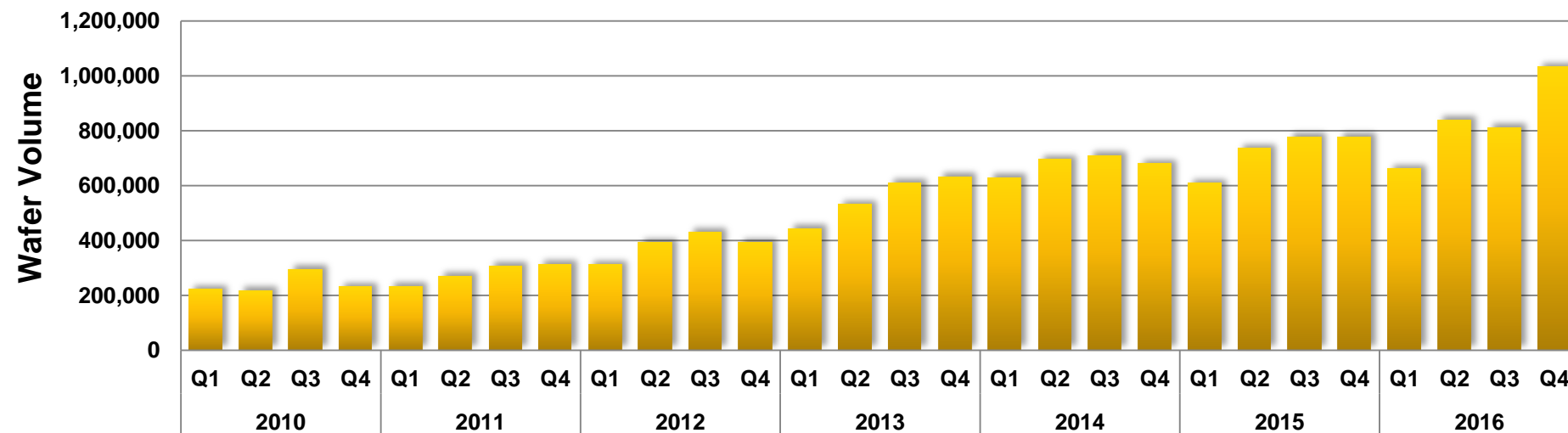


note 1: Due to the 2009 recession, royalty income was down annually 1.5%.

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%  |

# Outline

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



# 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<br>GHD < 16Mb | < 4Mb     | < 2Mb    | < 4Kb         | < 512Kb       |

# Applications by Technology

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

## NeoBit



## NeoFuse



## NeoFlash



## NeoEE

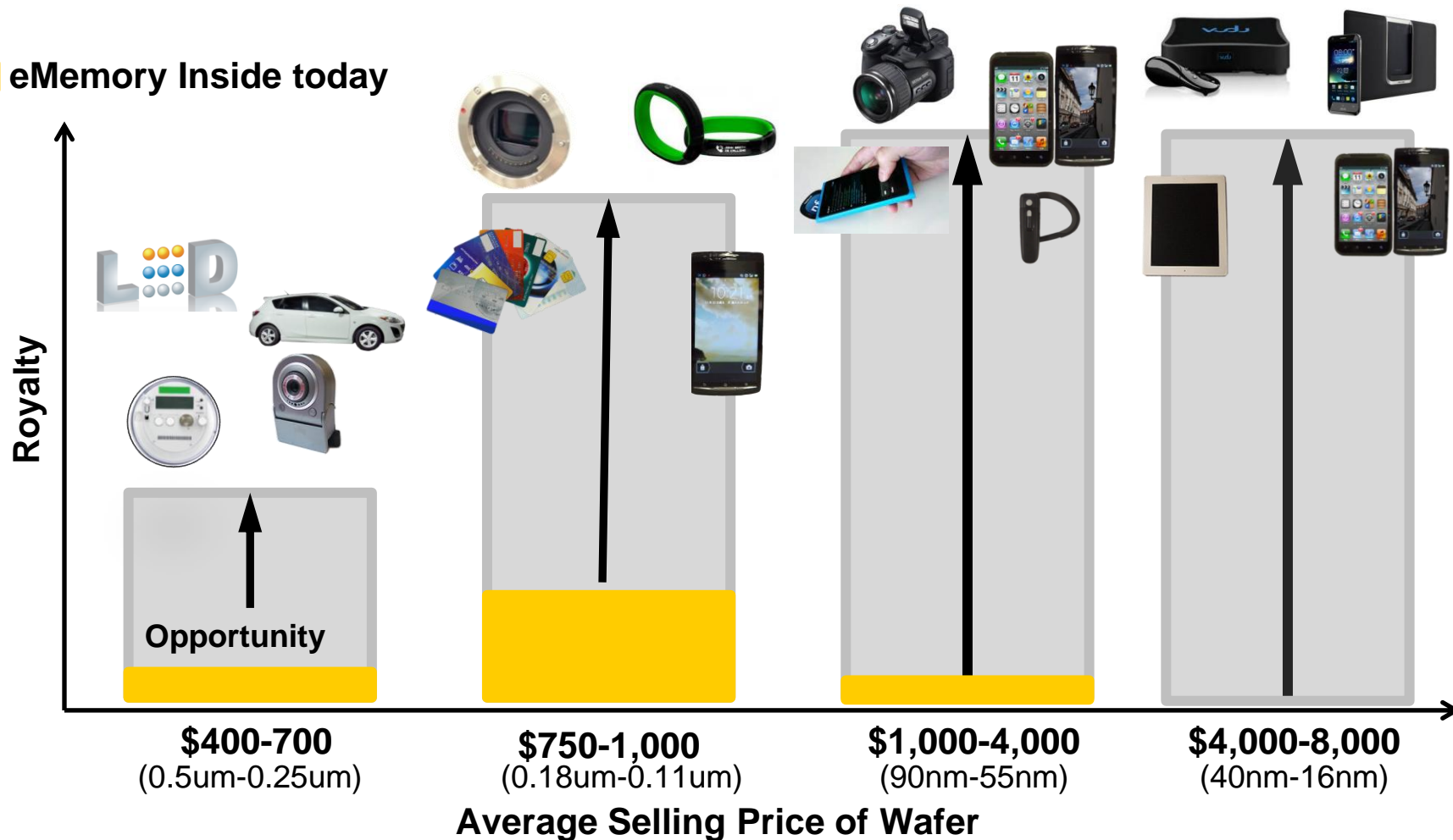


## NeoMTP



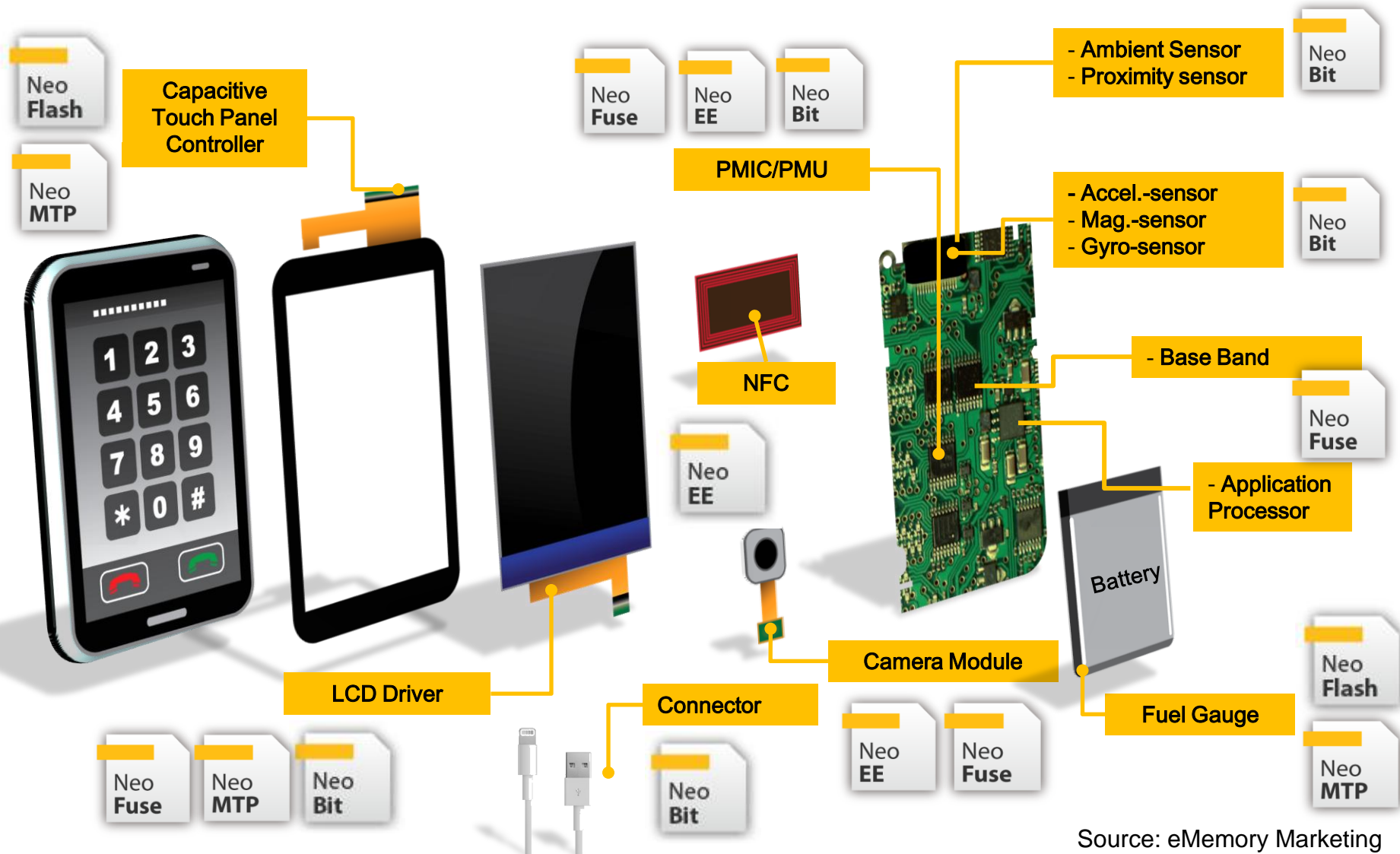
# Opportunity at all Price Points

 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

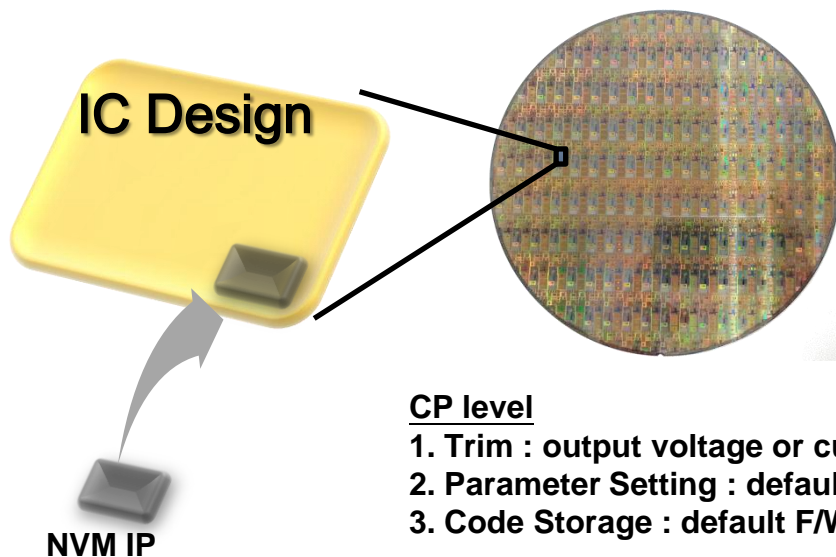
## Package/FT level

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

## CP Test

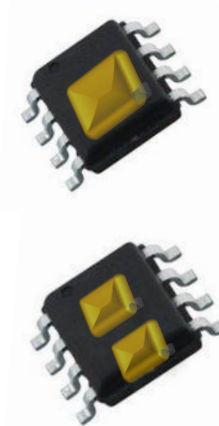
## Package/FT

## System Assembling



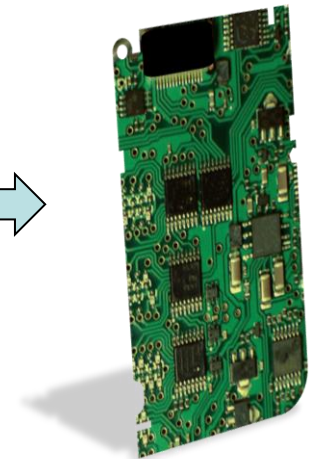
## CP level

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



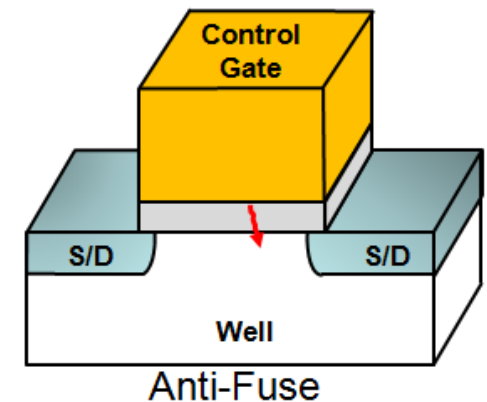
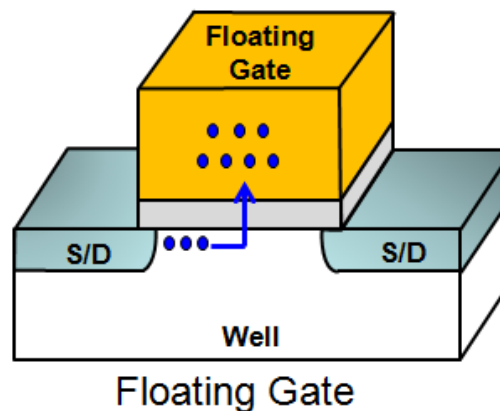
# Invisibility for Security

- 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



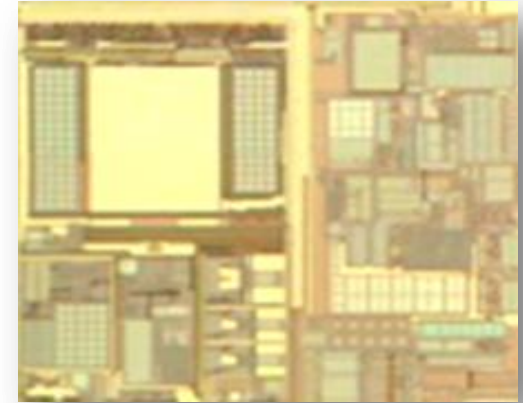
reverse  
copy

re-produce



without protection

Fake Product

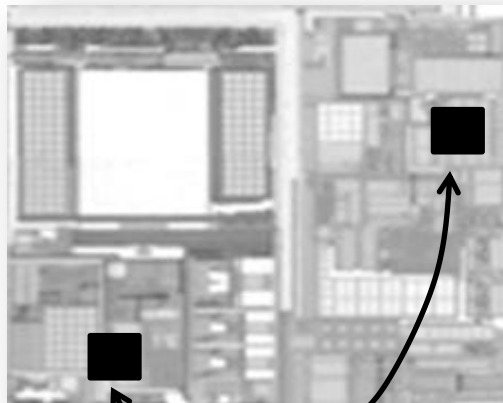


reverse  
copy

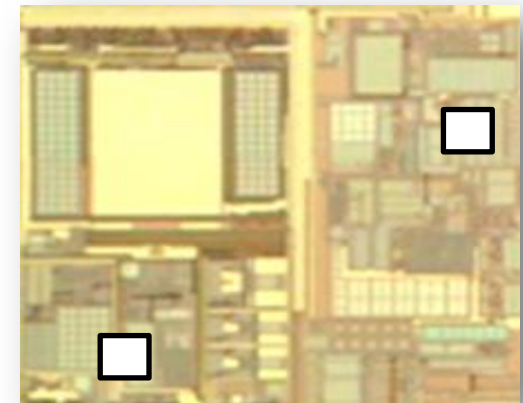
re-produce



with protection

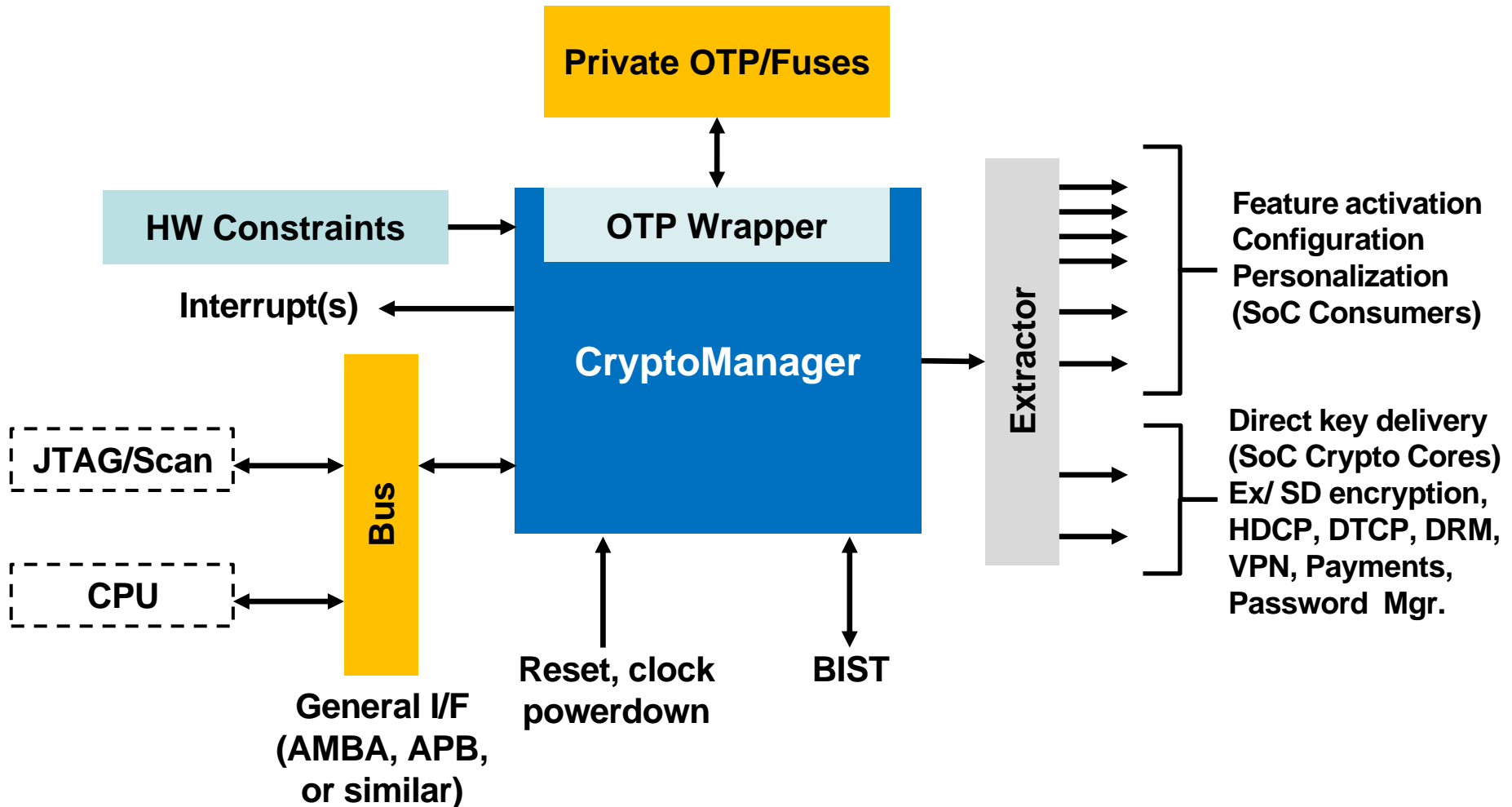


Security IP/Code by  
Authorized Use



Can NOT Work w/o  
Security IP/Code

# OTP for security storage



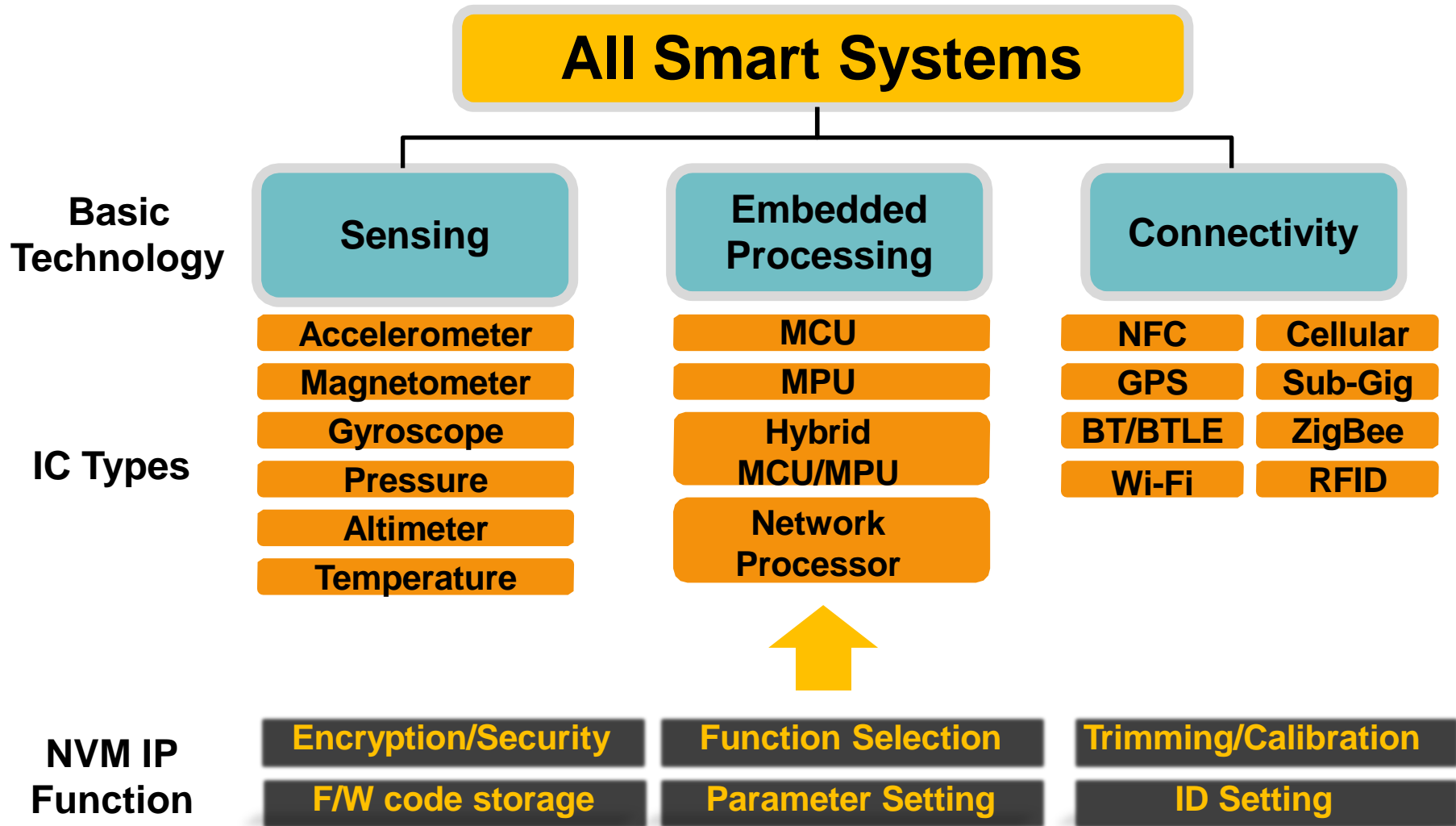
Source : Rambus crypto manager platform



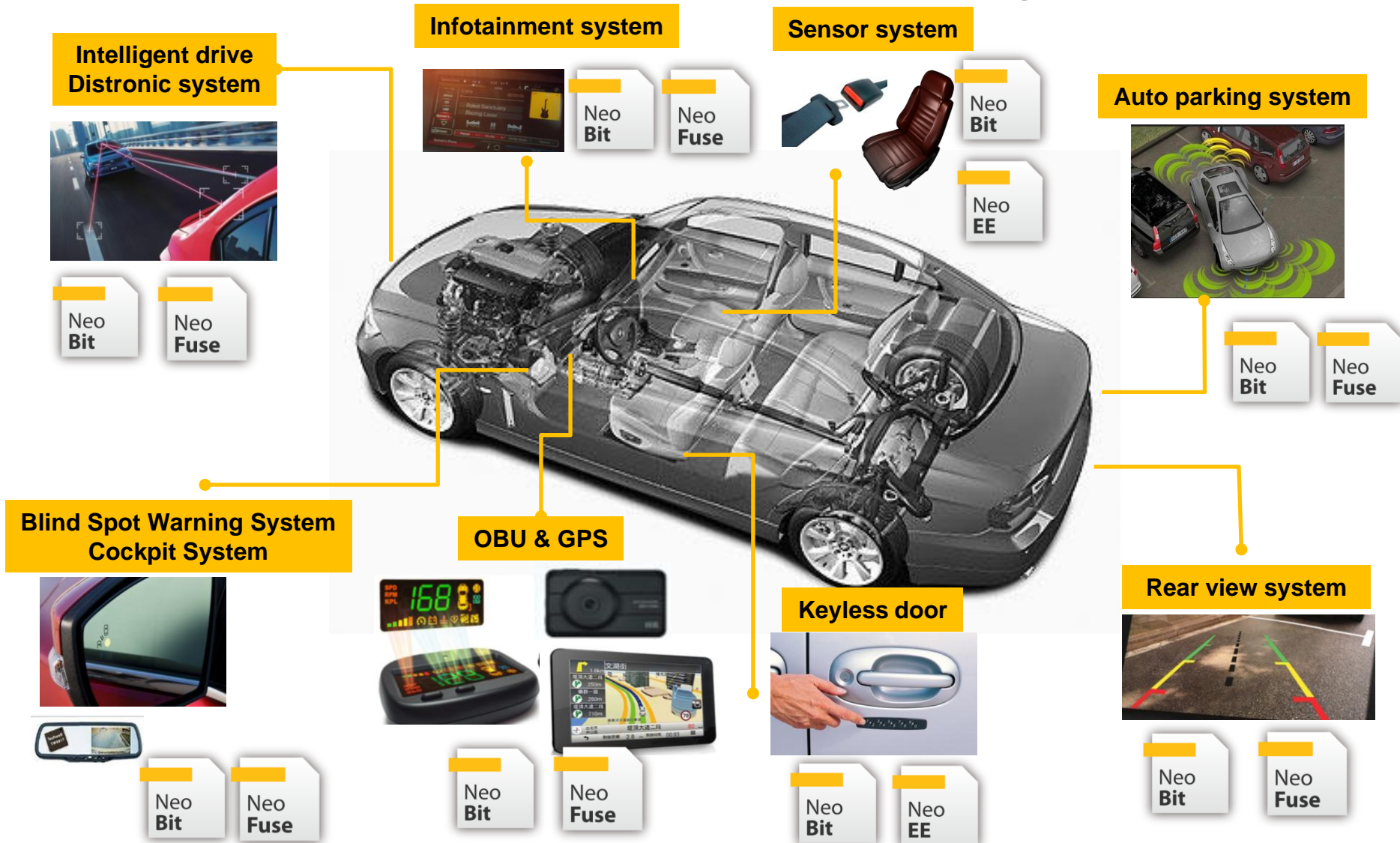
# Security with eMemory IPs



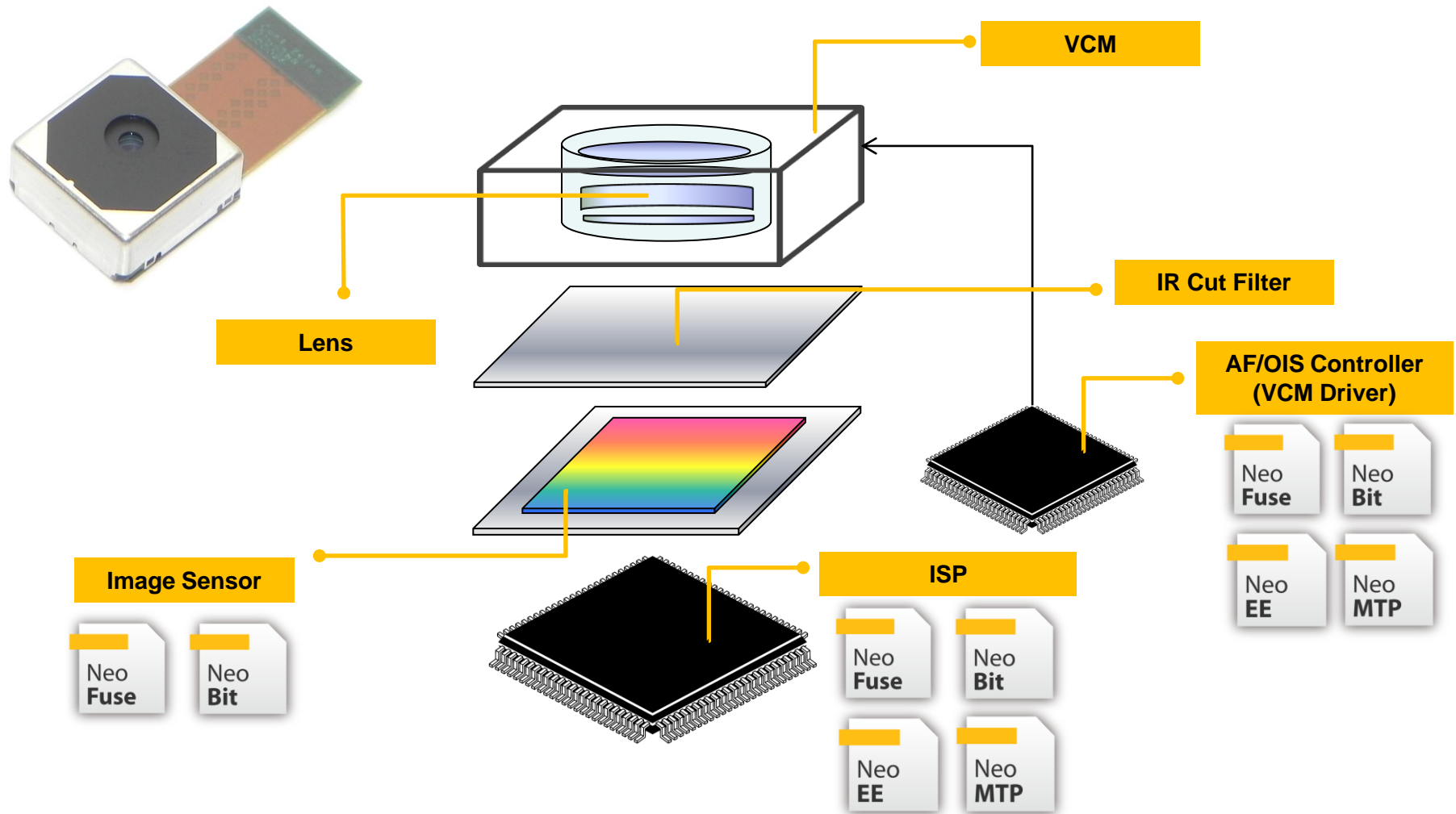
# NVM IP Demand in IoT



# Autotronics with eMemory IPs

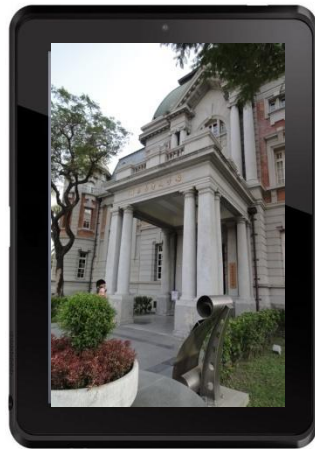


# Imager Module with eMemory IPs



# Advanced LCD Driver ICs

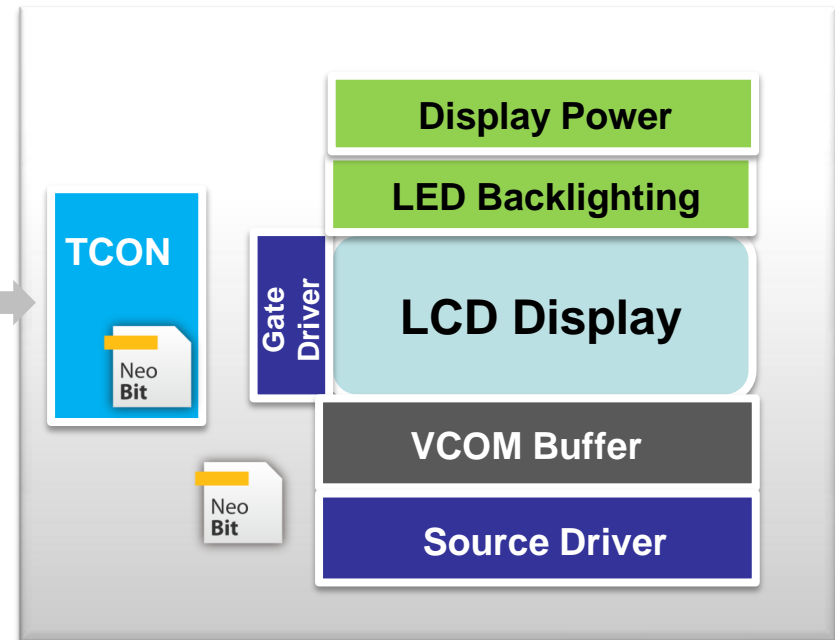
Process Technology : 0.11um HV/80nm HV/55nm HV



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



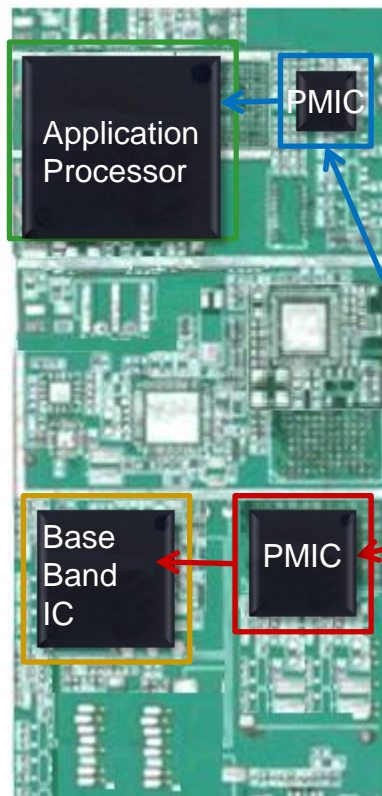
DDI



| Density | Endurance | NVM Type | Purpose      | NVM Usage   |
|---------|-----------|----------|--------------|---|
| 2K8~4K8 | 1         | OTP      | Trimming     | 1. Accuracy enhancement<br>2. Mismatch cancellation                                   |
|         |           |          | Code Storage | 1. Gamma Correction Table<br>2. Timing Control Pattern<br>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



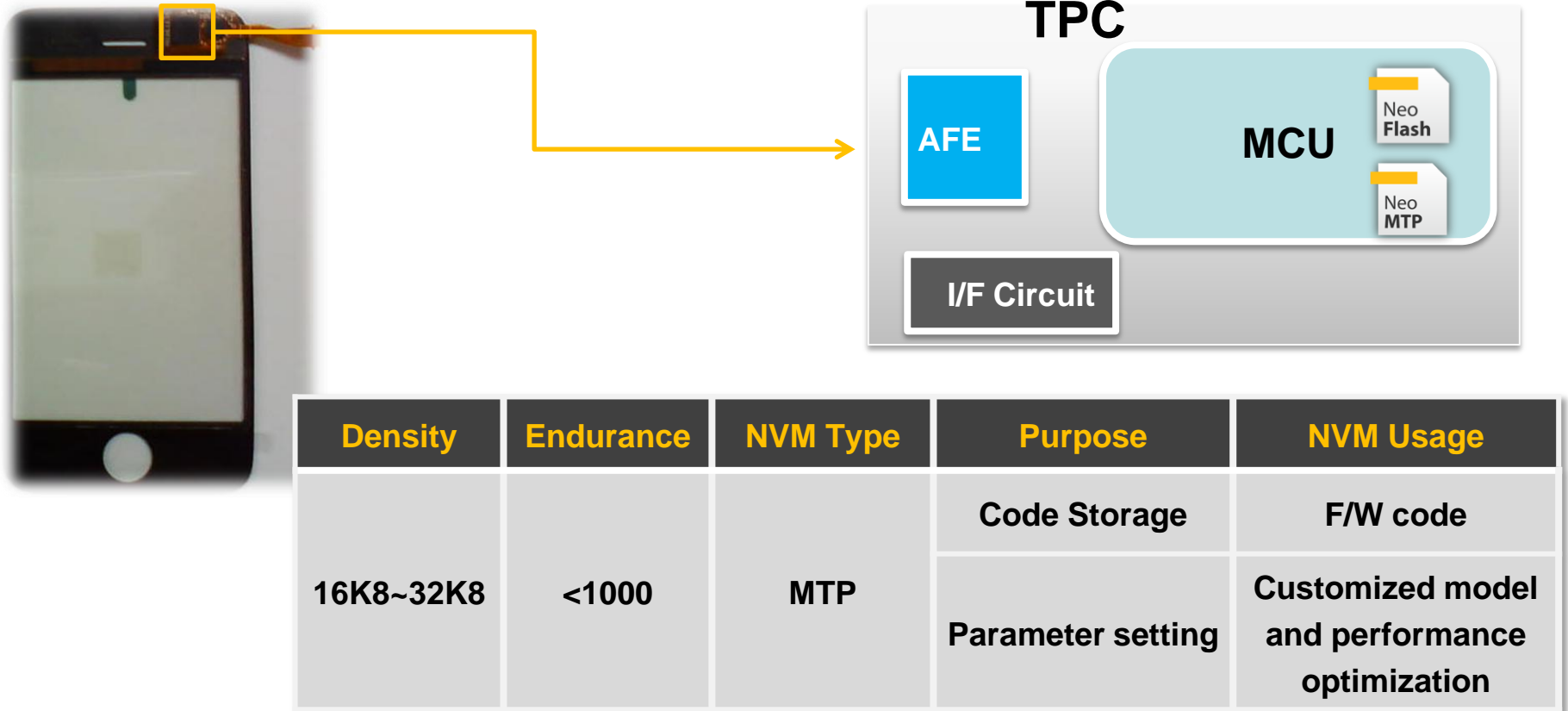
| Density | NVM Type | Purpose           | NVM Usage  |
|---------|----------|-------------------|--|
| 2Kb~4Kb | OTP      | Trimming          | DC/DC, Bandgap                                   |
|         |          | Parameter Setting | Design flexibility & Performance optimization    |
|         |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

PMIC



# Touch Panel Controller ICs

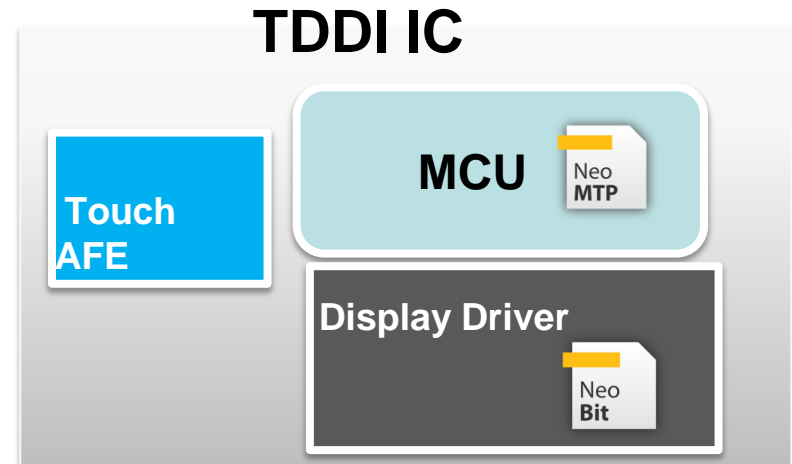
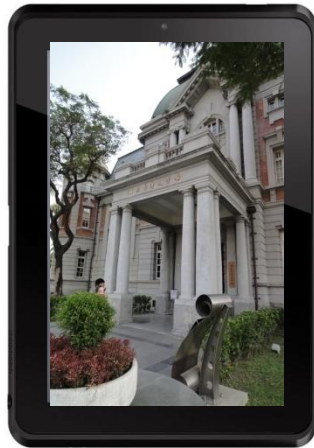
Process Technology : 0.16um HV/0.11um G





# In-Cell Touch Panel Controllers ICs

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

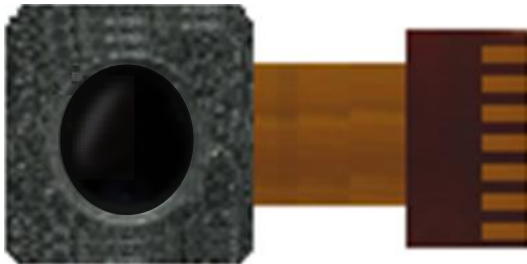
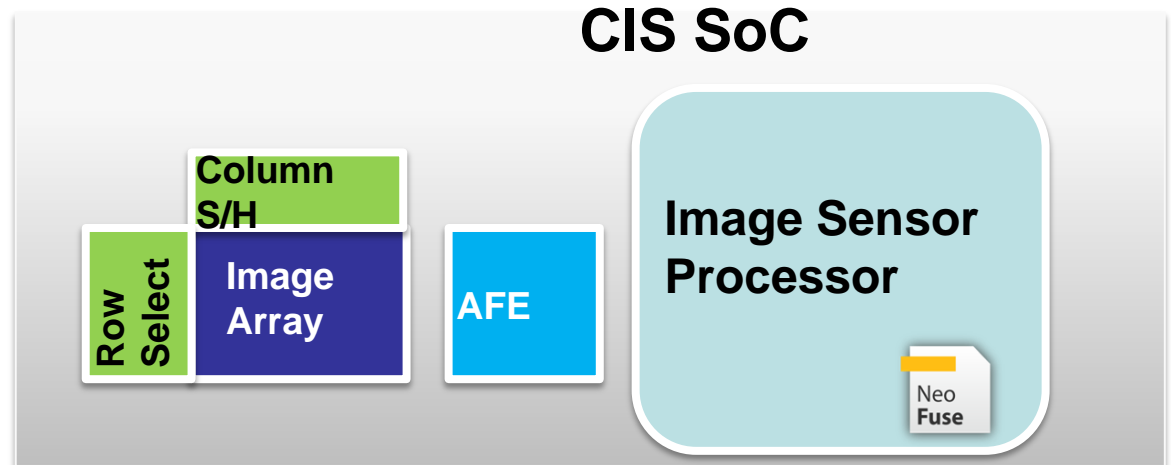
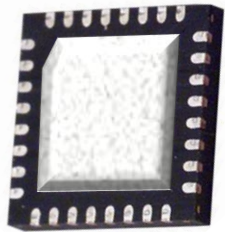


| Density   | Endurance | NVM Type | Purpose           | NVM Usage                |
|-----------|-----------|----------|-------------------|--------------------------|
| 2K8~4K8   | 1         | OTP      | Trimming          | Accuracy                 |
|           |           |          | Code Storage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



# CMOS Image Sensor

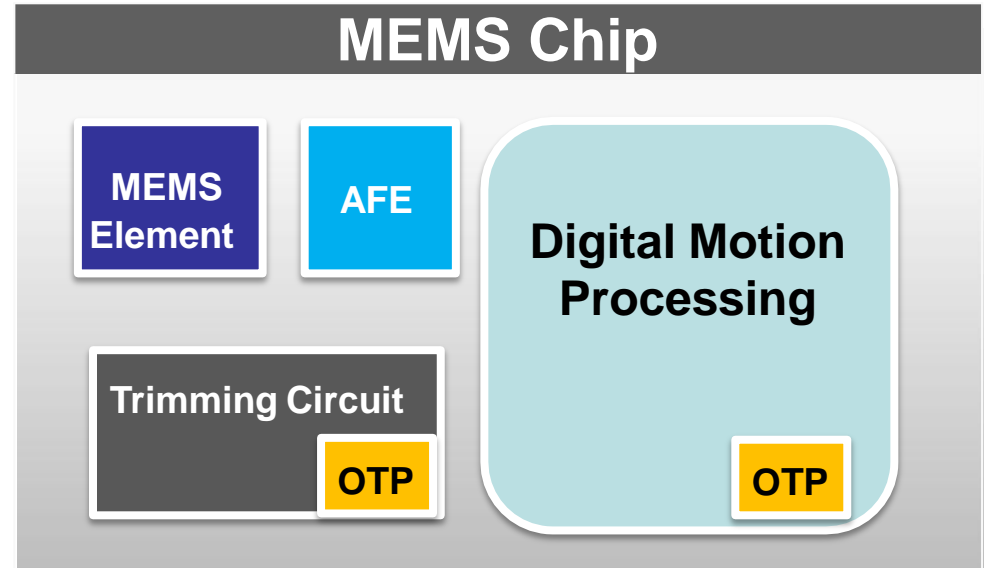
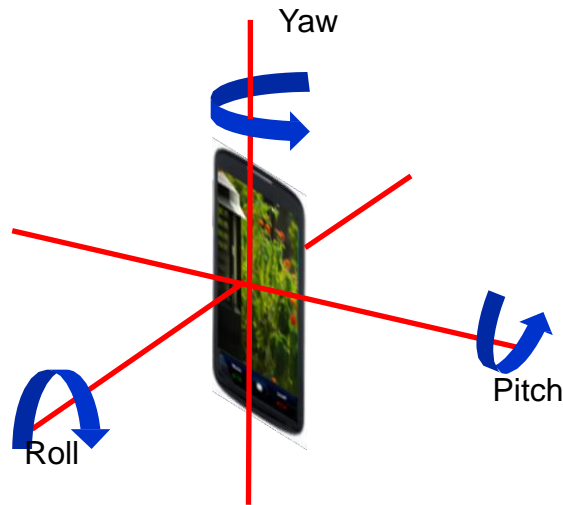
Process Technology : 0.11um CIS/90nm CIS/65nm CIS



| 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

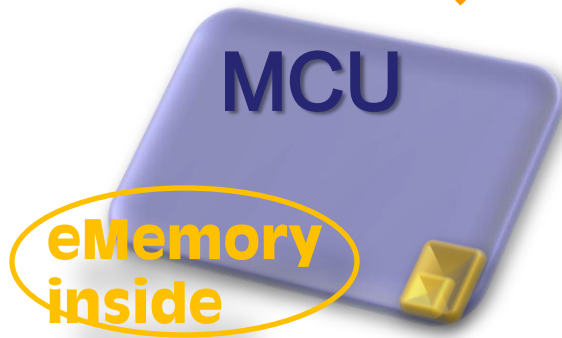


product design & manufacturing by  
embedded Flash  
Logic Process + 10 Masks



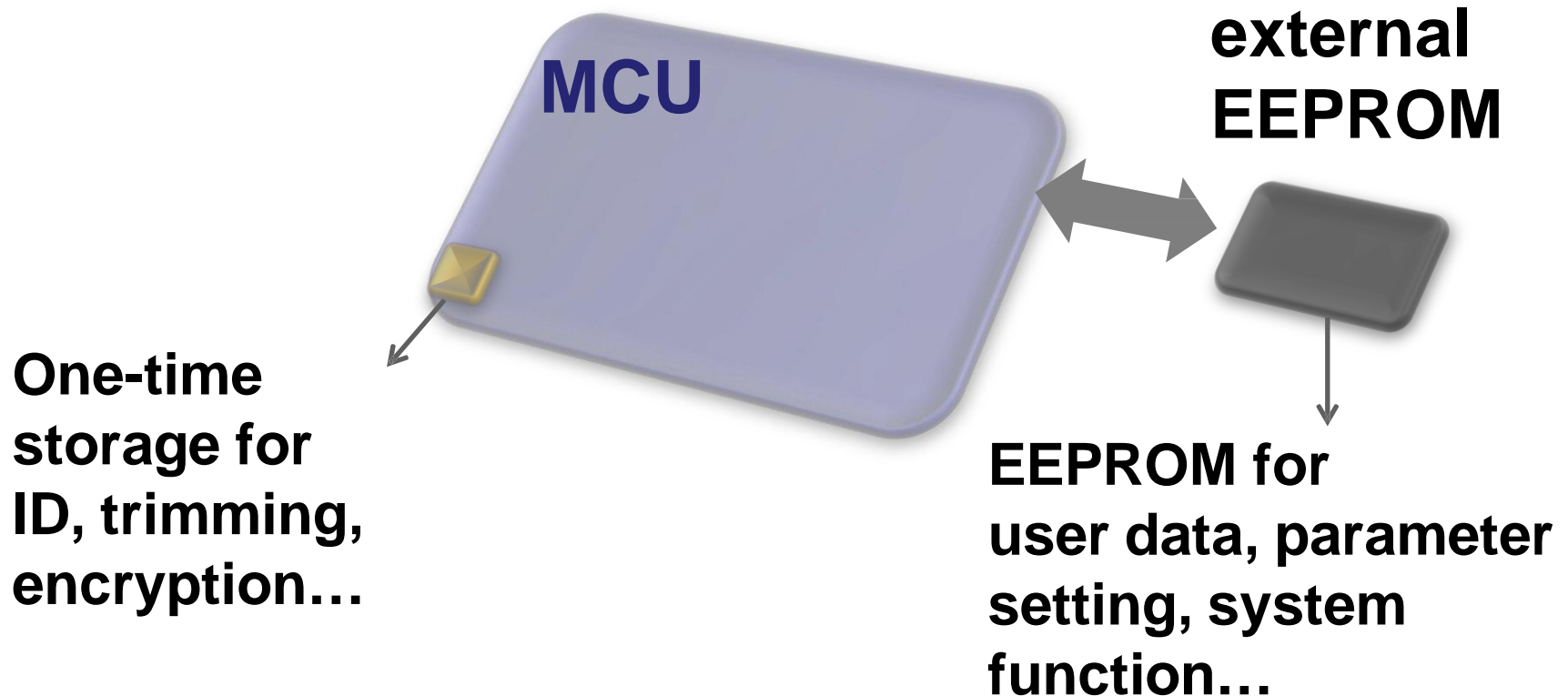
*30% more  
cost reduction*

*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.

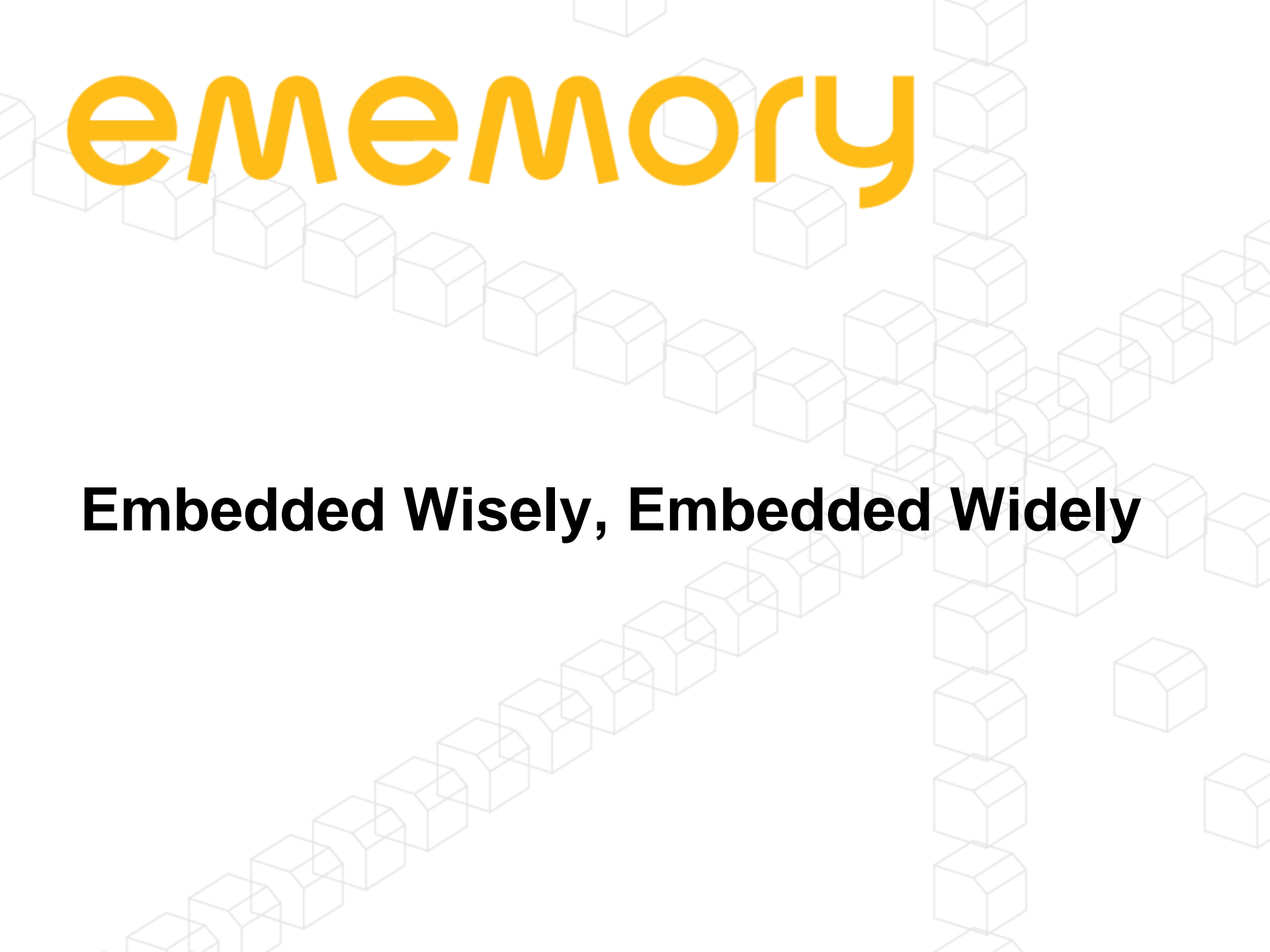
## **Growth in advanced technology**

- 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**